STUDENTS' AND LECTURERS' PERCEPTIONS OF FACTORS WHICH INFLUENCE THE CREATION OF A SUSTAINABLE E-LEARNING ENVIRONMENT IN A UNIVERSITY OF TECHNOLOGY

By

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DECLARATION

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DEDICATION

To my wife and my daughter:

Nomkhosi Bongiwe Sizakele Msomi

and

Ayabonga Ntandoyenkosi Msomi

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My supervisor, Prof. Sarah Bansilal, please accept my heartfelt gratitude for agreeing to supervise my work and providing me with such wise counsel. It was a dream come true to work with you. There were moments on this journey where I felt I had been tossed into deep waters, but you were there to offer a hand and urge me to keep going. Your candor and assistance will be remembered for a long time.

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ABSTRACT

By virtue of their designation, South African universities of technology need to be pioneers in the use of technology in learning and teaching. Many of these universities have knowledge and expertise in establishing and maintaining an ICT-driven environment for instruction. Accordingly, this study is an investigation into how the integration of technology into learning and teaching practices at the University Technology in South Africa, has been experienced by students and lecturers. This study aims specifically to comprehend access and technology usage difficulties, as well as infrastructure and training levels in ICT-challenged environments. In doing so, this study created a conceptual framework for encouraging instructional ICT in universities. The present study conducts a thorough assessment of one historically underprivileged University of Technology in South Africa using a case study methodology.

The following individuals made up the study's target population: 835 students across first, second, and third-year levels; and 97 lecturers across the faculties of Engineering, Management Sciences, and Natural Sciences from whom data were collected using questionnaires. In addition, the researcher in the current study, performed semi-structured interviews with Deans of the faculties (2), Heads of Department (5), senior staff members in the Teaching and Learning Development Centre (TLDC) (2) and senior staff members in the Information and Technology Network Department (ITN) (3). Hence data were collected from various sources to gain multiple perspectives regarding the creation of a sustainable eLearning environment within a University of Technology.

A mixed-methods approach was used in the current investigation. The use of technology for social empowerment to bridge the digital divide is the focus of a mixed-methods approach, which gathers, analyses, and interprets quantitative and qualitative data in a single study via the theoretical lens of creating a sustainable e-Learning environment. Informed by a continual literature review of the use of emergent learning technologies, the lived experience of e-Learning students, lecturers, and involved stakeholders was utilised as the basis for the first data collection. When choosing participants, deliberate sampling was utilised. From a standpoint of methodological interpretivism and positivist viewpoints as a technique of inquiry, the researcher's function was that of participant observer, interviewer, and human instrument. Thematic analysis was utilised in this study because, in contrast to descriptive statistics and inferential statistics, it is effective in identifying patterns in participant-reported qualitative data.

Using the test-retest reliability approach, the instrument's reliability coefficient was calculated using Cronbach's alpha. The data gathered using quantitative approaches had response rates of 84 and 84.3 percent, whereas the data gathered using qualitative methods had a response rate of 100 percent. While processing qualitative data with the ATLAS.ti's package, the quantitative data was analysed using the R statistical computer program, 2020, version 3.6.3, to provide descriptive and inferential statistics. By following the university under study ethical guidelines, the study's ethical component was successfully achieved.

The results of this study have shown that integration of technology in an educational institution of higher learning is dependent on many factors. The clearly distinguished factors from this study were: (i) poor access to internet connectivity, (ii) lack of continuous training for both students and lecturers on how technology could be integrated in the teaching and learning practices, and (iii) unaccommodating technology infrastructure. These factors were indicated as having a potential in facilitating or hindering technology integration for lecturers and students. The implications of this finding require the immediate development of capacity-building plans and strategies for the adoption and integration of students and lecturers to an e-Learning platform. This study also suggests that for lecturers to effectively incorporate ICT into educational practice, they must have suitable pedagogical abilities in addition to fundamental ICT knowledge and skills. University policies and strategic level agendas are critical for success using the framework developed in this study for ICT-challenged environments. Based on these findings, it is recommended that the university management for the participating institution in the present study understands that the e-Learning system has great potential to improve the teaching and learning environment, provided in-depth ICT policy and strategies are put in place and suitable technology infrastructure is available.

Keywords: access and use of technology, integration of technology, e-Learning platform, technology infrastructure and training, internet connectivity.

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CHAPTER 1: Introduction

1.1 Introduction

Many higher education institutions have embraced online learning and teaching, despite it not being necessary for them to utilise this mode. The COVID-19 pandemic's onset, however, prompted a broad adoption of e-Learning systems for learning and teaching in higher education (HE), which ultimately altered the nature of education. On March 11, 2020, the World Health Organisation (WHO), declared COVID-19 to be a pandemic. Universities around the world were compelled to shut down and switch to online delivery methods. In South Africa (SA), the president instructed universities to close and investigate means to offer lectures online as of March 18, 2020 (DHET, 2020). Since social meetings and face-to-face class attendance at educational institutions were considered a possible source of the virus's propagation, conventional educational methods were thus substituted with e-Learning. Due to the outbreak, universities were obliged to conduct all their student interactions online (Sobaih, Hasanein & Abu Elnasr, 2020). The University of Technology (UoT) in South Africa, which operates under an ICT-challenged setting, expressed reservations regarding the practicality of e-Learning in response to this request. Prior to the pandemic, this HE institution primarily provided physical learning and teaching which is regarded as traditional and restricts students' experiences as it takes place in the presence of a lecturer who imparts knowledge to students in a formal classroom, while using lecturer-centred and conventional resources like textbooks, chalkboards, and others. Consequently, the onset of the COVID-19 pandemic led to the widespread use of the e-Learning system in learning and teaching in higher education institutions (HEIs). However, students and lecturers, on the other hand, were not prepared for a totally online experience and consequently both had to overcome several challenges. The current study started prior to the COVID -19 pandemic since the researcher was interested in investigating how much online learning and teaching was being embraced by the stakeholders in the university and how well the use of online tools and technology was experienced by these stakeholders. Due to the pandemic, the university had to rapidly, move completely to an online system. Hence, this study became even more urgent and relevant in the face of the changed circumstances brought on by the pandemic.

The idea of e-Learning environment was examined further in this study. Any form of education that includes technology or employs instructional strategies that effectively utilise technology and include the use of various techniques, such as blended learning and online education, is referred to as e-Learning (Lara, Aljawarneh, & Pamplona, 2020). E-Learning, often referred to as online learning, is a general word for all learning that occurs online, remotely, and without a face-to-face setting. It occurs over the Internet (Mpungose, 2020). Various researchers have defined e-Learning to suit their environment or context, circumstantial experience, and exposure to the learning and teaching system such that it is difficult to have a universally accepted definition of this concept (Lytras, Damiani, & Mathkour, 2016). A traditional meaning of the word "e-Learning" emphasises a technology platform that enables students to learn at their own speed and time, using network services like discussion boards, live conversations between classes of students and lecturers, online assignments, and online answers and queries (Solangi, Al Shahrani, & Pandhiani, 2018). E-learning is a method of learning and teaching that comprises all, or a portion of the educational model utilised, according to Sangrà, Vlachopoulos and Cabrera, (2012). It is an instrument to enhance access to education and engagement, and it facilitates the adoption of new conceptualisations of, and methods for learning by individuals. Thus, the relevance of e-Learning in 21st-century university education, which occurs using the Internet, is apparent, particularly for today's students who are digital natives (Bennett, Maton, & Kervin, 2008).

According to Mzangwa and Dede, (2019), the National Plan for Higher Education and changes to higher education institution policies have significantly improved the way that higher education has addressed historical injustices since 1994 (Ministry of Education, 2001). However, most historically underprivileged black South African students have not profited from these adjustments in terms of access to e-Learning (Mpungose, 2020). The disparity between those who have access to computers and the Internet, and those who do not, appears to be another major obstacle to e-Learning in SA (van Deursen & van Dijk, 2019). Researchers in the Ghana context suggests that some of the main challenges students encountered in an e-Learning environment were societal problems represented by communication gap and engagement with students and lecturers (Aboagye, Yawson, & Appiah, 2020). Additionally, some factors that could be viewed as obstacles in the learning processes of students using e-Learning platforms include demotivation, delayed responses or help because lecturers are frequently unavailable when students need assistance while learning, or feelings of isolation because classmates are not physically present (Yusuf & Al-Banawi, 2013). The absence of crucial human relationships between students and lecturers as well as between peers is the major drawback of using e-Learning (Fathali & Okada, 2018). It is obvious that switching to an online system would have a substantial impact on the educational process. Consequently, research into the acceptance of technology and e-Learning systems implementation, is necessary in order to inform successful practices. Additionally, some research has found many challenges, including low levels of confidence and competence among lecturers, negative attitudes, a lack of computer skills, an inadequate knowledge of e-Learning systems among both students and lecturers, and high costs associated with purchasing and maintaining the necessary electronic equipment (Almaiah & Alyoussef, 2019; Maatuk, Elberkawi, Aljawarneh, Rashaiden, &Alharbi, 2021). These difficulties could make it harder for students and lecturers to use e-Learning systems. In addition, other concerns affecting both students and lecturers include a lack of use of technology, access to technology, provisioning of technology training, and technology enhanced infrastructure that has been upgraded to make use of technology (Alshehri, Rutter, Smith, 2019). The e-Learning system is becoming more and more significant in the present educational environment since it is revolutionising education as a whole and becoming among the most talked-about topics among instructors (Samir Abou El-Seoud, Taj-Eddin, Seddiek, El-Khouly, & Nosseir, 2014). Nowadays, the e-Learning system is enforced, and technological advancement is promoted over traditional teaching and learning practices. This is because e-Learning solutions present both students and lecturers with more flexibility and freedom for learning and teaching processes using computers, tablets, cell phones, and Internet facility. Mpungose (2020) contends that in-person learning is indispensable and the cornerstone of every learning, and teaching institution. Others contend that blended learning, which combines online and in-person instruction, is the best option since it gives students many methods to obtain course material based on their strengths and limitations (Bates, 2018). Similar research has shown that students do not see online courses as having the same value as courses given in the classroom, even though the bulk of studies concentrate on students' favourable opinions regarding e-Learning. They prefer blended learning, which blends online and in-person instruction, to solely online learning (Galy, Downey, & Johnson, 2011); Tagoe, 2012). The present study is carried out in a HEI that supports blended learning.

1.2 Rationale for the Study

The present study focuses on a previously disadvantaged higher education institution (HEI), which was formerly a Technikon but is now a UoT in South Africa (SA). It is one of the disadvantaged HEI in SA and was not set up for integration of technology. Generally, Universities of Technology are not well resourced with technological infrastructure (Ng'ambi, Brown, & Bozalek, 2016, Basitere & Ivala, 2017; Ndevu, 2020). The limited attention to develop the necessary resources to support the e-Learning platform and increasing class sizes have resulted in resources gradually becoming strained.

The researcher has been an academic at this University for more than 20 years, and possess a PhD in pure mathematics, which was not in harmony with the UoT under study, so it required me to pursue a second PhD in Education. The Fourth Industrial Revolution (4IR) has begun, and as such, the researcher has attempted to introduce novel teaching methodologies and encouraged technology integration with an e-Learning system. During his time, the researcher has witnessed both periods before and after the 4IR and noted how it has changed the way we interact and particularly how we teach and learn, prompting universities across the country to adjust their policies to accommodate the requirements of this new learning era for both students and academic staff. The necessary integration of teaching strategies with technology through e-Learning platforms became a central focus of discussion between himself and his colleagues. In addition, the researched university also required some direction but thus far, research studies in this area are minimal. It was largely due to this that the researcher decided to embark on an investigation into the factors that could impede and enable technology integration for both students and lecturers in learning and teaching at ICT-Challenged universities in SA.

When the researcher was a student, he had the pleasure of owning computers, but all his teaching and learning experiences took place in a lecture hall. No learning experience was provided outside of the institution. As a result, the plan to register for a PhD under expert supervision in the e-Learning field, as well as this current study, has broader implications as he has attempted to package the findings so that they can be implemented at policy levels in institutions across the country, and not only in the context of the university under study.

Since the researcher taught Engineering Mathematics for more than twenty years at this University, it was convenient to consider a sample of students and lecturers from this institution of higher learning. Due to the limited number of mathematics lecturers at this institution, a conscious decision had to be considered to open the participation of respondents of this study by inviting not only mathematics students and lecturers, but students and lecturers across the university.

1.3 E-Learning in Higher Education Institutions

The South African HEIs are undergoing a process of transformation when it comes to learning and teaching strategies, and the acceptance of e-Learning systems is of paramount importance (Mashau & Nyawo, 2021). The current fast-paced environment, ongoing technological advancements, and advanced learning and teaching technologies' development and systems have all positively impacted how students learn, lecturers impart knowledge to students, and how content is designed and presented (Ruxwana & Msibi, 2018). However, one of the biggest challenges confronting colleges today is using technology through e-Learning systems to support and improve learning and teaching (Fischer, Heise, Heinz, Moebius, & Koehler, 2015). HEIs in SA face several challenges in providing effective learning and teaching techniques in the present digital age. Socioeconomic reasons, infrastructural shortages, Internet connectivity instability, a lack of online learning culture, insufficient ICT skills, and students underprepared for HEIs are some of the difficulties influencing learning and teaching (Mlitwa & Van Belle, 2011). While such barriers persist, facilitators at HEIs are pushed to successfully use digital tools in the classroom to assist content learning and teaching.

Because the development and use of technologies have promoted the growth and educational possibilities, the e-Learning in university education and students' evaluations of its utility have grown to be areas of interest for many studies (Zare, Sarikhani, Salari, & Mansouri, 2016). Based on (van de Heyde & Siebrits, 2019), developing technologies in learning and teaching contexts are typically underutilised in SA, yet e-Learning is crucial as national HEIs collaborate to bring about a worldwide change in education.

Research conducted in 2018 by Vitoria, Mislinawati, and Nurmasyitah, all students said they had no trouble understanding the content, navigating the e-Learning module, and accessing the documents (Vitoria, Mislinawati, & Nurmasyitah, 2018). Another study by Bhuvaneswari and Dharanipriya, (2020) discovered that using e-Learning as an addition to conventional classrooms improved learning for students’ experiences and improved their participation in lectures. Mahdizadeh, Biemans, and Mulder (2008) examined lecturers' opinions on e-Learning using the Technology Acceptance Model and found that, when combined with prior knowledge, lecturers' opinions of e-Learning environment made a difference to their behaviour and usage of it. Overall, the same study showed that e-Learning environment is useful, effective, and has a positive effect on student performance, which supports its usage in HE.

According to research that looked at how e-Learning affects students and lecturers, most lecturers felt that it has the potential to improve the educational process and improves cooperation and interaction with students, and provides flexibility, and helps them to absorb lectures (Burac, Fernandez, & Cruz, 2019). Rhema and Miliszewska found that students had positive views about online learning and that these sentiments are enhanced by their perceptions of the ease with which online learning systems may be used (Rhema & Miliszewska, 2010).

1.4 Role of the Different Stakeholders in the e-Learning System

The current study focuses on the perspectives of multiple stakeholders in the UoT in SA. These stakeholders include students, lecturers, staff members in the Information and Technology Network Department (ITN), staff members in the Teaching and Learning Development Centre (TLDC), middle management (Heads of Departments), and senior management (Deans of Faculties) in the researched institution. The participation of different stakeholders was considered in the current study since they play a crucial role in the uptake of the e-Learning system. The description of each of the stakeholders and the importance of their contributions are outlined below.

The students from level 1 to level 3 of their studies who took part in the study were from Faculties of Engineering, Management Sciences, and Natural Sciences. The level 1 students provide data on the level of preparedness of students to work on the online system as they come from basic school education. Conversely, level three students were chosen so that they could share their experiences of working on the online system in the UoT under study. Several issues have been identified as impeding students from maximizing the benefits of the e-Learning system, which have the potential to further deteriorate the learning and teaching process in an already failing educational system (May, Fessakis, Dimitracopoulou, & George, 2012). The issues that could possibly prevent impediments to students' using and accessing e-Learning have only received limited research (Mirza & Al-Abdulkareem, 2011). Studies have demonstrated that using e-Learning effectively may boost student engagement, involvement in class, behavior, and performance in fundamental courses (Jeffrey, Hegarty, Kelly, 2011). To fully utilize the potential of ICT in their learning process, students need assistance with their digitally enhanced learning (Samir Abou El-Seoud et al., 2014). It is therefore crucial that HEIs make the appropriate ICT infrastructure investments to allow students and lecturers easy access to ICT hardware while utilizing accessible software and offering consistent technical assistance.

Lecturers from the Faculties of Engineering, Management Sciences, and Natural Sciences were also invited to participate in the present study. The different faculty perspectives were considered to give a holistic view of their experiences in the integration of technology through the e-Learning system at this institution. According to various studies, the lecturers' pedagogical competence, content understanding, control over instructional design, and ongoing professional growth in pedagogical and technological knowledge are the key factors in the efficient integration of technology (Convery, 2009; Johnson, Cowie, De Lange, Fallon, Hight, & Khoo, 2011). Rhema and Miliszewska, (2017), in their research confirmed that lecturers' integration of technology and engagement in an e-Learning system can be affected by both intrinsic and extrinsic motivational factors. The possible barriers that could impede lecturers in the integration of technology should first be investigated to realise a sustainable e-Learning implementation (Rohayani, Kurniabudi, & Sharipuddin, 2015b). The infrastructural backdrop, the cultural context, and the transmitted knowledge are only a few of the challenges and barriers that technology integration in HE, particularly in developing countries, encounters (Kohn, Maier, & Thalmann, 2010). If lecturers have not received appropriate assistance and training regarding the systems and procedures, this might cause difficulties with the implementation and in how students perceive the material. The e-Learning environment is built on a carefully balanced learning and teaching process (Demiray, 2010). Nonetheless, educating lecturers on how to utilize e-Learning to improve teaching practices should instead emphasize how to be adaptive to both formal and informal teaching methods and strategies rather than how to use the hardware and software (Ingerman & Yang, 2011).

Members of staff in the Department of Information and Technology Network (ITN) were also among the participants in the present study. They were considered for reasons that they are an operational department responsible for all IT-related infrastructures and provide a service delivery and support function to learning and teaching. They are responsible for providing an Information Technology and Network service to the university as well as updates on challenges facing Internet networks and all other e-Learning system-related obstacles, by reporting to all internal structures.

The Teaching and Learning Development Centre (TLDC) staff members were among the participants of the current study. TLDC is an academic support department at the researched university of technology. Its mission is to provide academic development services and programmes aimed at improving the quality of students' learning experiences, while also promoting the professionalization of academic staff. This University of Technology constantly improves its usage of ICTs to keep up with the competitive global higher education environment to stay on the leading edge of global knowledge and skills requirements.

Finally, the heads of departments (HoDs) and Deans of faculties played an important role in the present study in the sense that they have delegated duties by executive management to promote the integration of technology through e-Learning systems and give direction to both students and lecturers on all issues they may experience when working on an online system. The various stakeholders mentioned above were considered for their contributions to the investigation of factors that could possibly enhance or inhibit the ability of students and lecturers to integrate technology in their learning and teaching methodologies through an e-Learning system.

The details presented above indicate that the study was designed to elicit multiple perspectives regarding the implementation of e-Learning systems at the university. In order to gain a deep understanding of how an online system can be implemented successfully in conditions of limited resources; it was necessary for me as a researcher to approach all these stakeholders. This was done to gain their perspectives which then allowed me to undertake an in-depth analysis of the factors that can enable or constrain the integration of technology in the learning platforms of a previously disadvantaged and under- resourced higher education institution.

1.5 Problem Description

Despite the changes to SA's educational system following the democratic elections of 1994, there are still significant obstacles to accessing the provision of high-quality education (Collins & Millard, 2013, Kanjee & Sayed, 2013). From conventional face-to-face contact courses to the usage of an e-Learning system, learning and teaching in HE has undergone significant change (Akaslan, Law, & Taskin, 2012). Since many students entering the system originate from underprivileged educational environments and low socioeconomic backgrounds, there is a rising need to use the e-Learning platform as an additional tool for learning and teaching objectives (Chikh & Berkani, 2010). However, the majority of formerly underprivileged HEIs in SA are unable to fully appreciate the advantages of implementing the e-Learning system due to their ICT-challenged settings. Before beginning any potential e-Learning efforts, it is essential to research the aspects that will affect their formation and long-term viability.

1.6 Aim and Objectives of the Study

The main objective of the current study is to investigate factors that have the potential to impede and enhance the integration of technology through the e-Learning system in an ICT-Challenged environment by extrapolating the perspectives of different university stakeholders.

The current study aims to address the three main research goals listed below:

1. To investigate factors that students perceive as barriers and enablers in creating a sustainable e-Learning environment.
2. To investigate factors that lecturers perceive as barriers and enablers in creating a sustainable e-Learning environment.
3. To investigate organisational design and technological factors impeding the development of a sustainable e-Learning environment.

1.7 Research Questions

The subsequent three research questions relate to these objectives:

1. What factors do students at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment?
2. What factors do lecturers at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment?
3. What are the organisational design and technological factors that can impede or support the development of a sustainable e-Learning environment at a university of technology?

1.8 Contribution of the Study

The present study is carried out in a higher education institution that presents an ICT-Challenged environment which is why the researcher decided to focus on it as a case study. By considering multiple perspectives of different stakeholders within this higher education institution, the researcher provides a much deeper exploration because most studies focus on lecturers, while some focus on students. The researcher does not know of any study in SA that has explored the perspectives across multiple perspectives (students, lecturers, heads of departments, Deans of faculties, Teaching and Learning Development Centres and Information and Technology Networks). As far as the researcher knows, no study has considered the factors across these multiple perspectives. The importance of the current study is that it provides empirical evidence of the factors impeding or enhancing the access to technology and usage of an e-Learning system in an ICT-Challenged environment, and particularly the participating or researched university of technology in the current study and the findings are specific to this university. Furthermore, due to the widespread pandemic, many universities have moved to online systems without much research or preparation. The present study will assist us to understand some of the challenges. The current study may contribute to the expansion of knowledge on the barriers to ICT integration in the learning and teaching process. By expanding the body of information previously available, this research is anticipated to assist academics in the HE sector.

1.9 Theoretical Underpinning of the Study

The present study's emphasis is on the experiences of students' and lecturers' technology integration in a context of an ICT-Challenged environment; in this case a researched University of Technology (UoT) in SA. The position the researcher is taking on the experiences of integration of technology is drawn from four key constructs: use of technology, access to technology, provisioning of technology training, and provisioning of technology-enhanced infrastructure.

The Salmon's Five Step Model, Technological Pedagogical Content Knowledge (TPACK) and Unified Theory of Technology Acceptance and Use of Technology (UTAUT) e-Learning models were mainly the three models contributed to arrive at the conceptual framework of the current study in Chapter 3, Section 3.2, and Figure 3.6. Only specific variables of each of the three models were considered, for an example, facilitating conditions, performance expectancy and effort expectancy from UTAUT model. The conceptual framework is used for the investigation of factors that could enable or impede the use of e- Learning was developed. The conceptual framework that was developed for the study was constructed using a layered approach, which allowed the researcher to consider the various layers that could make up a sustainable e-Learning environment. Its goal is to support the current learning and teaching process of the participating university rather than replacing it. This conceptual framework for e-Learning provides decision-makers at the participating or researched university of technology at all levels of education with a roadmap for implementing a framework that offers a dependable, adaptable, scalable, and proven infrastructure for delivering e-Learning, in addition to the skills necessary to set up and manage such a system. The conceptual framework considers the fact that heterogeneous hardware and software environments may be found in all types of educational institutions, many of which are essential for the institution to continue utilizing, even when they cannot be replaced. The analysis of data collected following the conceptual framework underpinning the current study gave rise to the e-Learning integration framework in Chapter 8 Section 8.6 among other solutions, which can be implemented by the researched university of technology.

1.10 Overview of Research Design

The present study was undertaken within quantitative and qualitative research design. The study considers integration of technology into learning and teaching as a means of mitigation in the case of the increase in students' intake and giving necessary attention to content delivery and mastery. The approach of study is descriptive in nature. The current study used surveys for students and lecturers and semi-structured interviews for qualitative data. Interviewing Deans of Faculties, HoDs, ITN personnel, and the TLDC personnel, provided insight into the phenomenon as to the factors that could enable or impede the use of e-Learning environment at the university.

The current study used the Onion Skin research paradigm to interpret data on how students and lecturers perceive the use of technology in education in the context of an ICT-Challenged environment. The onion skin principle proposed by Saunders and Tosey, (2012) occurs in layers. The stages that a researcher must go through when developing an effective technique are defined. When observed from the exterior, each layer of the onion's skin signifies a more comprehensive step in the study procedure (Saunders & Tosey, 2012). A crucial step in creating a research technique is provided by the Onion Skin research framework. Its versatility comes from its capacity to be applied in a wide range of contexts and to practically any type of research approach (Bryman, 2015). The research process's tone is defined by the research philosophy, which is the top layer, which creates the framework that will be used as the research strategy in the subsequent level. The time horizon denotes the fourth layer, while the research technique is in the third layer.

In the current study, quantitative research is used to investigate general trends in the use of e-Learning systems among students and lecturers from the faculties of Engineering, Management Sciences, and Natural Sciences. The numerical methods are used to determine the magnitude of their acceptance or rejection of each of the statements on the questionnaire. A quantitative approach has been considered by the researcher to determine the factors' generalisability on a larger scale. After ascertaining the factors that enable or impede students and lecturers, the research initiative tries to suggest realistic pointers to specific e-Learning issues for gaining a better understanding so that their implementation efforts can be positively fine-tuned. Both descriptive and inferential analyses were used to analyse quantitative data. R programming was utilised in the study to perform various inferential and descriptive analysis. R is a statistical programming language that is popular among academics. The correlation of students' and lecturers' use of technology, access to technology, provisioning of technology training, and provisioning of technology-enhanced infrastructure, were the main emphasis of the inferential study.

The present study's qualitative data came from ITN, TLDC, HoDs and Deans of the faculties through semi-structured interviews. The aim of qualitative data analysis was to find new trends, patterns, ideas, perspectives, and understandings in the data (Atieno, 2009). According to Creswell (2013), qualitative research is a method for addressing problems that entails a researcher exploring and comprehending the significance of an event by depending on the opinions of the participants. The focus of qualitative research is on the consistency or substance of human experiences as well as what these occurrences signify to particular people. Snider (2010) noted that although numbers are stunning, they conceal more than they reveal, and most qualitative researchers concur (Suter 2012).

1.11 Outline of Thesis

The remaining chapters, with the inclusion of the first, are structured as follows:

CHAPTER 1: INTRODUCTION

Chapter one highlights the background for the study and gives a global picture of the current research investigation. A broad understanding of the concept of e-Learning in this chapter is discussed. The problem description together with the aims and objectives of the investigation are clearly identified.

CHAPTER 2: LITERATURE REVIEW

This chapter critically reviews relevant international and South African literature on issues pertaining to factors impeding and enabling students and lecturers to integrate and use e-Learning in learning and teaching in the HE sectors. This chapter further gives critical reviews of several studies regarding the development and effectiveness of the e-Learning platform and contextual analysis.

CHAPTER 3: THEORETICAL FRAMEWORK

Chapter three begins with a discussion of various e-Learning models and their suitability to current study models. The model guided by the design, presentation, and analysis of the present study as a framework underpinning this study is also introduced.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter explains the approach taken in this investigation. It covers research design, study context, participant selection, research instrumentation, data sources and techniques, data analysis, research reliability, and ethical issues.

CHAPTER 5: STUDENTS' DATA ANALYSIS AND PRESENTATION OF FINDINGS

As the first stage of the study, this chapter offers quantitative data findings from survey questionnaires given to students.

CHAPTER 6: LECTURER RESULTS

The study of the data is continued in Chapter six. The second phase of the current study's survey of lecturers yielded open-ended questionnaires, the findings of which are presented quantitatively in this chapter.

CHAPTER 7: QUALITATIVE DATA ANALYSIS

Chapter seven provides the third phase of the analysis. This is the last phase of data analysis chapter and provides a summary of the key findings emanating from the qualitative data analysis conducted through semi-structured interviews.

CHAPTER 8: DISCUSSION OF RESULTS, CONCLUSION and RECOMMENDATION

This chapter identifies the barriers and enablers related to successful e-Learning implementation. Furthermore, Chapter eight provides the reader with the justification and value contribution of the study on the integration of e-Learning implementation. After analysis of the collected data for the current study, this chapter presents the proposed e-Learning framework for the ICT-Challenged environment that locates the current study within an emergent conceptual approach which can be considered in any university for the advancement of a sustainable e-Learning environment.

CHAPTER 2: Literature Review

2.1 Introduction

This chapter provides a summary of the research findings in the field of technology integration through e-Learning systems. The chapter opens with an overview of comparative e-Learning implementation studies conducted in SA and elsewhere and goes on to reveal research findings regarding the elements that may enable or hinder technology integration. The study continues to evaluate literature on students' and lecturers' experiences with e-Learning implementation in higher education institutions, considering constructs such as attitudes and beliefs, use of technology, access to technology, provisioning of technology training, and provisioning of technology enhanced infrastructure.

2.2 E-Learning Policy Implementation in Higher Education

In every HE institution, policy frameworks are critical in directing the introduction and supply of e-Learning (Nyerere, 2016). The presence or absence of such frameworks affect the success or failure of e-Learning efforts. The process of developing and implementing e-Learning policies is a timely and arduous experience in the higher education (HE) industry across the world. The rising trend of incorporating Information Communication Technology (ICT) into education with the goal of improving both traditional and open distance learning has proven to be a significant problem in the learning and teaching environment (Sesemane, 2008).

The fundamental problem in South African HE appears to be institutions' readiness to cope with the self-motivation of associating their e-Learning policies with the requirements of government's e-Education policy (Sesemane, 2008). The existence of an e-Learning policy enables and assists institutions in adopting well-planned and directed methods for integrating ICT into the learning and teaching environment. E-Learning policy in SA is described as principles and policies that regulate the implementation of flexible learning utilising ICT resources, with a focus on interaction between instructors, students, and the online environment, as well as collaborative learning (Draft White Paper on e-Education, notice 1869 of 2004). South African HEIs are envisaged to adopt clear e-Learning policies that would allow them to own e-Learning content. In addition, the Draft White Paper discusses organised and controlled learning experiences, which include the use of CD-ROMs, software, and other media as e-Learning policy components.

It has been suggested that the value of a national e-Learning policy is that it provides a standard framework for the design, deployment, and delivery of e-Learning platforms on which different organisations may build their own policies Nyerere (2016). It would also assist with the deployment of e-Learning resources and quality assurance. It has been demonstrated that, the effective implementation of e-Learning environment is severely hampered by the absence of operational e-Learning policies at several Kenyan state-sponsored universities (Tarus, Gichoya, & Muumbo, 2015). Furthermore, the study found that, despite having e-Learning policies, several institutions were unable to apply them owing to financial constraints and a lack of appropriate ICT equipment.

2.3 Financial Constraints and Sustainability Issues

In their individual e-Learning studies, Manro, Sighn, and Joshi (2012) and Sabi (2014) emphasised that expenses are a key obstacle in establishing and delivering e-Learning in third-world nations. They found that the installation and maintenance expenses of reliable ICT infrastructure are too expensive for many institutions in poor nations, including South Africa, causing them to lag behind rich countries in technical advancements. Kashorda and Waema (2014), conversely, claim that a high level of ICT deployment and utilisation improves learning, teaching, and research. It also helps institutions of higher learning meet their academic and administrative goals. However, a higher degree of ICT deployment means higher expenses for universities, which typically operate under restricted budgets. Tarus, Gichoya, and Muumbo (2015) also observed that many state-sponsored institutions of higher learning (including the University of Technology under investigation) are hampered by financial resources, which can lead to e-Learning not being prioritised as a key investment, among other things, in their budgets.

According to research of African e-Learning practitioners, one of the top immediate objectives for action is finance (Njenga, 2018). Initial maintenance, training, e-content production, and bandwidth expenditures are all mentioned as cost constraints. The ever-changing technical breakthroughs and their various costs further complicate the issue of expenses, making it difficult for institutions to keep up with these developments.

The managerial support of an academic institution, as well as the associated financial resources, is critically required for the success of any project, including e-Learning systems implementation (Ng, 2020). This is especially true when e-Learning implementation has an impact on the entire institution's organisational structure and strategy. As a result, the danger of institutional e-Learning implementation failing due to individual e-Learning enthusiasts' efforts not being properly supported by institutional management is very high (Ng, 2020).

2.4 Critical Stakeholders of the Implementation of an e-Learning System

Several research studies have established crucial conclusions about the application of e-Learning (Wagner, Hassanein, & Head, 2008, Romero, Ballejos, & Caliusco, 2015). Several of them have closely analysed the dimensions and essential success aspects of the e-Learning system. In many of these research studies, students, lecturers, design and content, system and technological and institutional management services are defined as essential success criteria in e-Learning. In the current study, these factors are also considered as essential success criteria responsible for the successful implementation of an e-Learning system.

2.4.1 Students' Dimension

Traditionally, it has been argued that students are the one of the most important stakeholders in the e-Learning system and are also the main recipients of the e-Learning system that should be given precedence over other stakeholders (Previtali & Scarozza, 2019, Al-Fraihat, Joy, & Sicnlair, 2020). Additionally, it is anticipated that students use the system to get help, and if they do it appropriately, it will work better and be more advantageous. For instance, non-traditional female students' desire for such education has escalated. As a result, the dimensions of the students have a significant impact on the e-Learning system.

2.4.2 Lecturers' Dimension

The degree to which students' e-Learning experiences have fulfilled them is the focus of the lecturers' dimension. For the system to be used effectively, lecturers' attitudes and methods must be considered. Additionally, their approach to teaching is critical and has a positive impact on how well pupils embrace e-Learning lessons (Previtali & Scarozza, 2019). Students are more likely to participate in e-Learning if the lectures are interesting, instructional, and loaded with high-quality information. Additionally, the impact, efficacy, and quality of instructional learning management systems are significantly influenced by the lecturers' talents (LMS) (Selim, 2007, Ozkan & Koseler, 2009). Another study discovered that the lecturer's qualities, including their perspective on the application of cutting-edge technology, their learning and teaching strategies, and the technology they employ, improves interaction using LMS (Sun, Tsai, Finger, Chen, & Yeh, 2008).

The acceptance and implementation of essential changes in the academics' thinking and behaviour are crucial to the achievement of e-Learning (Parlakkilic, 2013). In the face of unclear future benefits, lecturers reject change (Oreg, 2018). When lecturers understand the benefits of e-Learning environment for themselves, students, and the organisation, they may change their minds about e-Learning and finally adopt it, so the university stays competitive.

According to several studies, the lecturers' pedagogical expertise, subject understanding, control of instructional design, and ongoing professional growth in pedagogical and technology knowledge are the key components of an effective implementation of e-Learning (Convery, 2009; Govindasamy, 2001, Johnson et al., 2011). Rhema and Miliszewska (2017) in their research confirmed that students' and lecturers' implementation and engagement in an e-Learning system can be influenced by motivational factors that are both intrinsic and extrinsic. Naturally, both intrinsic and extrinsic motivating variables influence how students and instructors make decisions and use cutting-edge technology (Hardaker & Singh, 2011a;Hardaker & Singh, 2011b; Wang, Guo, & Huang, 2014). The degree of their engagement in the management of the process to satisfy their demands particularly for learning and teaching, and the relative advantage they perceive in the integration of technology on what they consider content, make a difference on intrinsic variables. The success of e-Learning in HE is largely attributed to lecturers' capacity to create, shape, and combine a variety of ideas and practices into the creation of online course content (Kebritchi, Lipschuetz, & Santiague, 2017). Furthermore, assessment procedures which are the responsibility of lecturers, play an important part in the learning and teaching process when it comes to ICT (Malik, Abid, Kalaicevi, & Bhatti, 2018).

2.4.3 Design and Contents' Dimension

The content design aspect has a direct impact on how well an e-Learning program performs. Well-structured curriculum activities, and learning aids promote effective learning experiences. If a virtual course's interface and contents are easy to use, students will be more engaged and approve. Students may enrol in such courses and learn through the Internet at their own speed, location (Naveed, Qureshi, Tairan, Mohammad, Shaikh, & Alsayed et al., 2020).

Numerous studies have cautioned against equating well-planned online learning, which requires significant instructional design, extensive planning, and specialised teaching infrastructure, with the short and temporary switch to online learning carried out during COVID-19 to continue education (Bozkurt, Jung, Xiao, Vladimirschi, Schuwer, & Egorov et al., 2020; Fujita, 2020). It has been proposed that mixing emergency online learning with high-quality online learning might be detrimental to the latter in the long term, since students and instructors with little to no prior experience with online learning may think it is a substandard alternative to in-person instruction (Bozkurt et al., 2020).

In HE, the pedagogy and e-Learning environment design should be based on a student-centred approach rather than a teacher-cantered approach (Santoso, Batuparan, Isal, & Goodridge, 2018). Effective course content for e-Learning would prioritise active learning and student interaction (Ashwin & McVitty, 2015). The effectiveness of e-Learning is greatly influenced by the development of appropriate course material (Little & Knihova, 2014). With a well-organized and visually appealing e-Learning course design, students learn successfully online (Oh, Chang, & Park, 2020). It should be designed in accordance with the degree of competence and comprehension of the pupils (Ricart, Villar-Navascues, Gil-Guirado, Hernandez-Hernandez, Rico-Amoros, & Olcina-Cantos, 2020). Given the importance of lecturing in the acceptance and implementation of e-Learning systems, it is critical that lecturers are provided with new material regularly thereby increasing their confidence through training and refresher courses. If online learning programs are to succeed, lecturers must have the necessary facilitation abilities. Several empirical studies have focused on investigating ICT and the use of online learning in HEIs, and to ascertain the impediments and enablers of e-Learning systems in different countries, namely: Egypt (Abdel-Wahab & El-Masry, 2010), Nigeria (Ajadi, Salawu, & Adeoye, 2008) and Tanzania (Al, 2013). Results of these studies show that many underdeveloped nations lack the fundamental technology mechanisms which are crucial to the e-Learning implementation, such as computers and internet access together with the lack of technically qualified staff (Rhema & Miliszewska, 2010a). These factors have the potential to increase the failure probability of any e-Learning project including students' and lecturers' e-Learning infrastructure access restrictions (Al, 2013).

2.4.4 System and Technological Dimension

System and technological dimension play an important role in delivering instructional learning and teaching via online technology using various technologies (Chopra, Madan, Jaisingh, &

Bhaskar, 2019). System quality refers to the standard of the e-Learning platform that allows students to access learning resources for various courses with ease (Chopra et al., 2019). The utilisation of gadgets is aided by the creative system design with changing technical dimensions (Malik, 2010). For instance, web information stacking speed is directly related to the host server, whereas web information broadcast speed affects students' satisfaction (Wibowo & Laksitowening, 2015).

Many HEIs, like the UoT under investigation, accept e-Learning to fulfil the rapidly expanding demands on higher education by recognising it as an additional way of accessing learning (McPherson & Nunes, 2008;Wachira & Keengwe, 2011; Hardaker & Singh, 2011b). According to (Buabeng-Andoh, 2012), when introducing an innovation in any educational context, compatibility, difficulty, and comparative benefit are crucial factors to consider. The current study focuses more on using e-Learning through LMS (Moodle and Blackboard) to improve learning ((Buabeng-Andoh, 2012).

Although most academics recognise the importance of e-Learning, they rarely use it (Teemueangsa, Hoxsuwan, Jedaman, & Wangsaard, 2021). E-learning causes a cultural and behavioural transformation; opposition to e-Learning stems mostly from a fear of risk (Parlakkilic, 2013). Staff resistance during the implementation of an e-Learning system can be changed into a collaborative learning environment if the above-mentioned suitable climate is developed (Douglas, Muturi, & Ochieng, 2017). The university must be ready to deal with resistance and recognise it as a necessary component of the process (Sherratt, 2017). The tactics for coping with change resistance include communication, leadership, empathy, and support (Tarhini et al., 2015).

Several obstacles to the system and technological dimension, particularly in developing countries are prevalent when implementing institution-wide ICT systems are more expensive than in developed countries. The main problems include high expenses associated with buying, setting up, the usage of unlicensed software, outdated hardware, and a lack of technical assistance for system maintenance, as well as the operation, maintenance, and replacement of ICT systems (Abraham & Saravanaguru, 2013). Due to a variety of issues, such as, but not restricted to inconsistent energy, using high-priced, low-bandwidth satellite equipment, and not having access to fast internet is one of the most significant difficulties facing most developing nations. As a result of cost issues, institutions, especially in developing countries, fail to consider other parameters as you evaluate their e-Learning preparedness (Omoda-Onyait & Lubega, 2011; Keramati, Afshari-Mofrad, & Kamrani, 2011).

Mutingi and Matope (2013), however, indicated that implementation of an e-Learning platform is a multifaceted process, motivated and driven by numerous factors such as promoters, inhibitors, and imitators. Mutingi and Matope describe promoters as enablers, the inhibitors as obstructions, while both the enablers influence the imitators and inhibitors. In addition to Mutingi and Matope's viewpoint, various authors suggest that adoption of technology and use is influenced by factors such as individual, social, economic, organisational, and technological characteristics (Park, 2005; Labach, 2011; Kurnia, Mahbubur, Husada, Alhashmi, 2013). These variables are alleged to affect the kinds of e-Learning techniques adopted and their frequency of use once adopted.

2.4.5 Institutional Management Service dimension

The organisational support aspect that influences the success of e-Learning is addressed by the institutional management service component. How pleased all stakeholders are is highly dependent on institutional backing (Hussain, Muhammad, Syed, & Chin-Hong, 2018; Previtali & Scarozza, 2019). Infrastructure readiness, financial readiness, user training, academic support, and ethical and legal issues are among the crucial success criteria for this dimension.

Change requires awareness, desire, knowledge, competence, and reinforcement, according to Ng (2020). First, the university raises employee understanding of its significance of e-Learning growth and promotes personal mastery among the workforce through the institutional service management dimension. Second, a fresh perspective on e-Learning environment is produced by revealing and modifying the staff mental model to overcome the limits. Staff might develop energy to engage and support change to push towards common goals if they have a clear and objective shared vision. Third, with the help of the university and the necessary information and skills gained throughout training, personnel may put e-Learning environment into practice. Finally, the university provides personnel with reinforcement so that the change may be sustained when it is implemented. Aside from personal development, all team members must understand their role in accepting change.

The vision may stimulate commitment to change by giving personnel a unified purpose and compelling argument for why change is required and worthwhile (Ng, 2020). When employees realise, they must meet the university's objectives within a certain period, they are more dedicated. Most importantly, personnel must change with the times and reinvent themselves to survive. In the new era of e-Learning environment, academics must be willing to take it upon themselves to create competences and acquire new skills.

The institutional management can unite its personnel behind a single identity through effective conversation. Senior management highlights that when all levels of the organisation share the same vision of high-quality e-Learning growth the institution will feel secure in addressing these difficulties and will continue to offer high-quality education. This common goal encourages true dedication and enrolment rather than conformity among academics. The goal is to win people's hearts and minds (Mathews & Linski, 2016). Instead of doing what they are taught, all levels of the institution work together to achieve common goals. Staff members are extremely motivated to create e-Learning environment to work towards the shared objective of keeping the university viable in a challenging climate, in addition to improving their digital competency.

Some of the most renowned, esteemed, and prosperous universities in the world are among those that failed to successfully implement e-Learning ((Keegan, Harwood, Spray, & Lavallee, 2009). The primary elements identified were management, technological aspects, online course offerings, attitude, and economy, as well as historical institution experiences with online learning. Lack of an effective plan, and in some cases a complete lack of strategy, was cited as the primary cause of e-Learning failure at most universities (Keegan et al., 2009).

The study by Porter, Graham, Bodily, and Sandberg (2016) and Zuvic-Butorac, Nebic, Nemcanin, Mikac, and Lucin (2017) based on the influence of institutional senior management, suggests that an e-Learning strategy or implementation plan driven by management is essential as it guide students and lecturers on how e-Learning practices could be better conducted in the institution. Institutional policies that emphasise the use of technology at university across all relevant levels should be developed for lecturers to incorporate e-Learning systems in learning and teaching at these levels (Altun, Kalayci, & Ummuhan, 2011). Additionally, these authors think the university’s e-Learning policy should stress the value of collaboration across departments at Faculties in affording e-Learning infrastructure, technical support, and assistance to students and instructors. Therefore, institutional policies and strategic plans with specific goals for the integration of e-Learning methods at the institution of higher learning might be seen as a key motivator. Failures attributed to the absence of vision and goals reveal a lack of purpose and an inadequate justification for the factors that contribute to successful technology integration in learning and teaching (Zuvic-Butorac et al., 2017). According to other research, one of the most significant barriers to e-Learning deployment is a lack of financial assistance (Khan, Hasan, & Clement, 2012; Tarus et al., 2015). Leadership and resource coordination are tools for successful e-Learning deployment, according to best practice examples (Hardaker & Singh, 2011a). Macharia and Pelser (2012) observed in their study that the availability of e-Learning systems was significantly impacted by senior management support.

2.5 Challenges of Implementation of e-Learning in Higher Education

Many students entering their first year at university, especially those from low-income households, enrol at public institutions without adequate access to ICT and the core computer skills necessary to use e-Learning systems for their studies (Mashau & Nyawo, 2021). When they arrive at university, most of these students are exposed to computers and the Internet for the first time. Fewer homes have access to computers and the Internet, which exacerbates these problems and makes it more difficult for pupils to understand the educational materials used in learning and teaching (Kilfoil, 2015). On the other hand, most students entering higher education are proficient mobile phone users and have strong social networking abilities picked up via experiential learning (Kilfoil, 2015). Missed prospects for contact with students in learning by using their own devices stem from these skills and competencies, which are usually out of step with institutional practices and restrictions (Ruxwana & Msibi 2018).

As previously stated, successful online teaching and learning requires students to have the appropriate ICT skills. Many obstacles, including the infrastructure background, the cultural context, and the transmitted knowledge, stand in the way of the introduction of e-Learning systems in HE, particularly in developing nations (Kohn, Maier, & Thalmann, 2010). Accessibility to technology for students to acquire knowledge and information is one of the typical issues with technical classification. Access to adequate bandwidth, fast Internet, and the cost of using these technologies are all part of technology accessibility. Alongside these challenges is the consistent supply of electricity. The successful implementation and integration of e-Learning environment requires delivery of electricity without interruption and a steady power supply to operate. Similarly, lecturers who use e-Learning systems must have suitable ICT skills to properly implement educational technologies (Mashau & Nyawo, 2021).

Students and lecturers ought to be furnished with improved skills and attributes that go beyond the transmission of subject knowledge, so that they can be successfully acquainted with the opportunities that open with online delivery (McPherson & Nunes, 2008). According to (McPherson & Nunes, 2008), lecturers' responsibilities in e-Learning adoption, suggest the competence to establish collaborative learning programmes, the ability to impart guidance and leadership to the learning needs of an individual; and to structure delivery such that learning intentions are associated with systems, assessment, and expected outcomes. However, these new aspects go further than knowledge of discipline and traditional face-to-face teaching knowledge, underlining the social engagement dimension and challenging established beliefs regarding lecturers' work, considered opinion in quality, and work ownership (Benson & Brack, 2009).

Several empirical research studies have been conducted to research e-Learning and ICT in HEIs, as well as to determine the enablers and impediments of e-Learning systems in various countries, including Egypt (Abdel-Wahab & El-Masry, 2010), Nigeria (Ajadi et al., 2008), and Tanzania (Abdel-Wahab & El-Masry, 2010; Al, 2013). According to the findings of these researchers, many poor countries lack basic technology mechanisms that are essential for e-Learning implementation, such as computers and Internet connectivity, as well as a shortage of technically educated personnel (Rhema & Miliszewska, 2010b). Providing Internet access to students and lecturers is critical and has become a serious issue, since various prior studies demonstrate that lecturers' sufficient access to Internet connectivity in teaching and learning processes can improve students' accomplishments (Fathali & Okada, 2018; Jamieson-Proctor, Albion, Finger, Cavanagh, Fitzgerald, & Bond et al., 2013). Even with appropriate access to technology, effective professional development remains a barrier to increasing the amount of technology integration in classrooms (Harrell & Bynum, 2018). According to research by Keengwe and Kidd (2010), in comparison to traditional learning modes, lecturers in an online context have a far higher responsibility for creating specific structures and processes. It will take time for lecturers who are unfamiliar with online learning environments to get familiar with all their responsibilities. Furthermore, lecturers must always keep in mind that pedagogy, not technology, is the key to their success while developing and teaching online courses (Keengwe & Kidd, 2010). When creating a successful online learning and teaching environment, instructors should be aware of the elements taking part in both establishing the scene and overseeing the process of transformation (Keengwe & Kidd, 2010).

Further obstacles to the implementation of e-Learning environment exist at institutional level. These are, persuading management to invest in e-Learning; ensuring that the technological infrastructure is in place to offer e-Learning and that students have no problem accessing the information; overcoming workplace obstacles that might hinder e-Learning, such as lecturers that don't provide enough time for learning to take place; using e-Learning to engage students; overcoming e-Learning negative connotations (Keogh & Fox, 2008). Lecturers' capacity to educate is contingent on their having enough information. It may also be seen in the perspectives of lecturers with a conceptual teaching framework, especially when it comes to online teaching (Mardiana, 2018). Unfortunately, not many lecturers, particularly in online education, are completely aware of the tools available to them (Mardiana, 2018). Furthermore, many lecturers disregard their ability to teach online in favour of teaching in front of a class using textbooks (Kebritchi, Lipschutz, & Santiague, 2017).

Previous studies have also identified challenges for educational institutions in implementing e-Learning in HE (Tarus et al., 2015). For example, Mashhour and Saleh (2010) used questionnaires to investigate challenges of e-Learning implementation in the educational practice faced by students and lecturers at several Jordanian universities. Although there is a lot of interest in using e-Learning in HE, their analysis found that the benefits have not been adequately utilised (Mashhour & Saleh, 2010). In addition, nearly all the 120 academics who took part in the Mashhour and Saleh' study believed that one of the challenges of introducing e-Learning environment in academic institutions in the HE sector was the lack of sufficient resources and shortage of competent technical experts concerning e-Learning systems. Mashhour and Saleh also established that some academics did not comprehend how e-Learning environment would be of use to their own teaching.

However, this is not always the case, especially in SA. In some developing nations, politicisation has improved in terms of tackling numerous injustices and advancing democracy (Orazem & King, 2007). There are strong indicators in the literature that some developing nations are already battling e-Learning issues within their institutions.

Mashau and Nyawo (2021) suggest that the implementation of e-Learning environment in HEIs be considered holistically by all stakeholders related to learning and teaching at university level and should consider how integrating technology affects both students and instructors. Along with Van de Heyde and Siebrits (2019), even though the usage of e-Learning environment is essential as national HEIs strive toward a shared objective within the context of a global education transition, e-Learning systems are underutilised in SA. South Africa is a country with massive socioeconomic disparities, as well as extraordinarily high rates of unemployment and poverty (Stats SA, 2019). These problems make it difficult for students to use online learning and master ICT skills. Although implementing an e-Learning system in the HE sectors has enormous potential, it should be highlighted that its efficacy significantly depends on how widely it is adopted and used by the intended audience (Teo & Noyes, 2014).

Understanding motivating and impeding factors for both students and lecturers in accepting and implementing e-Learning practices is important in promoting integration of technology in the higher education sector. Although several initiatives have been made to close the technological gap between developed and poor nations at various levels, SA students and lecturers' use of technology is still rather low (Ng'ambi et al., 2016). In addition, no study in my view has attempted to bridge the gap of the integration of technology through e-Learning environment in an ICT-Challenged environment using various stakeholders as in the context of the current study. Numerous students and lecturers still primarily rely on the conventional teaching strategy centred on lectures and chalkboards. (Akuegwu, Ntukidem, & Jaja, 2011; Djajalaksana, 2011;Adomi & Kpangban, 2010). Accordingly, SA universities of technology are still to realise the full potential of the e-Learning platform (Mashau & Nyawo, 2021). According to recent research, to analyse the core business in current South African institutions necessitates the implementation of appropriate e-Learning strategies to meet the demands of students and lecturers (Swartz, Ivancheva, Czerniewicz, and Morris (2019). The current study is thus being done to bridge the information gap on factors that permit or hinder technology integration by students and instructors, particularly in an ICT-challenged context.

Developing countries, including SA, are of the view that e-Learning implementation in learning and teaching assists in providing a better quality of education (Ampofo, Bizimana, & Orodho, 2014). Since the introduction of ICT in developing countries, the blended approach is followed which includes various methods and modes (Hoic-Bozic, Mornar, & Boticki, 2009; Lalima & Lata Dangwal, 2017). After developing countries adopted e-Learning practices, the confidence and motivation levels of students and lecturers increased together with their technical skills and communication skills (Tarhini, 2018). However, the literature still shows that developing countries face many challenges in e-Learning practices. Among the numerous obstacles are a lack of expertise and effective technological approaches, a lack of administrative and technical support for technology adoption, a negative attitude toward technology, and changes to the educational system (Kundi & Nawaz, 2014; Madlela, 2015).

The e-Learning system in the HE sector is one of the supreme important transformations in education in the information age moving from lecturer-centred to student-centred education. The wide-ranging adoption of student-centred education and other modifications in educational training is facilitated by the emergence of the e-Learning system. e-Learning systems in HEIs introduce massive opportunities to meaningfully facilitate the process of effectively delivering learning materials and achieving access to educational information provided it is appropriately utilised (Dubey, 2016). An appropriately organised e-Learning system in the academic environment results in improving and enhancing educational quality which increases motivation, facilitating the achievement of fundamental skills, advocating knowledge inquiry and exploration, and training individuals for a technology-driven environment (Oroma, Herbert, & Frederick, 2012). Exclusively, academic staff members require extensive training on using e-Learning systems so that they can orientate their students on how to learn and access learning resources from the technology enhanced platform (Oroma et al., 2012). If students and lecturers do not comprehend the meaning and influence of e-Learning on education, they are more likely to oppose or avoid utilising it, resulting in institutional e-Learning failure (Avidov-Ungar & Eshet-Alkalai, 2011). Therefore, the inductive re-establishment of students and lecturers' ideas regarding their place within the higher education's structured social environment can offer routes to the immediate processes that might result in the adoption of the e-Learning system. (Kramer, 2007).

2.6 E-Learning Theories and Methodologies in Learning and Teaching

Theories are important in influencing practice in all disciplines. An examination of the available e-Learning literature indicates a theoretical void in the field; the only theories available are extensions of classical learning theories that include the use of ICTs in learning (de Freitas, 2004; Kibuku & Ochieng, 2018). An adequate amount of scholarly literature, specifically connected to e-Learning theories, is also lacking. Most of the available e-Learning literature and papers presented at conferences, are descriptions of practice (pedagogy), experiences, success, and obstacles in e-Learning (Andrews, 2011; Pange & Pange, 2011; Rüth & Kaspar, 2017).

Classic learning theories such as behaviourism, cognitivism, and constructivism have been applied in the practice of e-Learning environment all over the world. This is done on the justification that e-Learning environment is learning identical to traditional learning with the "e" acting as a conduit or vehicle for learning delivery (Kibuku and Orwa, 2018). Andrews

(2011) also claimed that e-Learning environment has been viewed as merely another learning site; nevertheless, applying traditional ideas of learning to e-Learning is unfair because traditional learning differs from e-Learning. As a result, a theory built particularly for e-Learning environment is required (Pange & Pange, 2011).

Open learning, learning communities, and distributed learning are some of the pedagogical models of e-Learning that have been used in the delivery of e-Learning (Behar, 2011). To summarise, these e-Learning pedagogical models were created to meet the needs and resources of institutions in developed nations that already benefit from established ICT infrastructures and technical breakthroughs. Borrowing them and trying to adapt them to the South African context will only cause further issues, given the challenges of ICT infrastructure, insufficient policy frameworks, restricted finance, and lack of or limited ICT capacity (Kibuku, Ochieng, & Wausi, 2020).

2.6.1 Learning Theories

Learning theories focus on the genuine learning process rather than the outcomes of what is learnt. Although learning theories offer several suggestions for how everyone can learn, they do not inherently dictate how to educate. By using these ideas during a learning process, instructors must figure out how to get from theory to practice. The fundamental philosophy of learning theories is that learning arises inside a person (Siemens & Design, 2016). In learning theories, there are fundamentally three primary points of view that provide an understanding of an intrinsic learning process in which students might accumulate information in a certain setting. Behaviourism, cognitivism, and constructivism are the three comprehensive learning theories frequently applied in the creation of instructional situations. These learning theories, however, were established before learning was technology enhanced. Connectivism is also a learning theory in a digital age. Learning requirements and theories that communicate learning ideologies and developments should be philosophical of fundamental social environments. Chatti, Jarke, and Quix (2010) focuses on the idea that "learning must be a way of being a continual collection of attitudes and activities by individuals and organisations that they deploy to try to stay up with the startling, novel, untidy, obtrusive, repeating experiences".

Behaviourism theory expresses learning as a recognisable change in behaviour. Accordingly, behaviourists pretend that behaviours are recognisable and can be associated with other recognisable events. In behaviourism, learning centres on stimuli and response. A study by

(Barab et al., 2004) underlines the importance of conditioning in behaviourism theories. These authors emphasise that learning takes place because of positive strengthening leading to outdated patterns being discontinued due to negative strengthening. The activities done during teaching are organised to provide opportunities for increasing the conditions in which pupils build their knowledge.

Cognitivism theory defines learning as linking the achievement of the cognitive structures within which human beings manage and keep information (Good & Brophy, 1990). These researchers demonstrate how students perceive, process, interpret, keep, and recover knowledge and are primarily concerned with the changes in students' understanding that results from learning. Students are involved in the learning process hence lecturers have to offer structured information that students can relate to. Another research highlights the cognitive approach's emphasis on learning as a worthwhile activity aided by the student's mental processes (Shuell, 1986).

Constructivism theory influences lecturers and students in organising, accomplishing, and encouraging differentiated activities through collaborative learning. Constructivism expedites critical thinking and problem solving. The student actively constructs or develops new ideas by means of previous knowledge and attained experience. During the process of learning, lecturers assume the role of a facilitator focusing on effecting corrections, encouraging new understanding, and building social disclosure. By eagerly participating in the learning activities that are at the core of the learning process, t students take on the responsibility of learning. Constructivism philosophy has guided many instructors in providing instruction that is supportive of pupils (Garrison, 1997). To this effect, Koohang and Harman (2005) assert that learning settings in constructivist environments mirror the typical complexity of the actual world. Consequently, various perspectives and representations that encourage supportive and cooperative learning are encouraged.

Connectivism is a learning theory in a digital age that underlines the function of social and cultural context in the facilitation of the process of learning. The phrase "a learning theory for the digital age" signifies the importance of connectivism to technology's effect on how we survive, converse, and learn. The fundamental viewpoint of connectivism is the representation of networks. Connectivism differs from other learning theories such as constructivism, since it considers learning as a process that can reside outside of ourselves and has the potential to connect collections of focussed information and the relationships between them, to allow us to learn meaningfully. Connectivism is a preferred learning theory in this study since it envisages knowledge as a network and learning facilitation as a process of pattern recognition (Del Moral-Pérez, Cernea, & Villalustre, 2013). It also views learning as an opportunity of establishing connections and increasing network complexity.

Learning theories rationalise the learning process within which students can acquire knowledge; however, there is no single learning theory that can fully account for all types of learning. Subsequently, many theories collaborate and balance each other during the learning process. Noticeable, is the attainment of the learning concepts that vary from one student to another with the learning methods dictating the knowledge level to be attained.

2.6.2 Learning and Teaching Technologies

Several e-Learning technologies are used for the learning and teaching process; however, they prescribe how learning will occur based on the environment in which they are implemented. These technologies involve CD-ROMs, LMS, CMS and computer-generated spheres as well as collaborative technologies (D. R. Garrison, 2011). An important task for academic staff in HELs, is to determine which e-Learning system is most appropriate to support their teaching needs and will provide optimum learning opportunities for students.

CD-ROM media has played an essential role in delivering learning material to students on distance instructions (Barrett & Lally, 2000). CD-ROM was adopted first and foremost in the early 1990s and maintains learning content in text/multimedia formats. CD-ROM media promotes independent learning where students learn by accomplishing specific computer training programs regardless of internet connectivity.

Learning Management Systems *(LMS)* are information systems and activities that directly or indirectly contribute to learning and to the management of that learning (de Freitas, 2004). They are predominantly established to provide online learning facilities for students, lecturers, and administrators. Examples of LMS include Blackboard, Moodle, Sakei etc. (Stiger & Gamble, 1997). The swift growth of ICT infrastructures in developing countries encourages every academic institution to use the Internet as a means of communication among lecturers and students. Through technology-based learning methodologies, effective and resourceful learning materials can be achieved. Proliferating use of e-Learning resources becomes an important aspect for some academic institutions. LMS in higher education has been extensively used because of numerous benefits such as accommodating learning moments and unlimited distance education (Hamuy & Galaz, 2010; Perkins & Pfaffman, 2006)

***Content Management Systems** (CMS*) like Modular Object-Oriented Developmental Learning Environment (Moodle) are established to expedite the collaborative content creation, group, influence, and to accomplish the documents dissemination in a centralised environment. This is a course management platform by means of Internet, sometimes called a LMS or Virtual Learning Environment (VLE). It is a free online service-learning milieu that teachers may use to provide efficient online education communities. The major advantage of Moodle is that it is an open source, available to any user, adaptable with software design knowledge to modify the environment for their individual goals. It is free to install on many servers, with no ongoing maintenance expenses to pay for development. CMS has wide-reaching users including academic institutions. The Moodle design is grounded on socio-constructivist pedagogy and its objective is to offer numerous tools that support an investigation and discovery-based methodology to online learning development (Bumpas, 2014). Moodle is known for satisfying the guidelines of the best LMS solution, which is considered in this study as having all components thought of within the complete university learning infrastructure to ensure optimum student achievement from a systemic and institutional viewpoint (Samsudeen & Mohamed, 2019). Moodle offers a more advanced and structured environment and resembles a set of tools that contribute to an efficient learning environment.

Collaborative Learning Technologies: are task-specific teamwork tools that are connected to goal- and task-oriented actions. Since they were first presented in 2005, collaborative technologies (CT) like Google Applications, the so-called "Applications of the Web" (AoW), have generated a fresh wave of no cost online word processors, spreadsheets, presentations, and wikis (Rienzo & Han, 2009). They offer widespread opportunities for producing, editing, and sharing content by bringing a degree of capability to a Web browser previously only available in desktop apps. However, there is little research that has examined how to forecast user uptake of e-Learning technologies in Web 2.0 contexts for instruction and learning. Instead of being created for solitary usage, collaborative learning environments enable user collaboration and sharing. (Liaw & Huang, 2011) created a web-based collaborative learning system for knowledge creation and sharing, and investigated how students feel about it. CT enable businesses to swiftly assemble remote employees into virtual teams to carry out a range of activities (Samaran, Paul, & Tadisina, 2007;Bosch-Sijtsema & Haapamäki, 2014). If properly applied, collaborative technologies (CT) have the potential to replace face-to-face interaction and can increase productivity. CT involves the use of the Internet or another technology to exchange information with one another. Lecturers must not only develop collaboration skills, but also familiarity with the systems. Knowing how to collaborate is being able to share your ideas with others and bring them together to make the team more successful (Zhang, Venkatesh, & Brown, 2011).

2.7 Use of Technology in Higher Education

The time required to handle e-Learning needs such as fostering students' ability to use technology, responding to questions outside the classroom, and developing students' learning materials; seems to be the biggest challenge faced by lecturers in e-Learning practices as they need to develop and restructure their modules to suit online requirements (Olatunji, 2013). The management system connected to an e-Learning system, which has the potential to improve technology utilisation in higher education, incorporates e-libraries with electronic books, interactive whiteboards, video conferencing or chat, learning stimulators, test design, and question bank systems (Tayyib, Ramaiah, Alshmemri, Ali, Asfour, Alsolami et al., 2020).

Anyone concerned with learning and teaching in the twenty-first century, according to (Bansa & Asrini, 2020), must understand the nature of the unique technology-mediated tasks students might engage in for learning activities, as well as how these tasks can be utilised for evaluation.

Previous studies found the increase of the use of technology could be attributed to lecturers having the necessary skills and training to develop online courses, while others lacked the confidence to employ technology in the classroom (Mosha & Bea, 2014; Oye, Iahad, Madar, & Rahim, 2012). Even though certain members of the teaching staff are computer literate, these abilities may not be adequate for them to use e-Learning in the classroom or for generating e-content, necessitating the need for training (Mosha & Bea, 2014). According to Tarus et al., (2015), a barrier to e-Learning integration at public institutions is that teaching staff lacks the necessary technical knowledge for developing e-Learning and e-content. Addressing the issues raised in this paragraph might lead to more positive interactions between lecturers and students during the learning process (Ramessur & Santally, 2007; Williams, Lewis, Boyle, Brown, & Holt, 2008).

2.8 Access to Technology in the Higher Education Sector

While universities that use technology in learning and teaching could benefit from an e-Learning system, they however face barriers that affect the use thereof (Hani, Hooshmand, & Mirafzal, 2013). Numerous factors have been reported to influence the ability of students and lecturers to achieve benefits from an e-Learning system and can cause more damage to the learning and teaching process in an already ICT-challenged education system (May et al., 2012). Research regarding the factors that could hinder effective e-Learning implementation in developing nations that could result in the delay of using e-Learning has been conducted (Mirza & Al-Abdulkareem, 2011). Due to the barriers such as availability and access of new technologies, such as e-Learning systems, remain asymmetrically distributed between developing and developed countries such as South Africa (Mikre, 2011; Baelden & Van Audenhove, 2015). There is therefore a need to investigate the factors that promote or inhibit the access to technology in adoption of an e-Learning system in learning and teaching in the higher education sector.

Universities keen for their students and lecturers to accept and adopt e-Learning practices in educational activities should provide sufficient access to technology resources and accommodating conditions. As indicated by Gulati (2008), lack of various resource categories is a common difficulty of e-Learning up-take in the HE sectors. The study by Ifnedo (2006) showed that HEIs in Nigeria have technological access issues making e-Learning implementation and the delivery of quality education impractical. Yildirim (2007) in his study revealed that one of the most efficient ways by which lecturers can make use of ICT in their pedagogy is their accessibility to technological resources. In addition to physical access, epistemological access is also required; therefore, in addition to traditional literacy and numeracy, both students and lecturers must be computer literate (Sahu, 2020; Quintana & Quintana, 2020). Therefore, having access to ICT resources and having the necessary ICT skills are the sole sources of motivation and confidence to incorporate ICT into learning and teaching (Mikre, 2011). Students who have access to the Internet can enjoy a more flexible learning process, but they may not take advantage of this possibility if they cannot obtain sufficient access to the Internet (Hassanzadeh, Kanaani, & Elahi, 2012).

Consequently, students with insufficient Internet access or no Internet access at all, at both university and home are disadvantaged in e-Learning environments. Additionally, because of more people enrolling in higher education, many students from low-income families don’t have much money to spare to pay for internet packages and backup generators in case load shedding occurs (Oye et al., 2012). Consequently, a greater dependence on technology to offer education might potentially cause social divides to grow (Hassanzadeh et al., 2012). In these situations, disadvantaged home environments actively oppose learning technology skills, which further hinder learning through online courses. When there is a lack of energy, it is impossible to revolutionise education with ICT or bring about a paradigm shift in education; it is impossible to have access to educational resources whenever you need them; and e-Learning is doomed (Ossai, 2020). Electricity power disruptions and inadequate ICT infrastructure for e-Learning were identified to be a key difficulty in research in public institutions in Kenya (Makokha & Mutisya, 2016).

The Internet provides the public with numerous options and endless chances for information, documentation, communication, and enjoyment. Due to Covid-19, South African education experienced a time of significant transition, with the Internet playing a key role in these developments. For many years, the Internet has always been a naturally instructive tool. Many people contend the fundamental goals of education are directly related to the functions of the Internet. For instance, information sharing, communication, and knowledge development are issues that both the Internet and education address. As a first step in integrating e-Learning environment, an integrated infrastructure should include free Wi-Fi and network connections on campus. In addition, adequate computers should be available in laboratories. This was also cited as a significant barrier to e-Learning rollout goals by other researchers (Khan et al., 2012; Tarus et al., 2015).

Many students struggle with poor classroom circumstances, poor Internet and network conditions, inadequate access to computers, and lack of Internet access. In students from Iran, Cameroon, and Canada, a lack of technological infrastructure and Internet access, as well as a bad Internet connection, offer hurdles for integrating e-Learning for learning and teaching and were identified as the key technical concerns for live online classrooms (Bediang , Stoll, Geissbuhler, Klohn, Stuckelberger, Nko, & Chastony, 2013; Lakbala, 2015). A research study was undertaken in a private institution in Pakistan to identify the hurdles and difficulties in the effective adoption of e-Learning systems to analyse the multiple challenges faced by Pakistan in the development of e-Learning systems, (Kanwal & Rehman, 2017). Computer access, technical terminology, and privacy concerns were identified as important problems in Pakistan.

2.9 Provisioning of Technology Training

Studies indicate that training is fundamental and must be made available if implementation of an e-Learning platform is going to be fully advantageous for both students and lecturers, (Taha Ahmed, 2013); (Kisanga & Ireson, 2015). Based on Stödberg and Johan Orre (2010) there are several issues to consider before e-Learning environment may be adopted in education from the standpoint of poor countries. This includes, but is not limited to, staff capacity development, especially in times when new approaches to learning and teaching in the HE sector are introduced, Internet connectivity, and structure technology training. It is important to recognise and treat seriously the issues raised by training and discussion about new e-Learning methods of teaching and learning. If universities are unable to provide necessary training on the use of technology, they will face the danger of falling behind in technological development (Khan, Vivek, Khojah, & Tahir, 2021). Furthermore, students and lecturers in these universities will face challenges of a lack of knowledge and efficient methods, a lack of technical assistance, a lack of administrative support, a negative attitude toward technology, and the transformation of the educational system (Kundi & Nawaz, 2014; Madlela, 2015).

If students' efforts to adopt e-Learning platforms are to be successful, they must get enough instruction on how to use online learning for learning at HEIs, (Chawinga, 2017). If this aspect is not addressed, students will encounter a myriad of technological and pedagogical challenges that they cannot overcome and will lack confidence to use technology (Chawinga, 2017). Students must be ready to adjust to technological advancements, particularly for learning and communication purposes (Rifai & Nabhan, 2017). To successfully utilise various e-Learning tools, students need to have specific skills, and these represent challenges they must overcome to succeed in e-Learning (Paechter & Maier, 2010). The findings of a study on students' use of LMS at three Saudi Arabian universities identified the primary obstacles that prevented students from using LMS, including but not limited to the lack of instruction on how to utilise LMS systems, while insufficient technical assistance from universities contributed to a bad perception of these platforms to students (Alenezi, 2018). Any ICT's success is determined by how well students are trained to use it, and a lack of utilisation prevents advantages from being realised. According to Mohammed Nasser Hassan Ja'ashan's (2020) research, students confront technological problems such as a lack of technical assistance, poor home Internet connectivity, and a lack of training courses.

Students, overall, have some rudimentary knowledge of computer abilities; nevertheless, these skills may not be sufficient to use e-Learning environment in the classroom, therefore, students require technical assistance, training, and Internet access. In their study on the constraints and prospects of e-Learning implementation in Iraq, Al-Azawei, Parslow, and Lundqvist (2016) noted that extensive training programs are necessary to improve students' computer and e-Learning technology usage abilities. Without a doubt, a lack of individual abilities might have a detrimental impact on their desire to integrate e-Learning environment. As a result, students may have problems with e-Learning environment, leading them to look for excuses to avoid it. Inadequate training and professional development, according to Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012), is the most frequently cited reason for a lack of technology adoption in classrooms. The use of ICT in teaching, learning, and educational administration requires the development of new skills, attitudes, and pedagogical practices, much like any other innovation which calls for ongoing training programmes for academics, developers, and administrators.

Professional development should focus on holistic coping mechanisms to enhance technical confidence, rather than an avalanche of precise knowledge and mechanical operational procedures, according to Esterhuizen and Blignaut's study (Esterhuizen, Blignautt, & Ellis, 2013). Academics in higher education face increasing pressure from students to provide more flexible, technology-enhanced course delivery, even as they race technology for their students' attention. They also confront pedagogical problems, such as designing new learning environments that react to the changing demands of technology-capable students and integrating technology to further the HEI's goal (Schneckenberg, Ehlers, & Adelsberger, 2011). On the one hand, research suggests that certain lecturers may lack enthusiasm and dedication among most teaching personnel in using e-Learning environment in public institutions, as a result of which they do not participate in training (Tarus et al, 2015). Kasse and Balunywa (2013) and Ssekakubo, Suleman, and Marsden (2011) performed research in which they investigated the problems with e-Learning uptake and use in underdeveloped nations. These researchers discovered that certain members of the faculty and students lacked sufficient knowledge and instruction in the use of online learning, in addition to the lack of necessary resources (Omoda-Onyait & Lubega, 2011). Aydin (2014) shows that e-Learning systems may still fail due to a lack of requisite skills for utilising resources, even when institutions occasionally have the resources for implementing it. Therefore, it is necessary to give training and skills so that the faculty and students can utilise e-Learning platforms efficiently.

Inadequately trained employees can become an impediment to a well-balanced learning process, as well as difficulties with application use in students' perceptions ((Samir Abou El-Seoud, Taj-Eddin, & Nosseir, 2014).

2.10 Provisioning of Technology Enhanced Infrastructure

Numerous studies, based on the acceptance and implementation of e-Learning systems in developing countries have been conducted. E-Learning is now being used in a hybrid fashion by three public institutions in Kenya. These institutions have recently conducted a study on the possible challenges having a potential to hinder e-Learning implementation (Tarus et al., 2015). The study has shown that insufficient provisioning of technology infrastructure can hamper integration of technology. Universities in developing countries like South Africa lack funding resulting in limited continued support which impacts on the technology infrastructure (Gewald & Jacob, 2013). According to Hani et al (2013) an advanced technology infrastructure can maximise the efficiency of the education system and increase learning outputs of students. The insufficient infrastructure is considered as a barrier to the success of e-Learning systems and has a potential to hamper the ability for universities to benefit from integration of technology in the classroom (Akaslan et al., 2012).

Adeoye and Adanikin (2020) conducted a study on the obstacles affecting the e-Learning success in developing countries from a Nigerian perspective. Their study results showed that infrastructure issues are prominent in developing countries and are a cause of low uptake of the e-Learning system. A similar study by Philomina, Bosco, and Okeeokosisi (2020) indicated that several higher educational institutions in Africa have inadequate infrastructure. Technology enhanced educational facilities are extensively scarce because of insufficient budget and over dependence on government funding. According to Ololube, Eke, Uzorka, Ekpenyong, and Nte (2009), an inadequate power supply in several African countries, South Africa included impact on basic ICT infrastructures. This implies that electricity supply has been a chronic problem in most African countries for quite a long time. Accordingly, a higher education institution that wants to implement and integrate e-Learning systems should first purchase and build a suitable ICT infrastructure to provide good e-Learning platforms to students and lecturers. In addition, higher education administrators should guarantee that the infrastructure in place is refreshed on a regular basis to keep up with new technologies. Exploration of various funding options, such as creating relationships with government sector entities, is one approach to meet infrastructural requirements. This might assist in raising funds for critical ICT infrastructure.

Inadequate infrastructure is a serious impediment to the realisation of students and academics in terms of the development of their scholastic, research, and new production knowledge initiatives, intellectual elevation, and academic success, as well as promotion of the students' cultural, intellectual, and social development (Hairon & Chai, 2017). According to (Unwin, Kleessen, Hollow, Williams, Oloo and Alwala et al., 2010; Mtebe & Raisamo, 2014; Sanga, Magesa, Chingonikaya, and Kayunze, 2013), significant infrastructural issues must be addressed if an academic institution is to achieve efficient utilisation of an e-Learning system in learning and teaching. Andersson and Grönlund (2009) and Ssekakubo et al., (2011) conducted research on e-Learning acceptance and use, moreover, the use of e-Learning systems in developing nations such as SA. According to their research, there is not enough ICT infrastructure to support the enormous number of students, and there is also inadequate ICT support for using an e-Learning platform. Additionally, HEIs should make the appropriate ICT infrastructure investments so that instructors and students may conveniently access ICT gear and provide consistent technical assistance. While lecturers in the current study recognise the potential of e-Learning to support learning and teaching, poor University infrastructure often limits interactivity (Alomari, 2009). To access the global Internet superhighway, some nations in East and Southern Africa have also invested in underwater cables.

2.11 Cultural Factors in e-Learning Systems Approaches

According to the results of preceding studies, researchers emphasise the necessity of considering cultural impact while investigating technological acceptability. Olson, Codde, and de Maagd (2011) underline culture and traditions as soundly associated to acceptable learning practices. According to Macpherson and Wilkinson (2005); Motaghian, Hassanzadeh and Moghadam (2013), any higher education institution wanting to successfully implement an e-Learning platform must ensure it can be culturally and technologically responsible to its students' needs. The influence of culture has a remarkable impact on learning and teaching, including interaction and communication approaches. Cultural factors in online learning approaches contribute to design and system development, as well as acceptance and system usability (Bourdieu, 2018). In the process of designing and promoting a successful system, cultural orientation must be considered in e-Learning environments (Downey, Wentling, &

Wadsworth, 2005). Based on Sun, Cheng, and Finger (2009), given that it may speed up adoption, considering users' cultural qualities in the design of an e-Learning system is one of its defining characteristics (Sun et al., 2009). During virtual learning implementation, socio-cultural aspects may create many barriers. Any e-Learning platform's user interfaces must also consider their ethical and cultural implications.

Culture educates us about our society's key laws, rituals, customs, and processes; it also cultivates and reinforces our beliefs and values (Rooney, 2013), and shapes our thinking and behaviour patterns (Hofstede, 2011). Hofstede and Milosevic (2018) developed the cultural dimensions, claiming that people with various value orientations see and act in different ways. When it comes to the acceptance and adoption of technology, culture impacts people's thinking and attitudes, their degree of innovation, and their willingness to accept risks, as well as determining what the norms are (how one should act in a circumstance in his or her organisation), which reveals subjective norms. Given how influential culture is on people's thinking, it's only natural to assume that culture influences how people view technology.

Research studies have compared individuals from two distinct cultural groups and utilised culture as a variable to investigate its possible moderating effects (Tarhini et al., 2015). Given that academics are the primary change agents in the use of technology in education (Teo, 2011a), it is critical to understand how cultural factors affect their ability to use technology. Universities intending to implement e-Learning systems have different cultures and facilitating conditions, which could be identified as obstacles in the integration of technology. Consequently, academic institutions need to identify cultural barriers and develop a coherent strategy that will address these barriers to realise a sustainable e-Learning implementation (Rohayani et al., 2015). Okaz (2015) underlines culture and traditions as soundly associated to acceptable learning practices.

Integration of technology in all developing countries is caused by social and cultural differences (Tarhini, 2018). According to Macpherson and Wilkinson (2005); Motaghian et al., (2013), any higher education institution determined to achieve an e-Learning strategy, requires a culturally and technologically equipped e-Learning approach. The influence of culture has a remarkable impact on learning and teaching, including interaction and communication approaches. Cultural factors in online learning approaches contribute to design and system development, and acceptance and system usability (Bourdieu, 2018). In the process of designing and promoting a successful system, cultural orientation needs to be considered in e-Learning environments (Downey et al., 2005).

Culture influences who we are, how we think, act, and react to our surroundings. Above all, it has an impact on how we learn. Education is a critical component of any country's progress. Globally, e-Learning has several issues, including communication, culture, and technology, that must be addressed before successful implementation and results can be achieved (Azer & El-Sherbini, 2011). The major goals are to address the cultural obstacles that students and lecturers face in the uptake of an e-Learning system. The biggest challenge is changing staff culture and inspiring lecturers and students to use emerging technology in teaching and learning. Macpherson (2006) suggests that any institution attempting to implement an effective e-Learning strategy should be prepared both technologically and culturally. A thorough investigation on the acceptability of e-Learning in Tanzanian HEIs revealed several obstacles to its deployment (Ndume, Tilya, & Twaakyondo, 2008). For instance, the study highlighted a lack of capacity analysis prior to the implementation of e-Learning programs as a key barrier to its acceptance in the country. Another impediment to its deployment was shown to be a negative learning culture against e-Learning environment. Kaba and Osei-Bryson (2013), claim that a person's reaction to technology use is influenced by their culture. They argue that culture has the potential to bridge the digital divide and alleviate inequality in organisations and at a national level. The authors draw the conclusion that cultural differences influence how technology is adopted and used in various nations. Culture, according to Ashrafzadeh and Sayadian (2015), is one of the barriers to employing electronic instructional material in the classroom. Academics' cultural and language origins, according to Rhema and Miliszewska (2010), are a barrier to technology acceptance and application in Libya.

2.12 Students’ Attitude towards e-Learning Systems

Although university students in poor nations have different opinions towards e-Learning, they are generally favourable. This is confirmed by Nassuora (2013) who noted that several students displayed favourable attitudes to online learning since it improves their drive and self-esteem. Concurring with Deb (2011); the physical distance between the student and the teacher sometimes makes the learner feel alone, which might result in negative attitudes. Numerous studies demonstrate that gender is a significant factor in elucidating disparities in views of integration of technology and attitudes toward e-Learning environment. As a result, several studies have found that male students are more enthusiastic about online learning than female students (Liaw & Huang, 2011; Papaioannou & Charalambous, 2011). They also discovered that computer-related expertise is an important determinant of learner self-efficacy and e-Learning passion. Self-efficacy and initiative, as well as intrinsic and extrinsic motivation, are all strong determinants of a student's e-Learning behavioural intention. Other studies believe the gap between male and female students is narrowing (Gillwald, Milek, & Stork, 2010; Gillwald, Moyo, & Stork, 2012). Several researchers have shown that in a positive learning climate, e-Learning environments provide the greatest contribution to students' attitudes toward accepting and adopting technology (So & Brush, 2008; Chen, Weng, & Hsu, 2010; Chen & Huang, 2012). After all, favourable attitudes, and behaviours among students toward online learning are vital and required for its acceptance and implementation (Barclay, Donalds, & Osei-Bryson, 2018).

Bertea (2009) also performed a case study to gauge students' perceptions about e-Learning environment. The goal was to figure out what aspects had an impact on the e-Learning process. The findings revealed there is a correlation between technical abilities and students' views toward e-Learning environment. According to her study, the amount of time spent on computers has an influence on attitude. Throughout their research, Struyven, Dochy, and Janssens (2005) discovered that how students evaluated the teacher's technique of grading performance in class was critical. Students, for example, prefer multiple choice examinations to other types of assessment. This discovery strongly influences their attitudes about studying and learning. Other innovative evaluation approaches are also met with resistance from students. Rhema and Miliszewska (2014) revealed that Libyan students who took part in the study were positive about e-Learning environment and valued its benefits. In addition, the study discovered a statistically significant link between students' attitudes about technology, and their exposure to modern technologies. The favourable expectations of students and their readiness to participate in online learning courses point to the high potential of future e-Learning initiatives in Libya. Bhuasiri, Xaymoungkhoun, and Ciganek (2012) also showed that the most important variables in establishing e-Learning environment in developing nations are raising technology knowledge, enhancing attitudes toward e-Learning, and encouraging students to use e-Learning systems with a high level of support from the institution.

2.13 Lecturers' Attitudes towards e-Learning Systems

The attitudes of lecturers have a significant impact in the online teaching and learning process and are critical components in the learning revolution, which drives them to become more involved in their teaching (Mardiana, 2018). Hue and Jalil (2013) conducted research in Vietnam to ascertain instructors' attitudes about curricular technology integration. They conducted a descriptive study using surveys to establish the acceptance and use of e-Learning practices among lecturers in learning and teaching facilitation. Their study focused on determining lecturers’ attitudes towards the integration of technology into the curriculum. The participants in the study included 109 lecturers from a public university. Another study, conducted in Malawi by Harvey (2012), emphasised the adoption and utilisation of e-Learning practices by both lecturers and students at Mzuzu University. Interviews and questionnaires were data. The findings of this study indicated that technological tools in this University were poor; however, lecturers and students were interested in integrating technology to the curriculum.

Several studies have explored and identified factors influencing academics’ attitudes towards e-Learning (Chen & Tseng, 2012; Karaca, Can, & Yildirim, 2013; Yilmaz & Bayraktar, 2014). The examined literature divided the extrinsic and intrinsic elements that influence academics' views about e-Learning systems into two groups (Teo, 2009). Intrinsic factors involve academics’ internal belief about technology developed by the level of which academics will observe encouragingly or adversely toward the technology. Intrinsic motivation has been established to have a meaningful positive influence on using technology; and more particularly, in e-Learning systems utilisation (Cheng, Wang, Moormann, Olaniran, & Chen, 2012). Subsequently, the extent which students and lecturers perceive usefulness of an e-Learning system and the intention to use it, depends on technology motivation. Accordingly, the more lecturers perceive that the e-Learning systems’ integration in learning and teaching activities will demand less physical and mental effort, the positive intention towards its usage increases resulting to the higher the opportunity that it will be utilized (Mohammadi, 2015). Conversely, extrinsic factors involve subjective norms, organisational structure, technical factors such as complexity of a technology, and environmental factors such as ICT infrastructure, features and support (Teo, 2009; Chien, Wu, & Hsu, 2014). The consideration of lecturer changes of attitude in favour of using e-Learning system is necessary since their beliefs influence what they do in classroom. Research studies have shown that lecturers’ understanding of how ICT will benefit them, and their students learning is the main area (Bingimlas, 2009). Based on the study by Gamdi and Samarji (2016), lecturers with positive attitude and required technical knowledge favour of using e-Learning system, can successfully integrate technology in learning and teaching.

According to certain research on attitudes toward employing e-learning systems, lecturers are hesitant to implement new technology in their instruction if they do not feel the need to alter their professional practice (Bingimlas, 2009; Hossain, Salam, & Shilpi, 2016;Mahajan, 2012). An extensive study of lecturers' attitudes about using technology in the classroom revealed that these sentiments, and a natural aversion to change were substantial obstacles to the adoption of e-Learning systems (Curriculum, 2003). However, the force of innovation, quick accessibility, inventiveness, and Internet access, facilitate the transition from current levels of understanding and use of the e-Learning system to a desired level of performance, while opposing forces like a lack of technical support, academic expertise, or planning time, delay it (Earle, 2002; Tomei, 2008; Noori, 2019). The lecturers who are resistant to change do not oppose the need for change; rather, they lack the training required to accept the changes and are not given the time to fully understand the new technology.

Lecturers’ attitudes towards using an e-Learning system and his/her control of ICTs, has the potential to influence students’ acceptance of the system. Academic qualities represent an important aspect of the success and acceptance of an e-Learning system (Solimeno, Mebane, Tomai, & Francescato, 2008). The proper stance toward embracing the new learning method is also influenced by several organisational, environmental, technical, and human variables. The attitude of both lecturers and students toward online learning is influenced by variables such as persistence, self-control, and confidence, as well as the simplicity of the program and peer support.

Several authors have indicated that successful e-Learning implementation in the integration of technology depends largely on lecturers’ attitudes (Salmon, 2011; Teo, 2011; Teo, Ursavas, & Bahcekapili, 2011). Based on Xhaferi, Farizi, and Bahiti (2018), gender influence, lecturing experience, age, and attitude towards ICT has a positive effect on technology adoption. In general, attitudes regarding technological integration indicate to some extent the potential for engaging behaviours. The current study lends credence to the idea that attitudes about using computers have a direct beneficial impact on behavioural intentions to utilise technology, indicating that lecturers with a good attitude toward the use of computers are more likely to use it for learning and teaching.

2.14 E-Learning Uptake among Students and Lecturers in Higher Education

Many institutions throughout the world have used e-Learning platforms in some form or another to improve the delivery of their programs. Many HEIs in Africa implemented some type of e-Learning environment, despite research indicating a poor uptake of e-Learning systems at these institutions (Mtebe & Kissaka, 2015). At Makerere University in Uganda, for example, just 0.15 % of students and academic staff used LMS (Kituyi & Kyeyune, 2012). Similarly, at the University of Nairobi in Kenya, less than 0.016 % of students and academics are said to utilise LMS (Ssekakubo et al., 2011). At the University of Zambia, only 0.11 % of students and lecturers are said to utilise LMS (Ssekakubo et al., 2011). In Tanzania, Mtebe (2014) found that just 3.48 % of students and lecturers at the University of Dar es Salaam used e-Learning platforms. Though online learning provides greater benefits to students, most developing nations have been hesitant to adopt online-based learning. The COVID-19 pandemic has forced institutions to implement more sustainable and creative learning solutions (Maphosa, 2021).

According to Gupta, Jankie, Pancholi, Talukdar, Sahu, and Sa (2020), students find it difficult to transition to an online environment due to a shortage of Internet connectivity and online learning tools. For e-Learning to be successful, students must move from conventional course offerings and navigate the modern technological environment, which has certain requirements (Gelles, Lord, Hoope, Chen, & Mejia, 2020). Massive data prices and other inequalities cause disparities in access to high-quality education, and the digital divide makes these problems worse (Tam & El-Azar, 2020). According to a study by Nigerian students, the high cost of ICT devices has a detrimental effect on the acceptance of e-Learning (Oyediran, Omoare, Owayemi, Adejobi, & Fasasi, 2020). Another research in Malaysia found that high data prices made it difficult for students to fully participate in online learning (Ramli, Majid, & Badyalina, 2020). Students from underdeveloped nations with insufficient infrastructure, according to Sintema (2020), found it difficult to completely integrate into the online world. Due to a shortage of Internet connection and gadgets for students and lecturers, most educational institutions in poor nations are bound to fail to adapt their traditional courses for the online environment (Gupta et al., 2020).

It has been discovered that characteristics of students, which are viewed as essential components in online learning in developing nations, significantly affect online learning and adoption (Bhuasiri et al., 2012). These traits include approaches to online learning, computer and Internet knowledge, computer usability anxiety, and internet self-efficacy (Chu & Chu, 2010). The effectiveness and ease of use of online learning courses, the usefulness of online learning, the students' level and computer skills, and other factors all affect students' opinions (Cakir & Solak, 2014). Their computer experiences, which obviously involve their own usage, enjoyment, and effectiveness, as well as the use of online learning, have a significant influence (Liaw & Huang, 2011).

The requirement for pedagogical flexibility to ensure that students' welfare and access to fair and inclusive learning environments are addressed, is another significant issue brought up in articles concerning the quick move to online education (Craig, Humburg, Danish, Szostalo, Hmelo-Silver, & McCrannie, 2020). The likelihood that such a redesign can help students cope with anxiety brought on by unforeseen life upheavals, such as the quick conversion of all classes to online learning, is equally important. Other studies have in fact emphasised how crucial it is for educational institutions to put their students' and instructors' physical, mental, and psychological well-being ahead of the need to teach the curriculum (Quintana & Quintana, 2020; Sahu, 2020).

Most of the research into the use of e-Learning environment has mainly focused on the availability of e-Learning platforms and facilities to measure the adoption of e-Learning (Lwoga, 2012; Ssekakubo et al., 2011). However, other crucial elements that affect the uptake of e-Learning, such as attitudes, awareness, and accessibility, have gone unnoticed (Al-Alak & Alnawas, 2011; Pinpathomrat, Gilbert, & Wills, 2013; Kisanjara, 2014). While previous research has added to my understanding of students' e-Learning environment experiences, there are still many information gaps among academics concerning e-Learning experiences, particularly in the SA context (Arthur-Nyarko & Kariuki, 2019; Bagarukayo & Kalema, 2015). Academics' behavioural goals, attitudes, and perceptions, according to Rentler and Apple (2020), are the most important aspects that impact their uptake and usage of e-Learning platforms for academic training.

Regardless of the opinions or perspectives of academics towards e-Learning, they must have the necessary abilities in terms of LMS training and technical assistance, since they are crucial to their proficiency in content generation, management, and facilitation (Abd Aziz, Musa, & Malik, 2021). Technology (2007a), Tena, Navas, and Fuster (2021) highlighted the degree of training and technical support that lecturers at HEIs received in terms of the integration and use of ICT as an e-Learning tool. These writers claim that African HE academics have systemic challenges and lack the abilities necessary to create and integrate e-Learning environment. In addition, many HEIs in Africa lack adequate e-Learning policies and administrative and technical assistance for academics in the development and use of e-Learning facilities (Technology, 2007a). Unfortunately, these flaws affect academics' knowledge, opinions, and attitudes towards e-Learning environment in a variety of ways. According to a research study by Makgato (2014), a key barrier to efficient and effective use of e-Learning services in various HEIs is the lack of support and help from the technical department. It should be noted that e-Learning environment encompasses more than simply the use of computers in the classroom; it is a method of enhancing learning capacity and widening educational horizons. Fast Internet connections are consequently necessary for the many e-Learning platforms used for online learning and teaching, which allow students to share and discuss course material, complete real-time online tests, engage in real-time chat rooms, and work together on projects (Uziak, Oladiran, Lorencowicz, & Becker, 2018; Adigun, 2020).

Alghamdi and Bayaga (2016) conducted a study on members of faculty from six Saudi Arabian universities to assess their attitudes towards the use of LMS in their teaching processes. The outcomes revealed that the attitudes of the members of faculty were the primary obstacle to using LMS, with most of the LMS educational tools not being fully utilised in the learning process. While the LMS offers a variety of instructional opportunities, academics' experiences with it may vary depending on several factors, including, but not limited to effort and performance expectations; the on-campus Internet access facility; the teaching style (Fresen, 2011); e-Learning activities support; societal factors; perceived ease of use; and time (Kim, Yoon, & Kim, 2021). Studies have demonstrated that instructors are more likely to sign up for and engage students on the LMS when it is built in a user-friendly way, despite there being some controversy regarding the scholars' experiences with e-Learning systems being influenced throughout time, notably the LMS (Coleman & Mtshazi, 2017; Sackstein, Coleman, & Ndobe, 2019).

Research by Bagarukayo and Kalema (2015) and, Govender and Govender (2013) revealed lecturers' perspectives and experiences using LMS. Lecturers interviewed by Govender and Govender (2014) were particularly pleased because the LMS helped them facilitate big courses, improved their assessment procedures, and better fulfilled the learning demands of students with a variety of needs. Furthermore, according to a 2017 survey conducted by Coleman and Mtshazi among certain lecturers at a South African institution, the LMS has a high degree of acceptability among the university's academic staff. The academic staff were delighted with the system's stability, as well as the LMS's interface, according to the twosome (Coleman & Mtshazi, 2017). Most academics surveyed by Sackstein et al., (2019) expressed greater satisfaction with the LMS, citing perceived usability for student tracking, uploading material, communicating, evaluations, and tracking, as factors that encouraged them to make use of the LMS at their university. Notwithstanding the benefits given to the LMS, Gautreau (2011) found some lecturers reluctant to utilise it for teaching. Many academic staff members, according to Gautreau (2011), are uncomfortable with the intricacies of the LMS interface, as well as the difficult chores associated with the design and posting of such educational materials. Furthermore, some academic staff who participated in the study by Sackstein et al., (2019), considered using the LMS as extra labour and were hence unmotivated to utilise the e-Learning platform.

Though research has demonstrated the relevance of the LMS in HEIs and student-lecturer engagement, Holmes and Prieto-Rodriguez (2018) argue that the curriculum and its contents are the foundation of online student-teacher collaborations. The curriculum material is an important part of the educational process in HEIs, and lecturers/academics are responsible for designing, creating, delivering, and implementing course content and curriculum. All of this must be done in a way that allows learners to increase their learning options. According to a growing body of research students learn best when they are actively engaged with the curriculum and subject (Olson, Codde, & Egidio, 2011). It's worth noting that, while online teaching offers a variety of benefits over F2F instruction, it's not without its drawback's instruction (Kumar & Al-Samarraie, 2018; de Waard & Kukulska-Hulme, 2019). To offset the loss of F2F interaction with the students, lecturers/academics must find strategies to deliver students' deeper understanding of course content using relevant, tangible examples. According to Kebritchi et al., (2017), obstacles related with the acceptance and use of the LMS among academics, particularly in developing countries, include course content concerns, multimedia infusion, pedagogical techniques, and students' learning styles. Additionally, although it is crucial that uploaded course content is presented in a way that helps students develop their skills, LMSs may be compromised by ineffective and inefficient Internet facilities, overly stringent procedures for developing, uploading, and implementing course content, as well as challenges in obtaining technical support.

Unfortunately, there appear at present to be issues with the assessment techniques of the learning goals for e-students at South African HEIs, in addition to the difficult process of material production and implementation for e-Learning environment. Wright (2014) highlights the importance of assessments for e-Learning environment, contending that evaluations of online instruction should be in accordance with the goals and knowledge provided by the LMS. E-learning activity assessments, according to Wright, must also be practicable and accurate. However, research has found that lecturers in HEIs who have utilised the LMS have voiced unhappiness with the platform's evaluation procedure (Hadullo, Oboko, & Omwenga, 2017; Makokha & Mutisya, 2016). Makokha and Mutisya (2016) found that teachers were dissatisfied with the evaluation procedure on the LMS platform in their analysis. Lecturers have been turned off by the interruptions in evaluation feedback, and their poor impact on students' academic results (Chawinga, 2017). The influence of technology on learning and teaching processes cannot be underestimated, regardless of the experiences acquired or the attitude toward the uptake and usage of various e-Learning platforms. The design and integration of multimedia into course materials, pedagogical methods, and students' unique learning styles are some of the difficulties connected with the adoption and utilisation of an LMS across various HEIs in developing countries, notably in Sub-Saharan Africa (Kebritchi et al., 2017). The University of South Africa, for example, has addressed these obstacles to a considerable extent by properly training and equipping their academics for virtual learning and teaching activities, and now claims to be Africa's largest university, with over 350,000 students registered on its LMS (Letseka & Pitsoe, 2014; Ngubane-Mokiwa, 2017).

To effectively compete with other institutions across the world in the higher education sector, SA universities have over the past ten years, introduced several e-Learning platforms. The work done by HEIs to educate academics on the nuances of e-Learning to use it effectively and efficiently for learning engagement is also acknowledged (Makgato, 2014; Padayachee, 2017). Maphalala and Adigun (2020) revealed that although the HEI surveyed lecturers were given training on how to use the e-Learning platforms of the various institutions, there was a lack of continued technical support for these academics to make sure the e-Learning platform was installed and used successfully. This deduction supports prior findings by Bagarukayo and Kalema (2015); Fresen (2011) and Rubaai and Hashim (2019), all of whom claimed that sufficient training and retraining of academics was one of the most significant hurdles to effective e-Learning utilisation.

According to Bagarukayo and Kalema (2015), Ndung'u, Mothobi, and Lewis (2018); Greyling, (2018) and Mahabeer and Pirtheepal (2019), when they acknowledged SA's swift rise in digital access and Internet connection, they noted that the latter had greatly improved over time. These authors found that Internet connectivity at the SA university hasn't attained acceptable standards of performance yet, since it is unpredictable, and not always available around campus. This has a detrimental influence on learning and teaching engagements in this university's LMS. In several SA universities, Internet viability and access are also a problem, according to Oyedemi (2012) who claims the lack of Internet access at SA universities echoes prior inequalities in the country. In virtual learning and teaching, the production and development of material for e-Learning environment is a crucial idea. Without proper and explicit material produced in a student-centred way, virtual teaching is inadequate (Holmes & Prieto-Rodriguez, 2018). Even in the 21st century, most lecturers still have insufficient knowledge and expertise in e-Learning pedagogy and are accustomed to a teacher-centred form of instruction. This means they are unfamiliar with the more student-centred paradigm associated with e-Learning (Bada, Asianzu, Lugemwa, Namataba, & Milburga, 2020). According to Olson et al., (2011), when programmes are concentrated on the teacher, such as excellent teacher training, professional development, mentorship, networking, and support, there are achievements, which help the integration of e-Learning pedagogical techniques into classroom practice and curriculum. Since they are familiar with the teacher-centred paradigm, students have little or no awareness about Learning Management Systems. Large class sizes, which interfere with the efficient management of online classrooms, a lack of e-Learning skills, limited bandwidth, resulting in sluggish Internet connections, and a conservative culture among course instructors are a challenge. Other issues surrounding the adoption of e-Learning include a lack of recognised and accepted pedagogical methodologies for online education, and a lack of legislation for its implementation (Bada et al., 2020).

Researchers have also conducted numerous studies on the uptake of e-Learning with a focus on identifying key success aspects, institutional strategic teaching, learning practices and policies, and conception of online learning uptake in higher education institutions as a form of innovation that is disruptive (McPherson & Nunes, 2008; Keengwe & Onchwari, 2011; Hardaker & Singh, 2011b). Another contributing factor on poor uptake of e-Learning in HE, according to Laurillard (2010), is costly transition to digital concept. As a result, the inductive re-establishment of lecturers' ideas of their roles in HE's structured social environment can provide access to the early stages of the processes that can result in e- Learning adoption (Kramer, 2007).

In the uptake of e-Learning, lecturers should be furnished with improved attributes and skills that go beyond the transmission of subject knowledge, so that they are aware of the opportunities opened by online delivery (Nathan & Scobell, 2012). According to (McPherson

& Nunes, 2008), lecturers’ responsibilities in the uptake of e-Learning, suggest competence to establish collaborative learning programmes, imparting guidance, and leadership to learning needs of an individual; structuring delivery to meet learning intentions associated with systems, assessment and expected outcomes. The social engagement feature is highlighted in these new elements which go beyond subject knowledge and conventional F2F teaching knowledge, and challenge conventional wisdom about lecturers' work, considered opinion in quality, and work ownership (Benson & Brack, 2009).

Literature on the uptake of e-Learning environment and lecturers’ responsibilities indicate numerous challenges commonly experienced across higher education that may impact negatively on lecturers’ perceptions and confidence. Lecturers’ resistance in the uptake of e-Learning environment is caused by numerous factors. For example, additional teaching demands; accommodating co-operative teaching and learning undertakings; having to meet the enormous demand for content; , students’ questions and answers; and lastly, the strengthened demand to improve communication and reasoning learning through mechanisms of instructor imminence (De Vries et al., 2005; Martins & Nunes, 2016; Nagel & Kotzé, 2010). The literature on the uptake of e-Learning environment further indicated that lecturers found their new tasks time consuming and added to their responsibilities beyond the scope of student achievement and knowledge construction. (Goodyear, 2006; Martins & Nunes, 2016).

Moreover, these challenges at institution level are not alleviated. For instance, in their study, Birch and Burnett (2009) “perceived a lack of reward and a lack of recognition from management and peers had consistently inhibited academics’ willingness to develop e-Learning environments”. In the same way, Green, Alejandro, & Brown (2009) contend, “seldom will faculty participate in activities that take time and resources away from their careers, especially when trying to get tenured at an institution”. Furthermore, lecturers’ teaching and administration workloads compound the adoption of e-Learning such that they view it as increasing time commitment Uys et al., (2011); Orr et al., (2009), “lack of tenure considerations, lack of course releases, and lack of training and support” (Cook, Ley, Crawford, & Warner, 2009). Because institutions of higher education lack rewards and incentive systems, lecturers consider e-Learning adoption uninviting (Loureiro-Koechlin & Allan, 2010).

2.15 Using e-Learning Platforms in Mathematics Teaching and Learning

Mathematics has long been related to conventional chalkboard instruction. The current scenario with the COVID-19 epidemic underscores the necessity for higher education mathematics lecturers to transition to online instruction (Nantschev, Feuerstein, Gonzalez, Alonso, Hackl, Petridis et al., 2020). The web-based world has revolutionised educational contexts, and technology-based teaching tools are transforming teaching and learning (Grand-Clement, Devaux, Belanger, & Manville, 2017) (Jeffrey, Milne, Suddaby, Higgins, 2014). The use of technology in the mathematics classroom has been shown to improve student engagement, critical thinking, and problem-solving abilities (Marinagi, Skourlas, & Belsis, 2013). Technology integration in mathematics pedagogy benefits teaching and learning while also improving student performance (Cheung & Slavin, 2013; Mlotshwa & Chigona, 2018). According to studies, incorporating technology into the classroom has the potential to shift teaching towards a more student-centred approach (Tondeur, Van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Constructivist philosophy is frequently used in calls for revamping mathematics education by embracing more creative teaching methods (Nantschev et al., 2020).

However, the lack of computer skills has a detrimental impact on mathematics lecturers' use of technology-based tools for teaching and learning in South Africa. As a result, many math lecturers are unwilling to change their approach to incorporate technology into their classes (Stols, Ferreira, Pelser, Olivier, Van De Merwe, De Villers et al., 2015). The application of technology in mathematics education and learning may be divided into two categories: The use of domain-specific mathematical software (such as GeoGebra) and generic learning technology (such as Moodle) (Nantschev et al., 2020). Mathematics-specific software applications are tools that can help students comprehend mathematical modelling, visualisation, and simulation more conceptually (Rashad, 2016). In mathematics education, education and technology have become two intertwined ideas (Nantschev et al., 2020). The adoption of innovative pedagogical and technical approaches to mathematics learning and instruction may thus be hampered by mathematics lecturers' lack of digital literacy (Nantschev et al., 2020).

The use of the Moodle Learning Management System (LMS) in mathematics learning and teaching in higher education helps students learn by improving their attention, which has a favourable impact on student performance (Taban, 2021; Lin, Tseng, & Chiang, 2017; Handayanto, Supandi, & Ariyanto, 2018). Furthermore, the adoption of learning management platforms, such as Moodle, leads to an improvement in students' mathematical proficiency

(Naidoo, 2020). Additionally, as the use of technology-based aids in mathematics has been associated with enhanced student achievement, both successful and failing mathematics students may benefit from using digital tools (Bray & Tangney, 2016; Cheung & Slavin, 2013). In addition, the use of LMS for mathematics learning supports the formation of supportive relationships among students and lecturers (Mlotshwa & Chigona, 2018). However, the effectiveness of adopting digital tools is partly dependent on the digital platforms' and tools' design, as well as the amount of time allotted to complete certain topics within the curriculum (Drijvers, 2019; Alabdulaziz, 2021; Das, 2021).

2.16 Chapter Summary

A review of the literature in the field of technology acceptance and integration utilizing an e-Learning system started the chapter, presenting examples of worldwide and national studies that uncover the potential elements that limit or enable technology use in an ICT-challenged setting. The study continued to evaluate literature on the topic of technology integration, taking into consideration constructs closely connected to the concept of acceptance and adoption of an e-Learning system for learning and teaching, such as factors affecting technology integration, challenges in e-Learning system implementation, and e-Learning system effectiveness and benefits.

CHAPTER 3: Theoretical and Conceptual Framework

3.1 Introduction

This chapter centres on the theoretical foundation supporting the current research. According to Manda (2002), theoretical frameworks are an essential component of the formation of theories in any subject. It assists the researcher in identifying variables in a study and proposing relationships to test or relationships with the other characteristics (Polit & Beck, 2014). The relevance of a theoretical framework rests in its ability to drive study and knowledge expansion by giving both direction and motivation (Polit & Beck, 2014). As a result, Day, Pedhazur, Schmelkin (1994) propose that the variables in a theory be integrated into the research for a study to be scientifically significant. This chapter examined some of the most popular e-Learning models to recognise typical components that impact effective implementation of e-Learning environment and, consequently, to design a framework that is appropriate for the university under investigation, and institutions with similar characteristics. The important models covered in the chapter that are pertinent to the current study, are Technology Acceptance Model (TAM), Salmon's Five Step Model (SFSM), Technological Pedagogical Content Knowledge (TPACK), Unified Theory of Acceptance and Use of Technology (UTAUT) Model, and Theory of Reasoned Action (TRA) model. The goal of this chapter is to establish a theoretical framework that could be used to gain insights into the circumstances that can influence the creation and sustainability of the e-Learning environment in a University of Technology.

3.2 Existing Models of E-Learning

In recent years, there has been an increasing amount of literature on integration of technology frameworks or models that have been introduced to gain a better understanding of the intrinsic and extrinsic factors influencing students and lecturers' use of technology in teaching and learning space. The generalisability of much published research on this issue is problematic. While some frameworks emphasize the integration of technology with pedagogy, others underline the critical role of beliefs in a successful implementation process.

3.2.1 Technology Acceptance Model (TAM)

Davis (1985) developed the Technology Acceptance Model (TAM), based on social psychology, in his doctoral thesis at the MIT Sloan School of Management. Davis, Bagozzi, and Warshaw (1989) later modified TAM in 1989 to come up with Figure 3.1. TAM was created with the goal of explaining and identifying the factors that influence the acceptance and use of information and communication technology (ICT) in organizations/institutions (Ramayah, 2006). Among numerous competitive models/theories for defining individual user adoption of information systems, the TAM is the most influential and widely used (Lee, Koza, & Larsen, 2003). This is because TAM provides a compelling explanation for user acceptance and e-Learning environment usage behaviour (Priyanka & Kumar, 2013). TAM is an empirically validated model in information systems research for this reason (King & He, 2006).

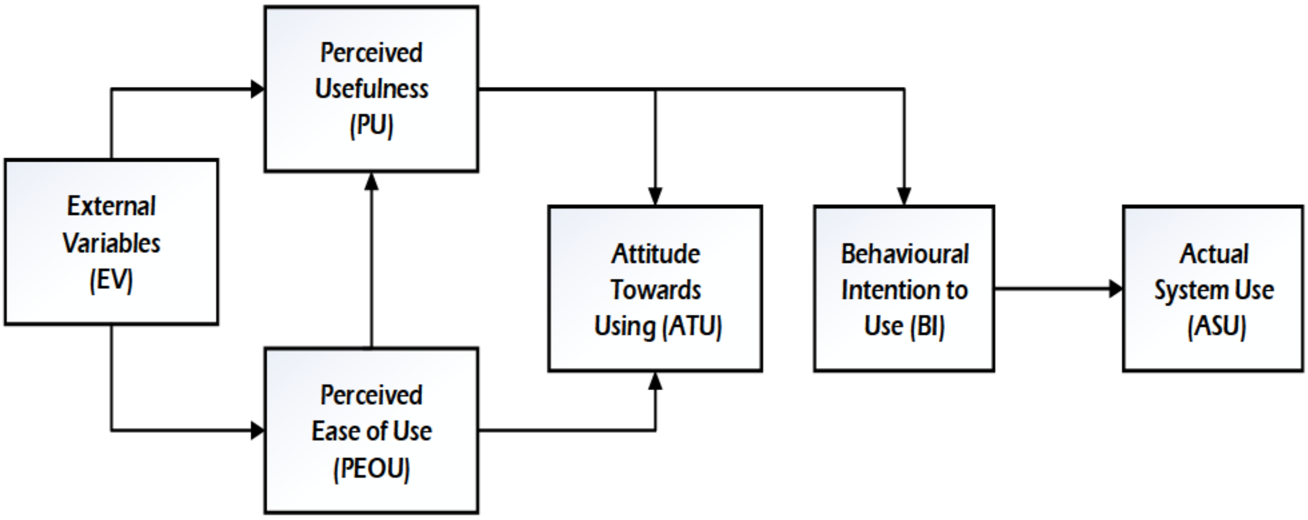

Figure 3. 1: Technology Acceptance Model of Davis, (Davis et al., 1989)

Because it focuses on the attitudinal explanation of desire to use a given technology or service, TAM is the starting point for most research on end-user adoption of technology (Devaraj et al., 2002). TAM is appropriate for investigating the link between people and technology, as well as determining the factors that influence technology acceptance and e-Learning environment usage behaviours (Venkatesh, Morris, & Davis, 2003).

TAM was founded on Fishbein and Ajzen's Theory of Reasoned Action (TRA) (Priyanka & Kumar, 2013). According to TRA, beliefs drive attitudes, which lead to intentions and, eventually, actual behaviour. TAM makes use of this association to understand e-Learning environment acceptance behaviour. Davis (1986) then proposes that three characteristics can explain technology utilization: perceived ease of use (PEOU), perceived usefulness (PU), and attitude toward using the system. According to the paradigm, a user's attitude toward a system, is determined by perceived ease of use and perceived usefulness.

Scholars such as Davis, Bagozzi, and Warshaw (1989); Davis and Venkatesh (1996) amended the original model (2000). Davis et al., (1989) extended the original model by include a new variable known as behavioural intention, with the hypothesis that behavioural intention would be directly influenced by perceived utility of the system. According to Davis et al., (1989), if the system appears useful, the user will acquire a stronger desire to utilize it.

The extent to which an individual believes that employing a given system would improve his or her job performance is defined as perceived usefulness (Davis, 1989). The degree to which a person believes that using a certain system will be devoid of effort is defined as perceived ease of use (Davis, 1989). According to researchers Oye, Iahad, et al., (2012), perceived ease of use and perceived usefulness affect users' attitude and behavioural intention to create an actual behaviour. Individual attitudes, however, are insufficient to predict adoption and usage of technology in any scenario. According to Oye et al., (2012), when a person recognizes the utility and ease of use associated with using e-Learning environment, their attitude toward such technology improves. Although empirical research show that perceived usefulness is the stronger of the two variables, perceived ease of use has been proven to significantly influence behavioural intention to use an information system through perceived usefulness.

TAM has been scientifically demonstrated to have good validity and has been used in a variety of educational or instructional technology projects. Examples include the use of a Learning Management System (S. Alharbi & Drew, 2014); e-Learning environment (Fathali & Okada, 2018); online learning (Davis, Venkatesch, and Davis, 2000).

TAM has the advantage of being specifically developed to address e-Learning environment acceptance as well as anticipate the use of information and communication technology (ICT) in varied cultural settings (Oye, Iahad, et al., 2012). TAM allows for more extensions and elaborations than rival models (Taylor & Todd, 1995). Even though TAM is the most extensively used and robust theoretical model in the study of ICT adoption and use, it has significant limitations and weaknesses (Sheikhshoaei & Oloumi, 2011).

TAM criticisms are divided into three categories: the method used to verify the reliability, its variables and the interactions that exist between them, and the theoretical foundation (Priyanka and Kumar, 2013). Many scholars, according to Priyanka and Kumar (2013), regard TAM as a hypothesis with uncertain heuristic relevance. TAM has low explanatory and predictive ability, is insignificant, and has no practical application. According to Shajari and Ismail in Priyanka and Kumar (2013), TAM does not adequately investigate the external elements that influence the PU and PEOU. Furthermore, attitude does not fully mediate PU and PEOU. According to Legris, Ingham, and Collerette, (2003) , TAM studies exclude applications used in the corporate context; thus, TAM does not consider constraints such as time or money as variables that could hinder an individual from using an e-Learning environment (Taylor & Todd, 1995).

Furthermore, TAM lacks the rigor and relevance that would allow it to become a well-established theory in the e-Learning environment field. As a result, academics have differing perspectives on its theoretical assumptions and practical efficiency (Chuttur, 2009). TAM does not explain technological acceptance in such a way that a real impact on the usability and acceptability of the technology can be felt (Venkatesh & Davis, 2000). According to Bagozzi (2007), there is a poor theoretical link between TAM constructs. He questions the relationship between behavioural intention and actual use, arguing that due to ambiguities, behavioural intention may not be representational of real use of e-Learning environment. TAM, in general, focuses on the individual "user" of e-Learning environment, with the concept of perceived utility, while ignoring the inherently social processes of information systems development and deployment (Priyanka and Kumar, 2013).

To summarize, TAM is restricted in understanding technology adoption because it fails to account for the implications of information system process design and ignores the societal variables that drive technology adoption. Hence, it is having been modified in Chapter 8 section 8.6 for this study since the university is a socialist structure.

3.2.2 Salmon’s Five Step Model

Developed following research into online education and training with the Open University, Muirhead and Salmon (2002) model features five stages (see Figure 3.2) presented as a flight of steps. Each stage identifies technical and e-moderating skills required, with an interactivity bar running along the steps that indicates varying amounts of interaction expected between the participants at each stage. This is seen as greatest towards the end of stage three (information exchange), throughout stage four (knowledge construction) and into stage five (development). Participants are expected to progress through each of the five stages as part of online networking and group working. The structure is designed to support a constructivist approach to learning.

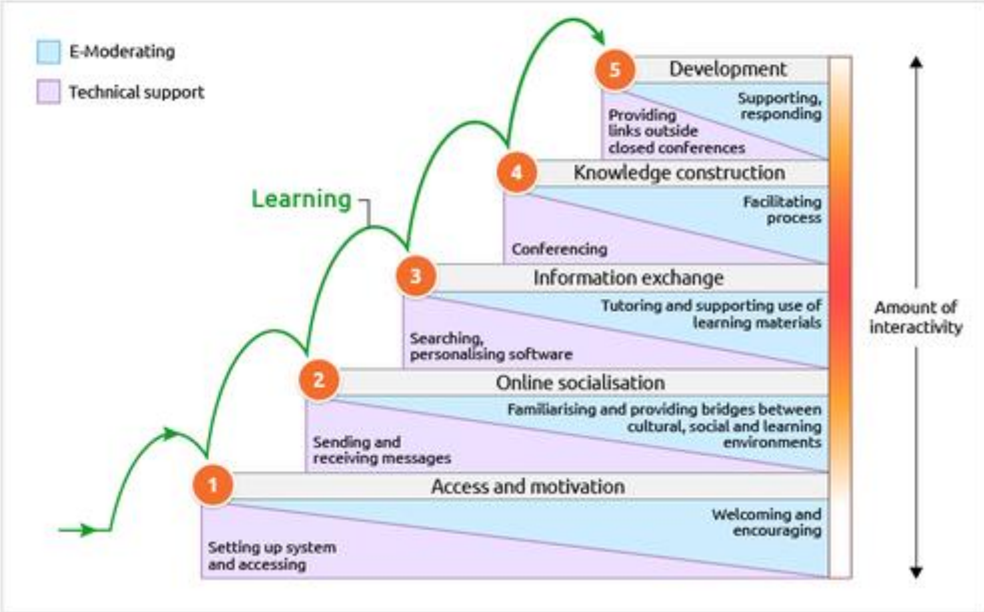

Figure 3. 2: Gilly Salmon's Five-Stages Model of e-Learning: (Source: Salmon. G., (2000; 2004; 2011))

The model's primary goal is to foster exceptional interaction and involvement among e-students in blended courses. It allows participants to gain experience and comfort by working both online and in person. Furthermore, moderators' purposeful efforts to success at each step of the course excite students, create a pleasing atmosphere with the help of appropriate e-activities, and accelerate students' progress in training and growth.

Stage 1 involves the crucial precondition of individual access and the motivation of students towards online learning. Stage 2 entails individuals developing their online characteristics and discovering others with whom to network. At stage 3, students exchange information and begin to encourage other participants' goals. Course-related discussions are expected to improve at stage 4 as the networks through group discussion become more collaborative. Finally, actual manifestation and individual advancement will occur in the attainment of goals at stage 5 (Muirhead & Salmon, 2002). An assumption of the model is that movement through the stages can also be influenced by the actions of the instructor. Table 3.1 explains briefly, the type of lecturer activities that are useful in helping students at the various stages. Table 3.1 indicates a responsibility to constructivist undertakings and the greatest positive conversation that is needed by students in the university to improve learning using an e-Learning system.

Table 3.1: The relationship between the students and lecturers

The stages	Student activities	Lecturer activities
Stage I: Access and motivation	Setting up the structure of electronic learning tools and gaining access to it.	Friendly, inspirational, and supportive direction on where to acquire technical support.
Stage II: Online socialisation	Forwarding, accepting, and switching the communication	Establishments, introductions, essentials, and the netiquette given.
Stage III: Information exchange	Distributing activities, giving an account, and summarising and interpreting results.	Support technology enhanced environment, streamline structured activities. Assigning roles and responsibilities, summarise the results, and promote conversations.
Stage IV: Knowledge construction	Creating connections between work-based learning experiences and models, debates and deep thinking concerning subject matter.	Questioning and examining; avail engaging activities. Encourage reflection and facilitate the process of discussion.
Stage V: Development	Understanding learning processes and becoming serious on the platform. Strategic conferencing and amalgamation of computer mediated communication into other forms of learning.	Promote reflection. Provide support and act in response of problem-solving.

This constructivist e-moderating paradigm provides a framework with distinct progressive stages to aid in the design and facilitation of online courses. When it was first published, it garnered many uncritical citations in the United Kingdom (Bennett & Marsh, 2002). Its clarity has sparked widespread interest, and as a result, the concept has been used to structure online programs (Lisewski & Joyce, 2003). However, it should be noted that the e-moderating approach evolved from experiences promoting online networking and group collaboration. Its primary goal is to create a paradigm for e-moderators to use to encourage online student engagement and learning using constructivist pedagogic theory (Salmon, 2011). As a result, it is limited since the variety of e-learning methodologies accessible for use within computer-mediated communication is overlooked, as is the spectrum of available learning theories.

Learning from a CD-ROM or interactive web-based products does not always take place as part of a community; it might be an individual and instructivist activity. Although the learners would be receiving objective information, such as through the basic life support CD-ROM (Moule, 2002), they are viewed as passive recipients of knowledge (Armitage & Leary, 2003).

While constructivist online learning communities are commonly used in higher education, the five-stage model has not considered the possibilities of using e-Learning as part of an integrated approach that incorporates face-to-face delivery (Wong, Russo, & Mcdowall, 2012). Indeed, when utilized to train those mentoring head teachers in the United Kingdom, Law and Chow (2008) found the program ineffective. Law and Chow (2008) proposed that the model assumes an exclusive online environment would be utilized to support a course that will be completed in one week for each level. The course format was challenging to maintain throughout the school year, leading law and Chow (2008) to conclude that the paradigm may not easily transfer to other learning environments.

Concerns have also been raised that the paradigm is dominating discourse in learning technology, serving as a template for the design of all online teaching and learning environments, regardless of context. There is widespread fear that, while addressing organizational needs for transferrable, multi-use goods, the reification of learning and teaching paradigms will dominate and restrict professional practice development. Lisewski and Joyce (2003), for example, described issues encountered while adopting the five-stage model as a template for an e-moderating training course. The training failed to take into consideration individual learning styles, and its design was difficult to question. This prompted them to emphasize the hazards of reification. Objectifying the model turns it into a 'one-size-fits-all' product that can be used in a variety of teaching and learning environments. Reification of the model, paradoxically, weakens its ethos, which attempts to foster thoughtful practice. Any potential to develop flexibility and reflexivity are lost by slavishly adopting the model as a strict course.

Jones and Peachey (2005) provide a critical critique of the five-stage model in their subsequent study. Their principal objections focus on the stages of socialization. Face-to-face contact was incorporated in the early stage by Jones and Peachey. They were unable to assess if a 'appropriate' amount of socialisation was reached in this setting because there is minimal advice that allows such measurement. Furthermore, activity in Stage two was low, with fewer postings noted. This prompted Jones and Peachey (2005) to propose that if initial socialisation in stage one was effective, step two may be skipped. The findings also show that people using the model may require more assistance to make decisions about the readiness of participants to continue through the model's stages.

3.2.3 Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge (TPCK) was introduced to the field of educational research as a theoretical framework for understanding teacher knowledge required for effective technology integration (Mishra & Koehler, 2006). The acronym TPCK (pronounced "tee-pack") was changed to make it easier to remember and to form a more integrated whole for the three types of knowledge addressed: technology, pedagogy, and content (Thompson & Mishra, 2007). The TPACK framework in Figure 3.3 extends Shulman's Pedagogical Content Knowledge (PCK) model to include technology knowledge as embedded within content and pedagogical knowledge.

The TPACK method reflects an emerging kind of transformative knowledge developed from existing instructional forms into new forms that have the potential to maximize the efficacy of integrating technology into teaching (Jang & Tsai, 2013). TPACK is a teacher knowledge framework for integrating technology in the classroom that improves effective teaching (Koehler, Mishra, & Cain, 2013). The TPACK model is a pedagogical construct that provides a theoretical foundation as well as practical difficulties for designing learning processes based on prior experiences (perceptions, attitudes, beliefs) of teachers and students with technology (Hechter, Phyfe, & Vermette, 2012). Furthermore, the TPACK framework provides a collection of categories for designing measurements and assessment instruments to execute ways for building technology inclusion processes (Angeli & Valanides, 2009).

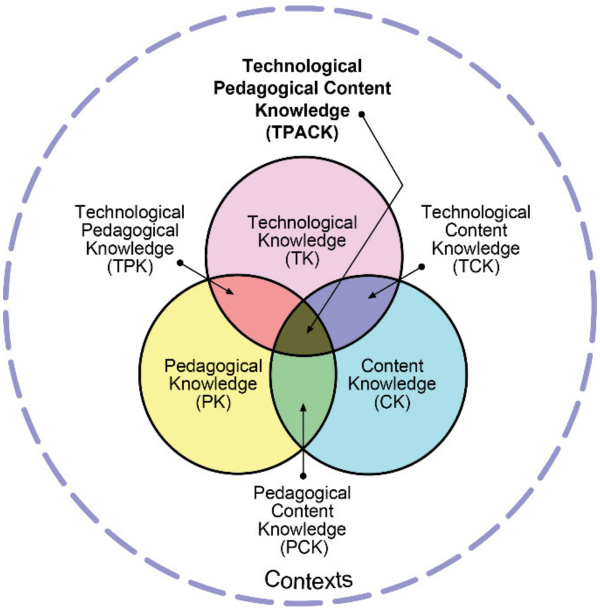

Figure 3. 3: Technological pedagogical content knowledge (Koehler et al., 2007)

- **Content Knowledge (CK)** –Mishra and Koehler (2006) define content knowledge as "knowledge regarding genuine subject matter that is to be learnt or taught." Teachers must understand the content they will teach as well as how the nature of knowledge differs between content areas. This knowledge, according to (Shulman, 2019), would include concepts, theories, ideas, organizations strategies, understanding of evidence and proof, as well as established processes and approaches to creating such knowledge.

- **Pedagogical Knowledge (PK)** – The strategies and procedures of teaching are referred to as pedagogical knowledge. Understanding how students learn, general classroom management abilities, lesson planning, and student evaluation are all examples of this generic knowledge (Koehler & Mishra, 2009).

- **Technology Knowledge (TK)** – Knowledge of numerous technologies, ranging from simple technologies such as pencil and paper to electronic technologies such as the Internet, video streaming, smartboards, and software programs, is referred to as technology knowledge. This includes comprehending computer technology widely enough to integrate it productively at work and in daily life, recognizing when computer technology can help or hinder the accomplishment of a goal, and being able to adapt to rapid technological advancement on a continuous basis (Koehler & Mishra, 2009).

- **Pedagogical Content Knowledge (PCK)** – Pedagogical content knowledge is content knowledge that is concerned with the teaching process (Shulman, 1986). PCK varies by content area since it combines both material and pedagogy with the purpose of developing superior teaching methods in the relevant areas. PCK addresses the essential business of teaching, learning, curriculum, assessment, and reporting, such as learning environments and the connections between curriculum, assessment, and pedagogy" (Koehler & Mishra, 2009).

- **Technological Content Knowledge (TCK)** – Technological content knowledge is the understanding of how technology can generate new representations of specific information. It implies that teachers recognize that by utilizing a specific technology, they can alter how students practice and comprehend concepts in each curriculum area. Teachers must identify which technologies are best suited for addressing subject-matter learning domains, as well as how the content dictates or even modifies the technology—or vice versa" (Koehler & Mishra, 2009).

- **Technological Pedagogical Knowledge (TPK)** – Technological pedagogical knowledge relates to understanding how different technologies can be used in teaching and how using technology may transform the way teachers teach. This includes understanding the educational affordances and restrictions of a variety of technological instruments in relation to discipline and developmentally appropriate instructional designs and tactics" (Koehler & Mishra, 2009).

- **Technological Pedagogical Content Knowledge (TPACK)** – The knowledge required by teachers to integrate technology into their teaching in any content area is referred to as technological pedagogical content knowledge. By teaching content using suitable pedagogical methods and technologies, teachers acquire an intuitive awareness of the intricate interplay between the three basic components of knowledge CK, PK and TK (Koehler & Mishra, 2009).

The justification for considering TPACK to play an important part in the current study stems from the fact that technology is now handled as if it is separate from teaching and learning. Most professional development workshops train participants on how to use a specific piece of software or tool, with little discussion of how to incorporate it into the classroom. According to Mishra and Koehler, this is a current detrimental influence. They believe that a lack of understanding of TPACK separates technology and leads to four issues with employing technology in the classroom. First, because technology is changing so quickly, it is exceedingly tough to keep up with all the latest innovations and apps. The second issue is that software is intended for business rather than education. This frequently indicates that students are studying how to use the program rather than the lesson topic. The third issue with keeping technology apart is the classroom's situational character. A lecture may tailor a lesson to the needs of a specific set of students, but an instructional video cannot. Therefore, each time this video is played, it is the same. Finally, Mishra and Koehler (2006) argue that keeping technology apart emphasizes "what" rather than "how." From the lecturer's perspective, the lesson becomes about what technology we are going to use today, what it says, and what abilities it requires, rather than how students can be taught.

As a result, the current study emphasizes the necessity of TPACK in identifying the competences that lecturers must build to successfully teach with technology (Angeli & Valanides, 2009). These competencies are concerned with identifying various factors such as topics and contents that should be taught using Information and Communication Technologies, effective instructional representations to connect technologies, learner expectations, teaching strategies, selected tools, and learner-centred strategies.

3.2.4 Unified Theory of Technology Acceptance and Use of Technology (UTAUT)

Transferring information technology and information system applications to institutions of higher learning has become an unavoidable requirement in achieving organizational performance. However, investments in such technologically advanced systems are inherently costly and dangerous. Furthermore, it is unknown whether it will improve organizational performance without the use of information technology and information system applications. It is a regular issue for end users, students, and lecturers to be resistant to employing such technology. To better comprehend user-oriented challenges and identify solutions, it is necessary to explain the adoption and use of new technology.

The Unified Theory of Acceptance and Use of Technology (UTAUT) in Figure 3.4 was proposed and validated to provide a unified theoretical basis for research on information system and information technology adoption and acceptance (Alatawi, Dwivedi, Williams, & Rana, 2012). The UTAUT theory was formulated and developed on the conceptual and empirical consolidation of eight key technology acceptance models used in prior research to understand information system usage behaviour. These models were: Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB), the Technology Acceptance Model (TAM), the Motivational Model (MM), Combined TAM and the TPB (C-TAM-TPB), the model of PC Utilization (MPCU); the Innovation Diffusion Theory (IDT), and the Social Cognitive Theory (SCT) (Venkatesh et al., 2003).

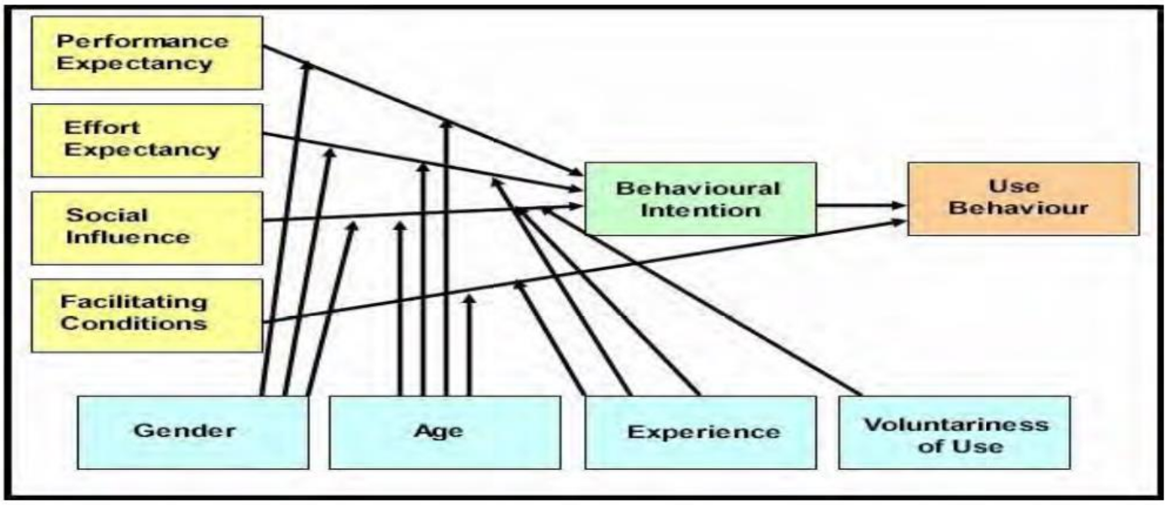

Figure 3. 4: The Unified Theory of Acceptance and Use of Technology (UTAUT) Model (Venkatesh et al., 2003)

Although there have been many studies on emerging models and theories, there have been very few studies that empirically compare theory and models (Wong, Osman, & Rahmat, 2013). Venkatesh et al. (2003) presented the UTAUT model, which tries to combine usage models by examining eight competing theories that attempt to explain users' technology acceptance and usage intention.

The primary goal of UTAUT is to investigate variables associated with ICT acceptance (Venkatesh et al., 2003). There are four constructs in the UTAUT: (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions. The model also proposes that gender, age, experience, and voluntariness of use influence the effect of these four fundamental constructs (Venkatesh et al., 2003). Detailed descriptions of the constructs are provided below.

3.2.4.1 Performance expectancy (PE)

The degree of belief that the user utilizing the system would perform better, is referred to as performance expectancy. The impact of performance expectations has been demonstrated in both voluntary and mandatory contexts, as well as in situations of higher learning with less experience (Zhou, Lu, & Wang, 2010). However, theoretically, performance expectation may fluctuate depending on gender and age (Venkatesh et al., 2003). Within the context of this study, performance expectancy suggest that learning management system is appreciated by students and lecturers because of its utility and is generally useful in executing its obligations. The performance expectancy component has been demonstrated to have a significant impact on intention to use in various studies employing the UTAUT model (Salloum, Al-Emran, Shaalan, & Tarhini, 2019).

3.2.4.2 Effort expectancy (EE)

The degree of convenience in using the system is expressed by effort expectancy. In both voluntary and forced usage situations, the effort expectancy component influences behavioral intention. However, in long-term and continuous use, the effort expectancy factor becomes small, confirming earlier study. The effort expectancy may fluctuate depending on age, gender, and experience (Venkatesh et al., 2003). According to Nasri (2014), effort expectancy measures a system's interface design, simplicity of use, adaptability, and ease of learning. As a result, it is believed that the EDMS usage aim will be simple to use. The effort expectancy element has been found to have a considerable impact on intention to use in various research employing the UTAUT model (Chen & Hwang, 2019).

3.2.4.3 Social Influence (SI)

The degree to which a person deemed important to the individual believes that he or she should use the new method is referred to as social influence. In the event of voluntary use, the social impact element has no effect. This aspect, however, becomes effective when the application of technology is required. Gender, age, voluntariness of use, and experience may all have different effects on social influence (Venkatesh et al., 2003). The social influence factor highlights the impact of influencing variables on user behaviour, such as friends' or hierarchical superiors' thoughts (Afonso et al., 2012). According to the UTAUT paradigm, user views are assumed to influence learning management system adoption. The social influence component has been demonstrated to have a considerable impact on intention to use in various research employing the UTAUT model (Zhou, Lu, & Wang, 2010).

3.2.4.4 Facilitating conditions (FC)

The degree to which an individual believes that organizational and technical infrastructure exist to facilitate system use is defined as a facilitating situation (Venkatesh et al., 2003). Similarly, perceived behavioural control in TPB/DTPB, facilitating conditions in TAM-TPB, and compatibility in DOI are constructs in earlier technology adoption and usage models. It has been discovered that facilitating conditions influence usage rather than behavioural intention.

The influence of conducive conditions on usage has been reported to be mitigated by the individual's age and experience (Venkatesh et al., 2003).

3.2.4.5 Behavioural intention (BI)

The goal of an individual to use technology is referred to as behavioural intention (BI). Venkatesh et al. (2003)'s underlying assumption on behavioural intention in terms of technology use is compatible with other underlying theories in predicting intention to utilize technology in actual situations. UTAUT asserted and shown that behavioural intention has a substantial influence on technology usage (Venkatesh et al., 2011). According to the UTAUT theory, three constructs are the key determinants of behavioural intention to utilize information technology, although among all UTAUT variables, performance expectancy is the biggest predictor of behavioural intention (Zhou et al., 2010).

For the following reasons, the current study is based on UTAUT as the dominating theoretical frame: First and foremost, UTAUT is regarded as the most recent theory, with extensive coverage of a variety of IT Adoption/Acceptance models (Qureshi & York, 2008). Second, UTAUT has been utilized on numerous occasions to investigate technology adoption and utilization in diverse organizations (Alatawi, et al., 2012). Third, it is a unified theory formed from the constructs of eight individual adoption and diffusion theories (the TRA, TAM, TPB, C-TAM-TPB, MM, SCT, MPCU, and the IDT) that may explain for 70% of the diversity in usage intention when compared to other technological acceptance and use models. Finally, the UTAUT instrument is robust enough to tolerate translation and might be used cross-culturally in a poor country scenario (OshlyanskyCairns, & Thimbleby, 2007). As a result, the model is appropriate for our study. The study was pre-planned based on the predictive capacity of the UTAUT and the DOI by mapping the research questions to the constructs of these two theories.

3.2.5 Theory of Reasoned Action

Fishbein and Ajzen proposed the Theory of Reasoned Action in 1975, but it has since been refined, developed, and tested (Chuttur, 2009). The Theory of Reasoned Action (TRA) is a well-known social psychology paradigm that has been used to describe and "understand the determinants of consciously intended behaviour" **(Ghobahloo, Zulkiflu & Aziz, 2010)**. Although TRA is the most basic model used to describe technology adoption **(Al-Quesi, 2009)**, it is still useful since it may explain the relationship between a person's behaviour and attitude (Teo, Luan, & Sing, 2008). Attitude can be described as beliefs or feelings (Dillon & Morris, 1996). TRA assumes that persons are reasonable and will use a given information system in a systematic manner by analysing its ramifications(Ajzen & Fishbein, 1980).

Attitude and subjective norms influence an individual's behavioural intention. Intention influences actual behaviour when it comes to the usage of electronic instructional material by academics in universities (Pickett et al., 2012). The degree to which performance of behaviour is valued positively or adversely is referred to as attitude towards behaviour. As illustrated in Figure 3.5, the Theory of Reasoned Action (TRA) considers behavioural intention, rather than attitude, as the primary predictor of information technology.

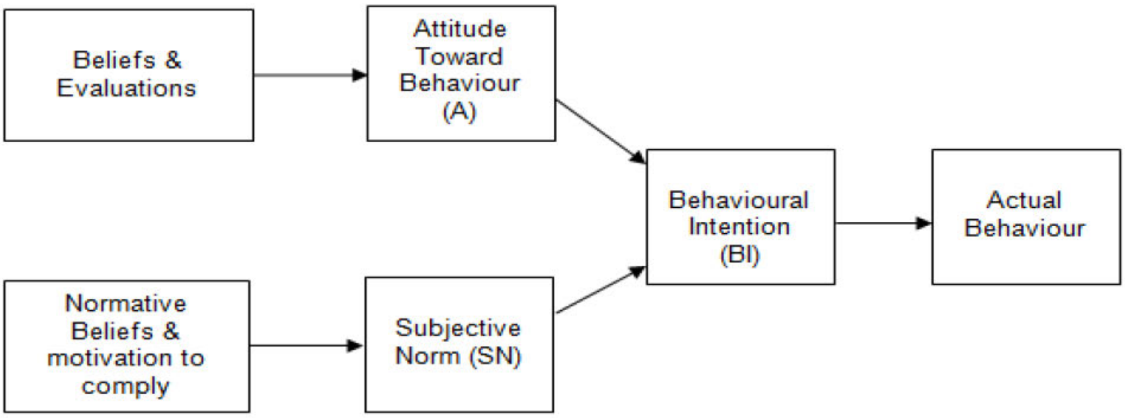

Figure 3. 5: Theory of Reasoned Action (TRA) **(**Fishbein and Ajzen, 1980 as cited in Davis et al., 1989).

Subjective norm, according to (Ajzen, 2020) and (Ajzen and Fishbein, 1980) Fishbein and Ajzen (1975), "refers to the felt social pressure to perform or not execute the behaviour." This indicates that subjective norm is how academics view that persons socially or professionally linked with them believe they should or should not do a specific behaviour, in this case, use electronic instructional material (Dillon & Morris, 1996). Subjective norms, according to the TRA, are determined by perceived expectations and a person's motivation to meet these expectations. The primary focus of TRA is that attitude is influenced by belief, which impacts behavioural intention to use electronic instructional material.

According to the preceding description, TRA is a universal model that may be utilized to explain nearly any human behaviour (Ajzen and Fishbein, 1980). As a result, TRA is appropriate and applicable for investigating the factors of e-Learning environment adoption and use behaviour (Davis, Bagozzi, and Warshaw, 1989). TRA offers a broader range of applications. The theory's most major shortcoming, however, is the assumption that conduct is under volitional control, leaving it unsuitable for the investigation. However, the concept of behavioural intention is pertinent to this current study to solve research question one and two, which sought to investigate factors that students perceive as barriers and enablers in creating a sustainable e-Learning environment. UTAUT contains the notion of behavioural intention, which justifies the adoption of UTAUT as the fundamental theoretical framework driving this investigation.

3.3 Conceptual Framework anchoring the current study

This section covers the evolution of the conceptual framework that underpins the current study, as depicted in Figure 3.6. Some most relevant variables of UTUAT, TPACK, and Salmon's Five-Stages models were integrated to form the conceptual framework anchoring the current investigation for the following reasons:

- UTAUT Model: First and foremost, the UTAUT model is the most appropriate model for consumer-focused scenarios in current study being students and lecturers (Venkatesh et al., 2012). Furthermore, Dwivedi, et al., (2019) found that UTAUT is the most powerful model for describing users' technology adoption when compared to other models. Second, the UTAUT model explained around 70% of the variance in behavioural intention to adopt a technology. Finally, some investigations in the literature (Al-Fraihat et al., 2020) have employed the UTAUT as a theoretical foundation for their study models.

- TPACK model focuses on designing and evaluating lecturer knowledge that is focused on optimal student learning in diverse curriculum areas. Furthermore, it provides a valuable framework for considering what knowledge lecturers must have in order to integrate technology into teaching and how they might acquire this information. Second, utilizing TPACK as a foundation for measuring teaching knowledge has the potential to influence the types of training and professional development experiences developed for both students and lecturers. As a result, there is a constant need to rethink our lecturer education preparation procedures and offer new ways that better prepare lecturers to effectively integrate technology into their teaching and learning. Third, properly incorporating technology into the classroom frequently necessitates teachers having adequate pedagogical, subject, and technological competence (Wang, 2019). As proposed by the TPACK framework, envisioning how technological affordances might be used to improve teaching and learning necessitates a detailed consideration of how technology, content, and pedagogy interact to produce distinct domains (Archambault & Crippen, 2009).

- Salmon's Five-Stage Approach: The five-stage model provides participants with critical assistance and development at each stage as they gain experience in online learning. Second, using Salmon's five-stage framework to develop blended courses that teach both lecturers and students by combining online and traditional face-to-face classroom teaching and learning. The methodology has the potential to provide active online and conventional learning, good contributions, interactions among participants, and satisfaction for both lecturers and students.

The three preceding models offer insights about what it is that helps students take on technological innovations and emphasises the role of the lecturers when trying to integrate technology in a higher education institution. However, there are other factors within the higher education institution which can influence the creation and sustainability of an eLearning environment in a University of Technology. The proposed theoretical framework anchoring the current study consists of four subjects derived from the reviewed literature having various factors that could influence the sustainability of the eLearning environment. These subjects are Lecturer actual usage of technology, Student actual usage of technology, Organisational design domain, and Technological domain. There are various constructs related to each concept as shown in Figure 3.6. Although the framework is divided into four distinct concepts, it is inevitable that some of the constructs of the various subjects overlap with one another.

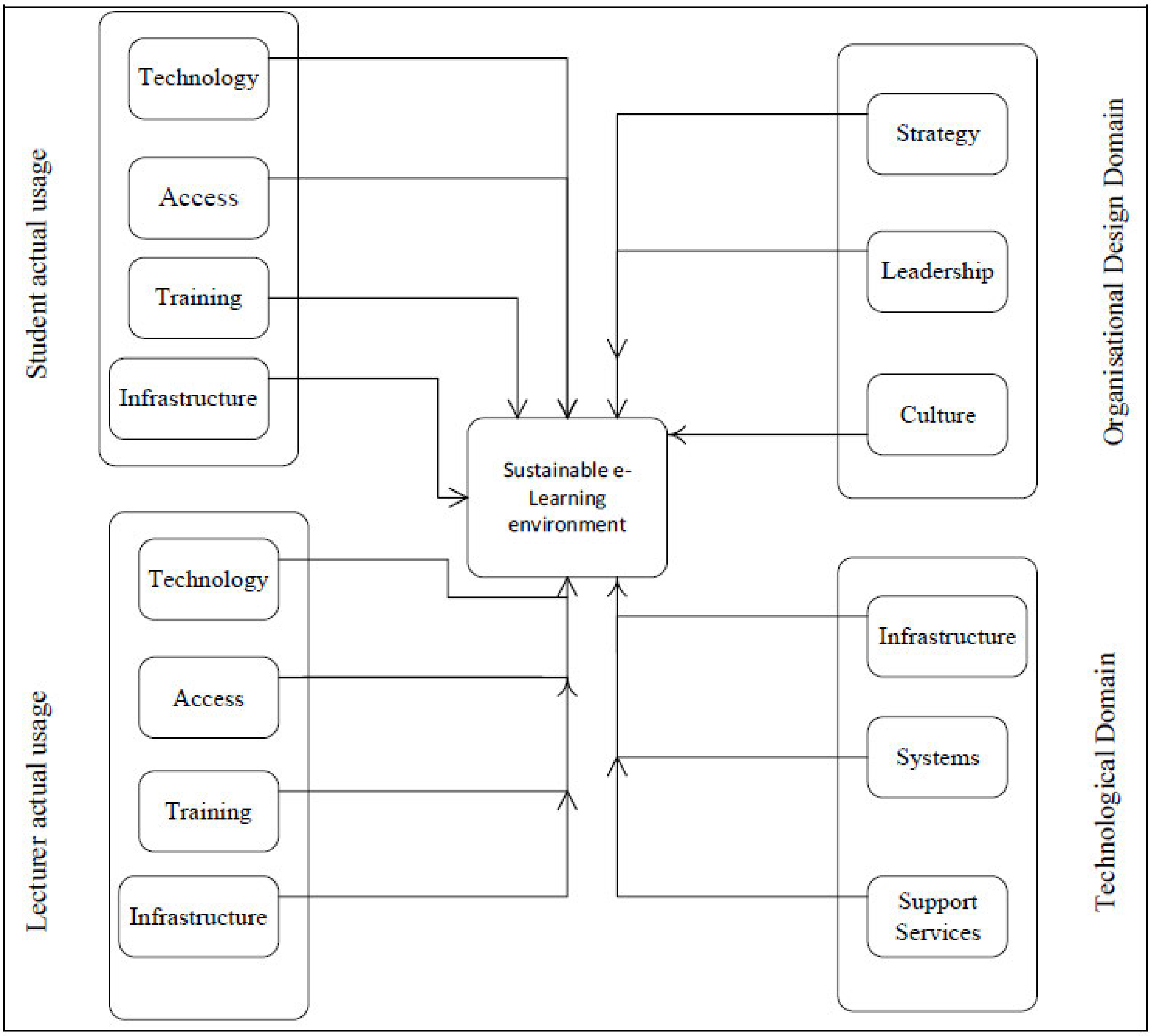

Figure 3. 6: Conceptual Framework anchoring the current study

Each of the subjects consists of constructs, which could be used to identify the specific circumstances that influence the sustainability of the system. These are the principal topics of discussion since they serve as the foundation for the conceptual framework that guides the present study inquiry investigation. Depending on the factors that the university participating in the current study deems important, various institutions have distinct e-Learning strategy approaches. Aspects of the constructs and their needed functions for institutions planning to implement an e-Learning system are also emphasised by the subjects' variables in the proposed theoretical framework suggested for the current study. The important constructs are conveyed as strategic areas for the capacity to execute e-Learning because they are interconnected rather than self-regulating, as shown in Figure 3.6. The sections that follow provide descriptions of each.

3.3.1 Student Actual Usage Domain

Many students who enrol at higher education institutions in South Africa (SA) come from underprivileged educational systems and low socioeconomic backgrounds. These students frequently lack access to computers and uninterrupted Internet service. Additionally, students entering higher education do not have sufficient reading levels to meet the requirements of their specialties. The student actual usage of an e-Learning system as depicted in Figure 3.7, being one of the subjects constituting the proposed conceptual framework, identifies four constructs that play an essential role in the access and use of e-Learning system. Students in South Africa typically face difficulties related to racial, linguistic, and background diversity. They also lack sufficient financial resources, experience technology enhanced infrastructure problems, access problems, a paucity of qualified instructors, who struggle to produce e-Learning content (Bagarukayo & Kalema, 2015).

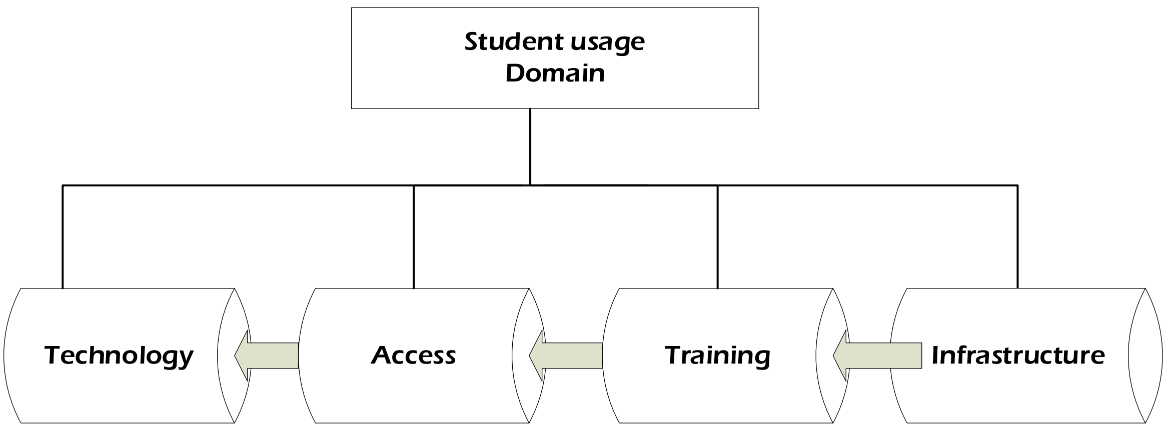

Figure 3. 7: Student Usage Domain for sustainable e-Learning

The student actual use of the e-Learning system is determined by the perception of its usefulness and ease of use, through the positive attitude towards its use with the behaviour intention of using e-Learning (Mahdizadeh et al., 2008). In the various studies, an increased focus on evaluating the impact of e-Learning system usage in the future has been developed (Ifinedo, 2006;Lin & Wang, 2012). Some researchers have shown that actual use of the e-Learning system relates positively with perceived benefits (Lashayo, Alkawaz, & Johar, 2018).

Students' actual use of an e-Learning system in the current study is a subject that evaluates the degree to which students intend to use the system and examines the efforts spent in interacting with the platform (Ramayah & Lee, 2012). It is also associated with behaviour use of an e-Learning system (Mtebe & Raisamo, 2014). The link between intention and actual usage of an e-Learning system has been explored by certain researchers, who found that satisfaction has a considerable beneficial impact on actual use. (Alkhalaf, Drew, Alghamdi, & Alfarraj, 2012; Chow, Herold, Choo, & Chan, 2012; Hassanzadeh et al., 2012). As a result, in the context of the current investigation, pleasure was presumptively beneficial for both intentions and actual usage. However, according to research done by others, students' satisfaction appears to have a substantial impact on their actual usage (Chow et al., 2012; Hassanzadeh et al., 2012; & Alkhalaf et al., 2012). The student actual usage subject in the context of the current study encompasses technology; access; training, and infrastructure. In each case the details of their impact to the proposed conceptual framework will be discussed below.

3.3.1.1 Students Use of Technology

Students frequently run into several difficulties and issues while using e-Learning environment due to lack confidence and experience with e-Learning systems. Students are required to be more independent and in command of their own learning when there is no face-to-face interaction with lecturers and other students in the e-Learning system. For students to successfully use an e-Learning system, this independence may need them to alter their methods of thinking, acting, and developing habits. Individuals' understanding of, and judgments about, an ICT tool's usefulness and worth in relation to their everyday activities determines whether they are willing to utilise it for their activities (Hanafizadeh, Behboudi, Abedini, & Jalilyand, 2014).

3.3.1.2 Students Access to Technology

Many students in SA attend under-resourced schools where they lack access to essential amenities like libraries and computer labs. As a result, students frequently struggle to handle the technical demands of higher education, where the corresponding abilities are typically taken for granted. There is a need to introduce an introductory computer literacy course that students should undertake prior the use of e-Learning intervention since most of them come from homes with no access to ICT and/or disadvantaged schooling backgrounds. The use of e-Learning systems evidently makes access to technology an empowering or hindering factor. Easy access to technology shapes students' opinions on, and interest in online learning to utilise it during the learning process. The topic of access is frequently exclusively brought up in relation to

Internet accessibility in developing nations like South Africa. When referring to access in the context of the present study, it is essential to understand that dependability of the connection and bandwidth are just as important as having regular access to a computer and an Internet connection. The adoption of e-Learning faces significant bandwidth challenges. The quantity of data that can be transferred or received at a certain location on a computer network is referred to as bandwidth; the larger the bandwidth, the faster the transmission may occur. The more complex the communications technology required, the greater the quality and quantity of audio, video, interaction, and processing tasks. Since bandwidth is expensive, it is necessary to regulate how much is utilised for e-Learning, especially when it supports remote users who might not have access to fast Internet connections. Additionally, the available bandwidth determines the kind of material and services that may be accessed via the Internet.

The most essential step toward successful technology integration in any academic institution is undoubtedly universal availability to the hardware needed to run instructional computer programs. If weekly computer lab time is only one hour, it is impossible to use instructional technology consistently. Even though many universities across the world are switching to one-to-one (1:1) computing, many students do not have consistent access to a computer (Warschauer, Zheng, & Farkas, 2014). This conclusion makes sense given that technology is practice-based and that a student's level of skill is more likely to increase if the resource is accessible at home. The problem of the digital divide among South African students is the unequal access to technology; as a result, some of them cannot buy computers owing to the cost in relation to the average salary of employees in the country (Abdellatief, 2011).

3.3.1.3 Provisioning of Technology Training for Students

Students in the e-Learning environment are expected to be independent and responsible for their own learning process due to absence of face-to-face interaction with lecturers or other students. Hence, they may need to alter their habits, behaviours, and ways of thinking to reach this independence (Al-adwan & Smedley, 2012). Students' lack of appropriate technical skills in e-Learning and e-content production is an impediment to e-Learning deployment in public universities (Tarus et al., 2015). In many institutions of higher learning, e-Learning is confronted with several problems, including technological and human aspects in relation to technology training, all of which have a significant influence on e-Learning's goals. The usefulness and efficiency of e-Learning systems are influenced by a variety of factors, including the students' technical abilities (Kanwal & Rehman, 2017). One of the key factors determining the effectiveness of the adoption of e-Learning is providing students with thorough training in the subject. (Tarus et al., 2015).

The use of technology to facilitate learning is an important factor in the overall success of the student learning experience. As a result, students who lack ICT skills are unable to profit from e-Learning possibilities, whether they take place in the classroom or online. Due to a lack of ICT abilities, students may develop a resistance to e-Learning, leading to scepticism regarding its benefits. As a result, improved availability and familiarity with the necessary technologies may help students improve their ICT abilities.

3.3.1.4 Provisioning of technology enhanced infrastructure

Huge differences occur across HEIs in the context of SA because of discrimination during the apartheid era. As a historically underprivileged institution, the researched university was given relatively little funding by the former apartheid government when it was established for the benefit of black students in the KwaZulu-Natal area. Despite the ongoing efforts of SA’s current democratic administration, the gap between privileged and underprivileged higher education institutions still exists. Lack of organisation, limited technology assistance, and insufficient infrastructure and network capacity make it more difficult for students to use online learning. A lack of integration of e-Learning business strategy and poor facilitating conditions are still a serious hindrance in the use of e-Learning environment (Isabirye & Dlodlo, 2014). It is crucial that the educational experiences of students be improved by using technology that engages them and facilitates cross-cultural communication to reflect the cultural reach of a virtual campus project that includes students and professionals from across South Africa.

3.3.2 Lecturer Usage Domain

In addition to managing the inevitable change that comes with integrating technology understanding, it is necessary to identify several characteristics or dimensions that are crucial for the adoption and acceptance of e-Learning efforts to design effective e-Learning systems and a framework to assist their development and implementation (McPherson & Nunes, 2008). The lecturer actual usage consists of four constructs namely: technology, access, training, and environment which are critical factors to the success of the current study proposed conceptual framework depicted in Figure 3.8 below.

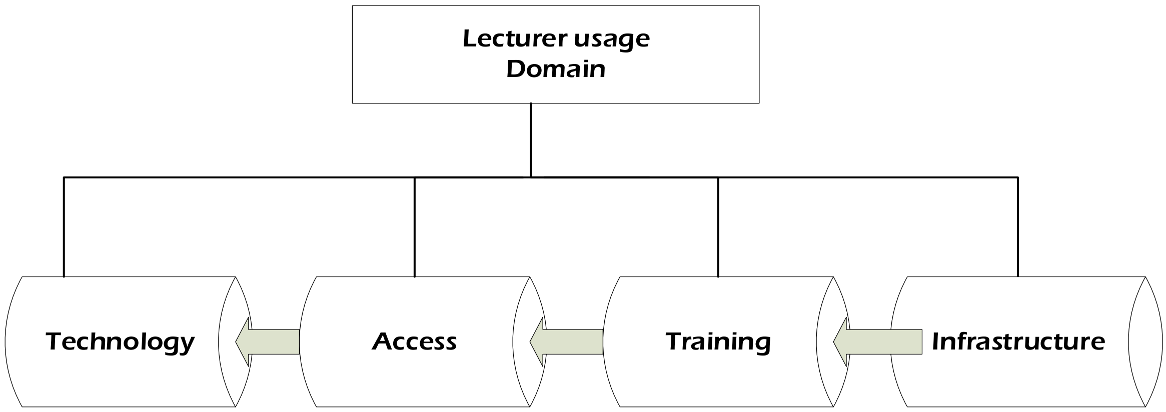

Figure 3. 8: Lecturer usage Domain

The above indicated lecturer usage domain constructs are not sufficient metrics for the real utilisation of an e-Learning system on their own since they can only partially measure system usage and do not capture it in its genuine form. Individuals utilize the functionalities of a system depending on three essential components, and these are the kind of patterns used, frequency of usage, and time spent utilising that system (DeLone & McLean, 2016). The degree to which users rely on the system to carry out their learning duties is referred to as the actual utilisation of the e-Learning system in this study. Because of this, the real utilisation of an e-Learning system is assessed using a firm evaluation of usage degree and intensity, which includes login frequency and login duration each week. Numerous research studies have revealed that lecturers' self-efficacy plays a crucial role in determining both their desire to continue using the e-Learning system and how much they use it (Padumadasa, 2012; Cho, Cheng, & Hung, 2009).

One of the challenges for lecturers' usage of the e-Learning system, is the time required to handle the e-Learning needs (Pérez-Sánchez et al., 2018). Developing and reorganising their lectures to meet online requirements is a common task for lecturers. These tasks frequently take more time and add to the workload. It is crucial to impose proper boundaries so that initial expectations are reasonable, and the student has a pleasant learning experience. Some lecturers lack the expertise and training necessary to create online courses, while others lack the confidence necessary to implement technology in the classroom (Buabeng-Andoh, 2012). The four components of the lecturer actual usage of the e-Learning system are discussed below.

3.3.2.1 Lecturer Use of Technology

The usage of the technology in the current study is examined from three separate aspects. Each aspect of usability, interactivity, and quality, affects how lecturers employ technology in their instruction in a different way. Using this method enables the researcher to integrate more significant components which sheds insight on prospective experiences with the use of technology. This study creates a multi-dimensional model for analysing lecturers' technology use in an ICT-challenged context. Inexperienced lecturers in the use of technology in learning and teaching need to devote effort to comprehend their various obligations under the new paradigm. They should always remember that pedagogy is critical to the success of the e-Learning system rather than technology (Shieh, Gummer, & Niess, 2008).

3.3.2.2 Lecturer Access to Technology

Lecturers play a critical role in incorporating e-Learning into teaching methods and have a problem adapting the traditional technique to include ICT tools as media in their instruction. The more instructional technology a lecturer uses in the classroom, the less lecturer-centred the classroom becomes (Bartram, 2009). Even though lecturer use of e-Learning is still uncommon, access to technology in the classroom is becoming increasingly vital. In the current study, the construct access to technology refers to the enhancement of the accessibility of technology equipment and components that aid in the facilitation of teaching and learning. In this context, it's intriguing to look at the issues surrounding the usage of e-Learning in the classroom. The access and use of e-Learning in HEIs presents several financial and strategic challenges. HEIs should thus secure sufficient funding to create and maintain appropriate equipment, offer ongoing technical assistance, and continuously support training programs for simple access to technology.

3.3.2.3 Provisioning of Technology Training for Lecturers

Among the biggest obstacles to the e-Learning implementation project is the absence of training opportunities for academic personnel (Isabirye & Dlodlo, 2014). The data indicates that staff development is a top priority for colleges using online learning techniques. According to Obaid and Al-Husseini (2020), even the best-designed e-Learning courses would fail if professors do not maintain a high level of facilitation abilities. It is crucial that an emphasis on educating lecturers on how to utilise the hardware and software does not squander the chance to reinvent and enhance university teaching methods through e-Learning (Syeda, 2017). As a result, instructors need to receive training in both integrating e-Learning systems into higher education and understanding the principles underlying online-based learning.

Technical and conceptual difficulties should be included in skilful training. If done correctly, it will boost support for the benefits of e-Learning (Alharbi & Vic, 2017). For e-Learning courses to be effective, lecturers need to have the right facilitation abilities. A carefully balanced learning process can be hampered by poorly trained lecturers employing e-Learning in educational settings, which can also cause issues with application and student perception (Wafula, Musakali, & Muliaro, 2019). HEIs should train their staff and organise seminars on using e-Learning and other teaching modalities, such as face-to-face, to address the issue of knowledge gaps. For instructors and students to create and use e-Learning media efficiently, they must have a basic understanding of computers.

3.3.2.4 Provisioning of technology enhanced infrastructure

The cooperative interactions between students and lecturers that take place inside the digital system that is online and computer-mediated, are referred to as the "e-Learning environment." Students must experience support, acceptance, and respect to create a vibrant learning environment. They like a learning environment that challenges their ability for learning through varying teaching methods and tactics. There is no question that the social, psychological, or cultural elements present in a learning environment have an impact on a student's capacity to learn. Both students and lecturers find it challenging to transition from a traditional teaching and learning environment, to an e-Learning system since they are accustomed to, and satisfied with, traditional teaching settings (Wong, 2007).

3.3.3 Organisational Design Domain

Organisational design domain is the practice of matching an institution’s structure to its objectives to improve productivity and effectiveness. The organisational design domain of the University of Technology (UoT) participating in the present study, is sparked by the necessity to embrace and use e-Learning because of a new requirement. This requires more than the creation of a framework, but also includes planning and managing the transition from F2F engagement to e-Learning learning and teaching techniques. It also involves understanding the need for change and the context. The focus is on putting online learning into practice and keeping track of the elements that might affect change in the institution. Several organisational changes within universities are required to implement an e-Learning environment. Among them are novel teaching techniques, flexible delivery to students (on and off campus), and staff organisational integration (Percival & Muirhead, 2009). Universities must have flexible organisational design structures to effectively benefit from e-Learning breakthroughs in HE. The components of the organisational design domain discussed in the current study are categorised into strategy, leadership, and culture within the proposed data analysis framework as shown in Figure 3.9 below.

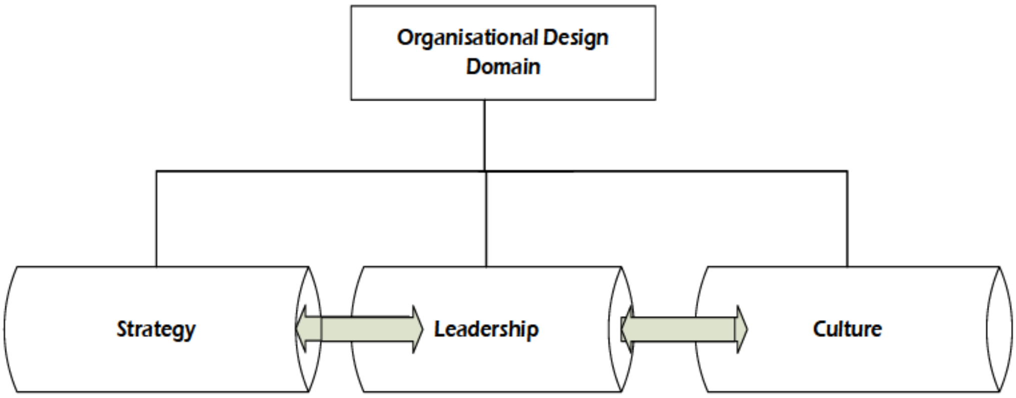

Figure 3. 9: Organisational Design for a sustainable e-Learning environment

The university is the main stakeholder in the access and use of the e-Learning system and should therefore identify a need for, and initiate integration of technology. The detailed discussion of how the strategy, leadership and culture constructs contribute to the current study follows below.

3.3.3.1 Strategy

Numerous initiatives have been made to determine what is required to encourage the adoption of technology in higher education institutions (Abrahams, 2010; Buabeng-Andoh, 2012). Leadership, technological foundation, institutional vision, and resource supply are frequently advised (Guvhu, Jita, & Akintunde, 2021). Within the case of the UoT participating in the present study, such advice has led to the acquisition of a virtual learning environment (VLE) that is supported by the institution, and the creation of an institutional e-Learning strategy. One solution that organisations might use to adapt to a changing environment is strategy. As the environment in which higher education institutions operate evolves, putting more emphasis on a strategic use of e-Learning has become crucial (Mpungose, 2020); Zalat, Hamed, Bolbol, 2021). HEIs understand the importance of strong leadership and that well-led organisations are more productive, competitive, and adaptable to change. Students and academic staff are more engaged and motivated when they have a better understanding of where they are going and why they are going there. The university strategy and e-Learning plan, as well as senior management leadership and institution culture, are significant components that are considered in the current study's data analysis approach.

Any HEI wanting to establish an e-Learning system must do so as part of a larger organisational plan to support teaching and learning (Istambul, 2012). Any institution incorporating e-Learning into organisational strategy needs to consider a few things. These include the institution's varied e-Learning requirements, budgetary restrictions, technological appropriateness, and e-Learning strategy and policy, to name a few (Sharpe, Benfield, & Francis, 2006). Developing an e-Learning strategy and policy is essential for the university to achieve predetermined teaching and learning goals (Sharpe, Greg, & Richard., 2006). Significant to the university's e-Learning strategy and its implementation process, is the importance of knowing the needs of students and lecturers, mainly with respect to the effectiveness and efficiency of the technology (Jawad & Shalash, 2020). Universities that want to create an effective e-Learning strategy must be equipped both culturally and technologically (Al-adwan & Smedley, 2012;Almarabeh & Mohammad, 2013). It is therefore essential for practitioners and policy development units within the institution to flag the main factors that may influence or hinder the adoption of e-Learning systems to enhance students' and lecturers' teaching and learning experiences (Liaw & Huang, 2011). According to (Agboola, 2006), p.32) "a true e-Learning strategy certainly addresses issues of technology and learning effectiveness, but it also addresses issues of culture, leadership, justification issues, talent and change".

E-Learning systems require systematic implementation and if not properly structured, could result in confusion. Effective e-Learning implementation in the academic institution largely depends on the strategic view of management and should fulfil the requirements for student and business goals of the institution (Ghavifekr et al., 2012). The academic policy framework of the institution must control and shape the teaching and learning environment. As technology becomes increasingly prevalent, it can lead to challenges that are either not fully addressed by the framework or fall outside of it.

3.3.3.2 Leadership

To effectively address possible issues and fully take advantage of possibilities, it is vital to have a clear vision, strong leadership, and a proactive approach with senior management (Altunisik, 2012; Miller & Ives, 2020). Through the university senior management, the institutional priorities regarding e-Learning in the learning and teaching process can be determined. Senior management involvement can promote collaboration of faculties in embracing e-Learning in formulating faculty operational plans that align with institutional goals and objectives. The challenges faced by HEIs in developing nations that promote e-Learning require involvement of leadership at all levels, so they can formulate focused standards to promote e-Learning in their institution. There is a need to address institutional disruptive influences that are centred on time and user workloads; and this is best achieved through management involvement.

University senior management has the role and responsibility of making sure that students and lecturers are satisfactorily involved in the use of e-Learning resources, together with technical staff being motivated and committed to supporting potential users. As one of the extrinsic motivating drivers, management must also construct incentives and reward systems through strategy formulation. The effective development and execution of e-Learning systems is always dependent on the policies of the institutions and how they utilise available resources (Akaslan et al., 2012; Bokolo, Kamaludin, Romli, Raffei, Abdullah, Ming et al., 2020).

3.3.3.3 Culture

Before implementing ICT in education, it is important to take culture and social concerns into account (Qureshi, Ilyas, Yasmin, & Whitty, 2012). The influence of culture, social life, and living standards, are to some extent challenging impediments to the incorporation of e-Learning into traditional pedagogy in South African higher education institutions (Shraim & Khlaif, 2010). Cultural influences impact on how lecturers teach, and students learn, as does interaction style and communication, all of which comprise the e-Learning core foundation. To create and advance a successful system in an e-Learning environment, cultural orientation should be considered (Al-Adwan et al., 2021). Based on (Mason, 2007) “one of the features of a successful e-Learning system is the involvement of users’ cultural characteristics in its design”. In addition, Vrazalic, MacGregor, Behl, and Fitzgerald (2009) emphasise that culture and traditions are interconnected to acceptable learning and teaching practices. When implementing an e-Learning system, socio-cultural issues may present several obstacles. As a result, some e-Learning approaches may be highly successful in some cultures while being outrightly forbidden in others. The ethical and cultural messages of some e-Learning system interfaces should also be considered. For example, due to Islamic beliefs which promote humility, many Arab nations consider eye contact, particularly between men and women, to be inappropriate (Rhema & Miliszewska, 2010).

The examination of the literature has demonstrated that e-Learning is distorted if the students' cultural demands are not carefully considered (Almarabeh & Mohammad, 2013). Cultural variations may generally affect how people communicate, engage, and participate in online learning, which can be difficult for students from various cultures. Additionally, e-Learning resources and instructional materials were created in western nations, but according to the present study, most of these customers are from South Africa, a country with a variety of cultural traditions. Consequently, it is essential that lecturers and designers of e-Learning systems have the necessary skills to provide culture-based education. Culture-based education has been studied from various perspectives. Other “cultural characteristics” are individualism versus collectivism. Individualism and collectivism are cultural distinctions that students must consider. Findings show that student satisfaction and the utilisation of e-Learning tools have a beneficial influence on how students see their personal contribution (Gwamba, Renken, Nampijja, Mayende, & Muyinda, 2018). Results show that individuality and collectivism have a determining influence on both personal and organisational outcomes. Those exposed to collaborative culture see more effects on the person and the organisation, than students exposed to individualistic culture. Other research examines the role that social context and cooperation have in completing courses (Kurnia et al., 2013; Park et al., 2020).

3.3.4 Technological Domain

When comparing the technical capabilities of different alternatives, technological elements and domains are employed as variables. Institutions of higher learning view it as a crucial tool for improving operations and functions. Several external environmental factors, technological challenges being only one of them, can significantly impact the adoption of an e-Learning system. Strategic leaders in the online system are always searching for new and improved technologies. They not only improve their operations, but also better comprehend the e-Learning transformational phase and develop revolutionary exponential growth strategies.

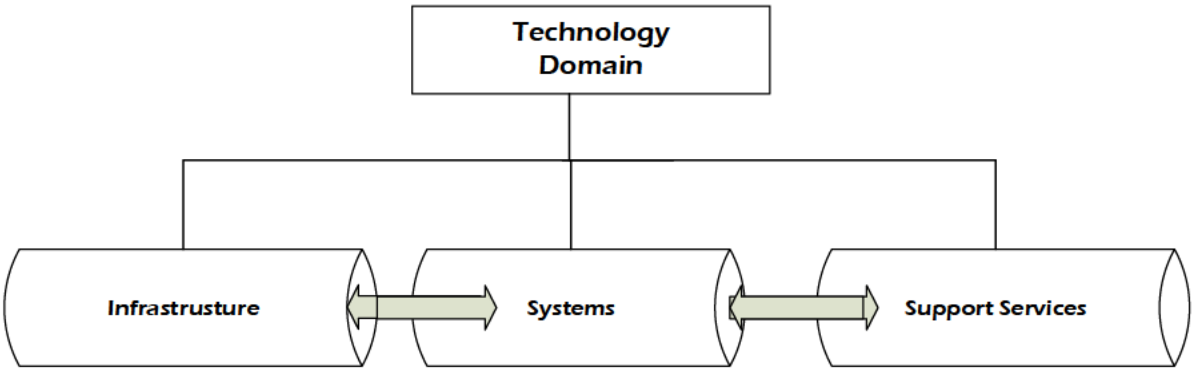

Figure 3. 10: Technology Factors for sustainable e-Learning

The Technological factors considered in the present study are depicted in Figure 3.10 and consist of three constructs, namely: infrastructure, systems, and support services. In the context of the present research, the university's physical and technological infrastructure that supports its e-Learning system defines the technological domain. However, physical infrastructure in the context of the present study refers to the network operation centre capacity to aid the e-Learning system including, computer network bandwidth, and university policies on technology integration. Conversely, technical infrastructure refers to hardware and software applications; LMS; library systems; management information systems; and e-mail services. Users' expectations and the technology's ease of use also have an impact on the deployment process at all levels. Examining the dimension's elements may reveal new e-Learning implementation challenges as well as aspects that will encourage and drive the acceptance and uptake at the university under study. The components of the Technological Domain are discussed in the following sessions.

3.3.4.1 Infrastructure Domain

The combined hardware, software, network resources, and services needed for the creation, maintenance, and administration of an IT environment for businesses is referred to as the infrastructure domain. It enables an organisation to offer IT solutions and services to its employees. It is frequently located inside owned premises and is internal to the business. It includes all components that contribute to overall IT and IT-enabled activities in some way. The following components make up a conventional IT infrastructure in the context of the current study: hardware, software, network, and cloud infrastructures.

Inadequate technology infrastructure, poor Internet connectivity, lack of technical expertise among students and lecturers, and limited time for lecturers to design and develop their e-

Learning courses are indicated in the literature review as barriers to faculty participation in the integration of technology ((Keengwe, Kidd, & Kyei-Blankson, 2009; Allen & Seaman, 2013). The main impediment to the development of the e-Learning system is a lack of accessibility to the necessary technology enhanced infrastructure, which often leads to unpleasant experiences that have the potential to do more harm than good to students' and lecturers' experiences with e-Learning. Access to technology is shown to be a challenge, however, numerous variables, including the availability and dependability of infrastructure, the university's financial situation, user abilities, and users' motivation, influence access disparities (Oroma et al., 2012). In developing countries such as SA, acquisition of ICT equipment and Internet access due to cost implication is a challenge. Sometimes institutions may be able to purchase the necessary technology, but maintaining a working system over time becomes problematic (Oroma et al., 2012).

The most reported institutional issues are the availability of the Internet, bad ICT communication infrastructure, power supply, appropriate computer labs with ICT technical assistance, a lack of ICT policy, and a lack of management support ((Al-Ghaith, Sanzogni, & Sandhu, 2010;; Technology, 2007; Nichols, 2008;Onasanya, Shehu, & Oduwaiye, 2010). Consistent with Technology, 2007b;; Unwin et al., 2010; Mtebe and Raisamo, (2014) and (Sanga et al., 2013), it is evident from their studies that there are still huge infrastructural problems that need to be addressed if an institution is to achieve satisfactory integration of technology in using e-Learning. E-Learning has cost implications that prevent most HEIs from procuring state-of-the-art technology equipment.

Therefore, appropriate infrastructure for e-Learning development is one of the principal challenges faced by HEIs in e-Learning implementation, particularly in developing countries (Drent & Meelissen, 2008). According to Wellmann (2013), an e-Learning environment must offer lecturers and students a high level of dependability and accessibility. To prevent harming higher education's e-Learning activities, institutions of higher learning must provide wired and wireless networks with high connectivity "bandwidth" (Noor-Ul-Amin, 2013).

3.3.4.2 Systems Domain

Universities procure resources in e-Learning systems to assist teaching and learning as Internet technologies advance (Deng & Tavares, 2013; Samir Abou El-Seoud et al., 2014). One such resource is the Learning Management System (LMS), which includes tools for delivering courses over the Internet as well as online collaboration. It allows for safe online exchange of course information, as well as communication between educators and students. LMSs have become nearly vital educational tools in recent years (Álvarez et al., 2013). Most institutions currently employ LMSs to enhance and improve learning and teaching processes, whether they focus on distant education or classroom-based education. The use of LMS by educational institutions has promised higher-quality, student-centred education (Islam, 2013). The focus of construct systems, in the current study, is on both lecturers' and students' perceived usefulness, behavioural information quality, system quality, service quality, system functioning, and intention to use.

3.3.4.3 Support Services Domain

Once a technology is adopted at a university, students and lecturers should have access to prolonged assistance from skilled experts, rather than a once-off training session. Naturally, this will necessitate funding for universities, but senior management should also place a greater focus on user assistance. With excellent support from educational technology workers, academic staff should have access to the materials they require. The most crucial type of academic support may change as the technology integration project develops. Only in the early phases of a project may academic staff members need further technical assistance. This may be offered by recruiting educational technology and information technology professionals. Academics' expectations may change as they become proficient in the technical skills required for the new technology, shifting to requests for administrative and peer support to help them create and execute creative applications of the technology in their classrooms. Regular conversations about innovative, domain-relevant uses of technology can give this sort of assistance in professional learning groups. Technical personnel should constantly be equipped with the essential knowledge and abilities to help users inside the environment to improve e-Learning practices. It is therefore essential to continually investigate pedagogically sound and futuristic e-Learning ways to improve student learning.

3.3.5 Sustainable e-Learning Environment

E-Learning has extended students' opportunities to learning enhancement off campus and transformed conventional education views (Collins & Halverson, 2010). Consequently, transformations require HEIs to adapt to meet the needs and expectations of students and other stakeholders. As such, the HE sector has to anticipate, endure and, where possible, take advantage of the present and future change influences (Stepanyan, Littlejohn, & Margaryan, 2013). HEIs in developing countries like SA, that rely on government funding look for continuing success of e-Learning initiatives, since this technological advancement influences the core principle and practice of traditional learning and teaching pedagogy. Thus, there is a demand for, and interest in, learning about sustainability principles and sustainable behaviour in e-Learning systems. In identifying workable methods to enhance the sustainability of the e-Learning environment, the current study builds on previous studies. Therefore, for the future growth of universities, a solid data foundation on the sustainability of e-Learning systems and their long-lasting advancements is essential. For strategic decision-making and policy formulation, it is crucial to conduct critical analyses of the data surrounding the sustainability of e-learning systems in the HE sector.

Researchers of e-Learning practices have come up with several interpretations of the term "sustainable". The current study views this term as defined by Gunn. When all three of these criteria are satisfied, an e-Learning effort is deemed viable, according to (Gunn, 2010):

- A learning design based on information and communications technology has been created and put into practice within a course. It has gone through a proof-of-concept phase and demonstrated to be advantageous for teaching and learning, based on the data provided.
- The idea, design, system, or resources for e-Learning can potentially be adopted and maybe changed for use outside of the initial development environment.

- The concept, design, system, or resources for e-Learning do not continue to be dependent on one, or a small number of people to the point that should their involvement be terminated, future possibilities would not be jeopardised.

3.4 Chapter Summary

This chapter examined some of the most popular e-Learning models to recognise typical components that impact effective implementation and, consequently, to design a framework that is appropriate for the university under investigation, and institutions with similar characteristics. The theories underpinning some of the most used or quoted models were investigated to develop an implementation framework considering the components of e-Learning competence. This was done to identify the key characteristics that impact e-Learning integration in HE. The literature review provided the foundation for the study design and methodology. The study methodology is presented and discussed in the next chapter.

CHAPTER 4: Research Methodology

4.1 Introduction

The research design and methodological decisions made by the researcher are presented in this chapter. This covers the goal and justifications for the approaches that were used. The paradigm, philosophical position, approach, and strategy used in the current study are all included in the design. The design also covers the procedures used to get the data and how it was analysed. The researcher presents aspects influencing the reliability of findings and how they were handled, as well as ethical issues, toward the end of the chapter.

4.2 Research aim and objectives

This study is an investigation of students' and lecturers' perceptions of factors that influence the creation of a sustainable e-Learning environment in a University of Technology. The overall aim of the present study is to investigate factors that have the potential to impede and enhance the integration of technology through the e-Learning system in an ICT-Challenged environment by considering the perspectives of different university stakeholders. Even though the objectives are listed in a precise order, they all hold equal weight in the present research project. The order just denotes different stages of the research process, wherein results from one stage serve as inputs for the next.

Objective 1 - To investigate factors that students at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment.

Objective 2 - To investigate factors that lecturers at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment.

Objective 3 - To investigate organisational design and technological factors that impede and enhance the development of a sustainable e-Learning environment at a university of technology.

The corresponding research questions are:

1. What factors do students at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment?

2. What factors do lecturers at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment?
3. What are the organisational design and technological factors that can impede or support the development of a sustainable e-Learning environment at a university of technology?

4.3 Research Design

For the current study, a research onion in Figure 4.1 below was chosen to gather in-depth participant life experiences of the e-learning adoption process in an ICT-challenged South African university of technology. According to Tobi and Kampen (2018), Mukherjee (2017), Jha (2014), and, McMillan and Schumacher (2014), research design is a set of instructions for carrying out a study that outlines the steps a researcher must take. According to Yin (2009), a design is a logical process that links empirical data to a study's original research objectives and ultimately results in its conclusions. The chosen descriptive qualitative research design offered a broad plan for integrating the various study components in a cogent and logical manner (Tobi & Kampen, 2018).

The layout made it easy to implement the numerous research activities (Mukherjee, 2017). It made it possible to get the best results with the least amount of work, time, and money (Omair, 2015). It provided instructions on steps to be performed and spelled out the procedures followed in the conduct of research activities. As a result, the study's conclusions were more reliable and its murky methods were eliminated, giving it a solid base on which to build. The methods used in descriptive qualitative research required a more systematic approach, ensuring the accuracy of the results (Mukherjee, 2017).

The design aspects are presented in the next section, which also highlights the chosen research paradigm, method, process, and activities.

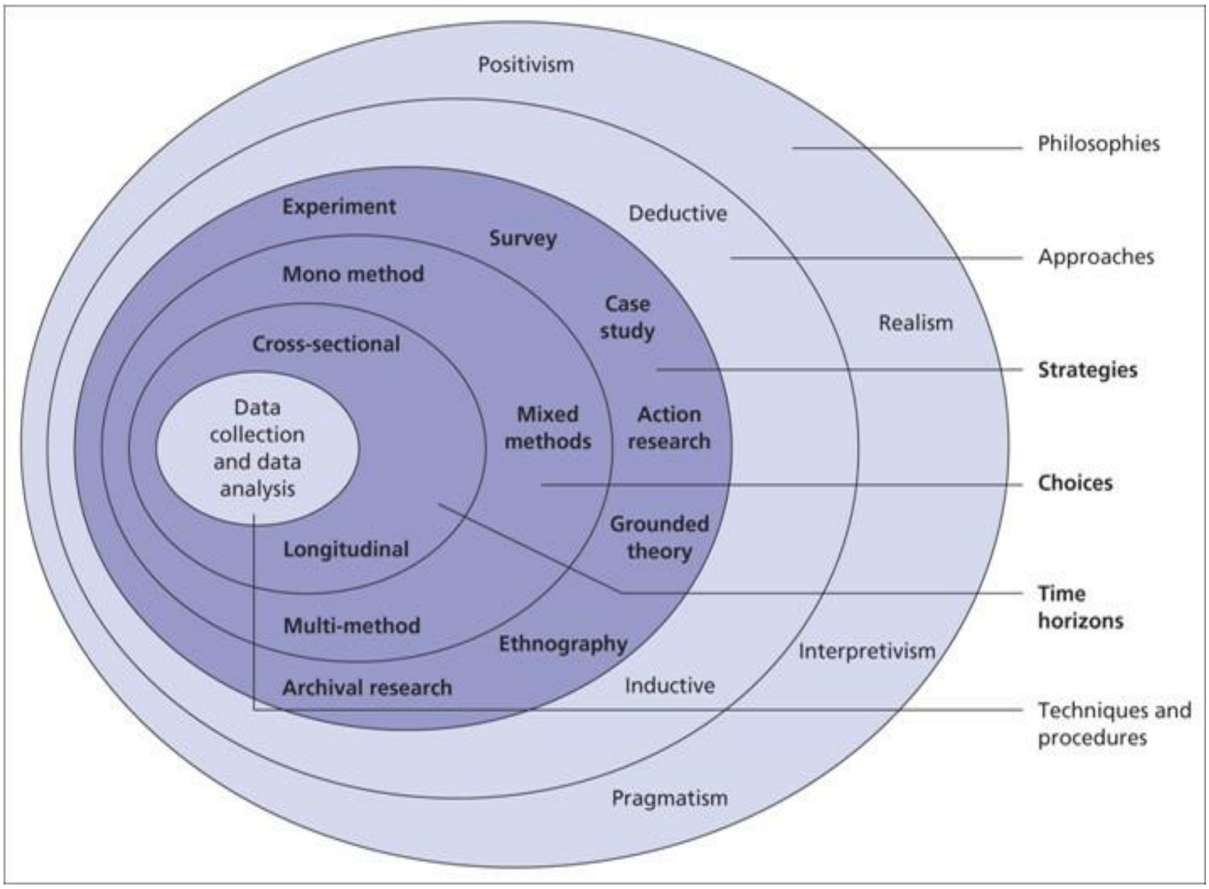

Figure 4. 1: Onion Skin Approach (Saunders et al., 2012)

4.3.1 Research Philosophy

Research philosophy is the most significant layer of the research onion. It is a system of views or principles about the collection, interpretation, and analysis of data (Bryman, 2015). Researchers employ the research philosophy layer in a particular study to reflect significant presumptions on their own ideas and opinions, as well as how they understand the world (Simpson, 2009). For the present study, interpretivism and positivism paradigm were considered appropriate for the current research which looked at the elements that impact the creation of a sustainable e-Learning environment in a University of Technology among numerous stakeholders.

The current study was informed and based on the following assumptions:

- As primary drivers of e-Learning environment implementation, students and lecturers were adopting the researched university approach in teaching, learning, and competence-based curriculum. Both students and lecturers confront difficulties in implementing an e-Learning environment in a university of technology that is under research.

- University-researched technology systems affect students and lecturers' implementation of e-Learning environment at any academic level.
- Both students and lecturers are computer literate, and they can integrate ICTs with their learning and teaching strategies.
- University senior management avail the funds to install e-Learning environment packages in the institution's computers.
- Students are familiar with, and capable of, using a variety of technological tools.
- Heads of departments are role models in the implementation of e-Learning environment technologies.

According to Scotland (2012) "every paradigm is based upon its own ontological and epistemological assumptions. Since all assumptions are conjecture, the philosophical underpinnings of each paradigm can never be empirically proven or disproven. Different paradigms inherently contain differing ontological and epistemological views; therefore, they have differing assumptions of reality and knowledge which underpin their research approach''.

Ontological ideas, often known as assumptions in philosophy, shape the types of questions that a researcher may ask about how the world works or how individuals act or interact. The ontological dimension shed light on the nature and types of e-Learning implementation realities (Neuman, 2014). It addressed the issues of what reality is and what can be known about it, given that interpretation is subjective and depends on the numerous lecturers involved in their respective departments. Ontology attempted to mediate and give consensus toward a shared definition of what e-Learning implementation is all about by defining what constitutes reality (Mertens & MacLaughlin, 2004**).**

Epistemology is defined as "a method of comprehending and explaining how we know what we know" (Crotty, 2003). Epistemology is also concerned with providing a philosophical foundation for determining what types of knowledge are conceivable and how to assure that they are both adequate and legitimate (Gill, Johnson, & Clark, 2010). Epistemology offers a conceptual framework for examining knowledge acquisition, generation, and communication (Gill & Johnson, 2010). According to Neuman (2014), epistemology focuses on how we know what we know or the most viable approaches to obtain truth. Epistemology is concerned with our assumptions about the nature of knowledge and the relationship between the knower and what is known or desired to be known. It discusses how to distinguish between truth and deception.

As seen in Figure 4.2, ontology, epistemology, and axiology collaborated to develop the theoretical framework then through a mixed method design, the researcher surveyed students and lecturers' use of technology, access to technology, provisioning of technology training and provisioning of technology enhanced infrastructure. Finally, using several interview questions, the researcher extracted sub-themes of the factors in the developing model. Because axiological assumptions were intimately tied to epistemological assumptions, they both worked together to inform the researcher's values regarding the study process. The researcher's values could not be suspended because they mediated and shaped the framework of the e-Learning environment implementation process.

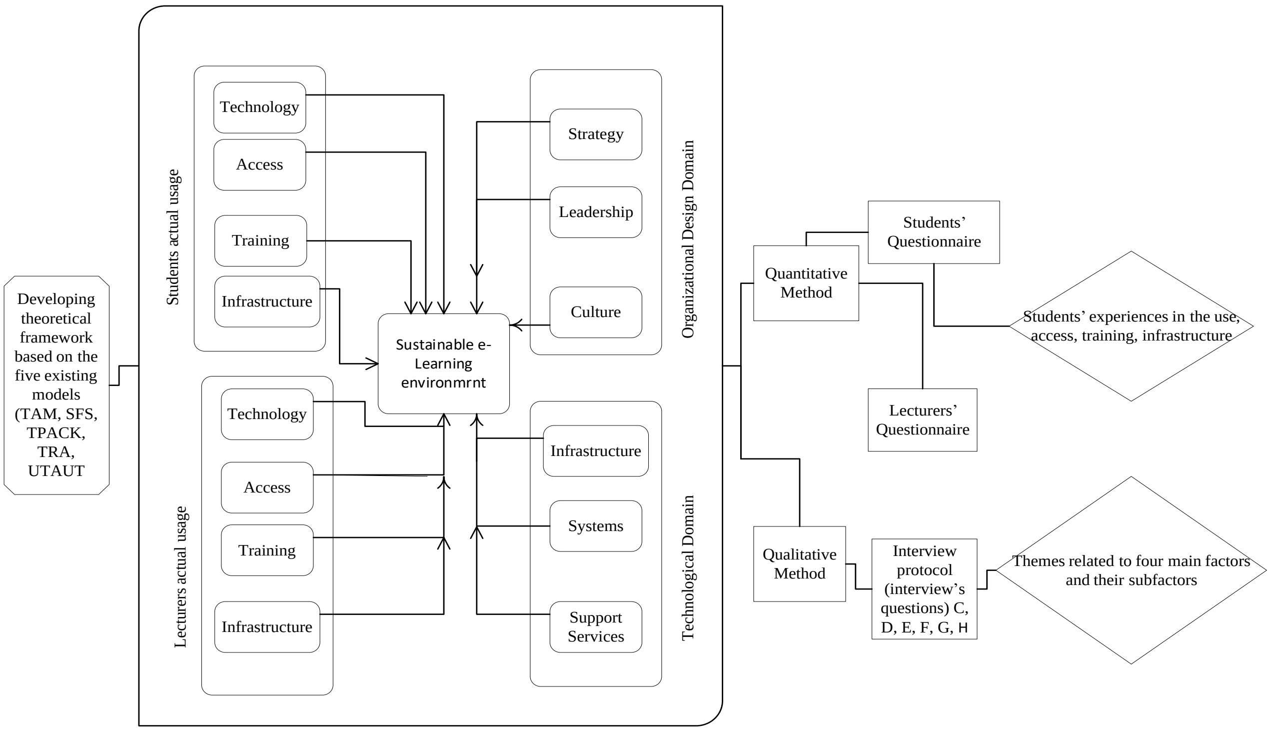

Figure 4. 2: Research Framework

The current study's epistemological perspective is interpretivism. Interpretivism maintains that humans build knowledge as they interpret their experiences of and in the world, as opposed to the objectivist view that knowledge exists only to be identified and collected **(**Constantino, 2008; Pascale, 2011). To provide an in-depth investigation of the social interaction incorporated in the usage of e-learning facilities, an interpretative research paradigm was used. The paradigm provided the researcher with a conceptual framework to guide and inform the researcher's choice of research questions, technique, and aims. Figure 4.2 depicts the research framework, which supplied a set of interconnected philosophical values and beliefs required to comprehend the participants' social reality. The interpretive paradigm enabled the researcher to interpret the three levels of interaction among the participants: philosophical, social, and technical. The paradigm is deeply rooted in ontological, epistemological, and methodological assumptions that shaped the researcher's paradigmatic perspective. This focused and illuminated the subjective and objective realities of how knowledge and experiences were obtained during the e-Learning environment installation process (Neuman, 2014).

The interpretivist technique allowed participants to express their perspectives, concerns, and practices, allowing the researcher to get insights and in-depth knowledge about e-Learning processes and practices (Creswell, 2014). E-Learning cannot be implemented in developing nations such as South Africa unless its practices and challenges are identified and addressed. As a result of using the interpretivist paradigm in this research, participants as change agents in technology were able to express their concerns about the implementation process from a variety of perspectives. Furthermore, using interpretive research in the study coincided with Kivunja and Kuyini (2017) argument that it is used to probe the researcher's beliefs and preferences, as well as those of the participants.

Consequently, an in-depth understanding of e-Learning environment implementation in the participating university of technology was enhanced since it was greatly influenced by the belief system and preferences of the practitioners. An understanding of these beliefs and preferences required probing and eliciting subjective views and thoughts of the participants. The interpretive approach enhanced the grasping of the concerns and claims of stakeholders in the context of the implementation of e-Learning environment in the researched university.

The interpretation of the quantitative data regarding the participants' perceptions of the barriers and enablers in creating a sustainable e-Learning environment, is guided by the positivist philosophy. According to Edirisingha (2012), positivist research must be unbiased and employ consistent, realistic, and coherent research methods. Positivism, as an objectivist research paradigm, underpinned most human and social science research in the nineteenth and early twentieth centuries and continues to have an impact in the twenty-first (Pascale, 2011).

Positivism is a philosophical philosophy of knowing that takes solely observable or quantifiable (i.e., empirical) world experiences as data for analysis, with the results deemed positive or absolute facts about reality. Researchers treat people as if they are things, believing that the truth of individuals' experiences, particularly interpersonal and social interactions, can be researched objectively.

The interpretation of the qualitative data was influenced by the interpretative research paradigm which concerned an individual's interpretation of the environment around them (Antwi & Kasim, 2015). This agrees with Cohen et al., (2007), who claim that the interpretive paradigm is defined by modelling works from a human standpoint and aims at understanding the experiences of participants.

4.3.2 Research Approach

The second layer of the onion represents the research approach given by inductive and deductive (Saunders et al., 2009). In the present study, deductive technique when designing the instruments for the quantitative data by ensuring they covered the main constructs in the framework was employed. An inductive approach at certain points as well was used. The building theory is a component of the inductive method, which entails first gathering evidence via multiple channels, such as interviews, and then basing new hypotheses on those results (Chan, Lee, & Woo, 2020). Since the current study used both quantitative and qualitative design, the inductive approach was used for interview questions as well as open questions in the questionnaire. Interviews facilitated the collection of realistic data. This approach assisted the researcher by providing various information that could not be gathered through questionnaires in relation to the current research topic (Bryman, 2015; Kumwenda, Niang, Orondo, William, Oyinlola, & Bongo et al., 2017).

4.3.3 Research Strategy

The research strategy or framework is the third layer of Saunders et al., research's onion (Saunders et al., 2009). This study takes on a case study approach, which is used to conduct an intensive, holistic, description and analyses of a bounded phenomenon. The phenomenon under scrutiny in this study is the factors, which influence the creation of a sustainable eLearning environment in a UoT. As such, to get an intensive holistic view, the study sought to gain the perspectives of the various stakeholders to understand the phenomenon.

4.3.4 Research Methods

A mixed methods approach was used in the current study investigation. It was used due to the complexity of the phenomena under examination and the dynamic nature of the situation. Because of the paradigm conflicts between quantitative and qualitative research methodologies, mixed-methods research has become a popular method of inquiry (Creswell, 2013).

In the current study, quantitative research is used to investigate general trends in the use of e-Learning systems among university students and lecturers from the faculties of Engineering, Management Sciences, and Natural Sciences. The aim of quantitative research, according to Arias, Arias, & Rodriguez-Medina, (2021), is to discover assertions of objective fact, prediction, law-like discoveries, and generalisation. Als in the current study, qualitative research was utilised to gain a more complex grasp of the problem under consideration than the generalised understanding provided by questionnaires using different participants from those of quantitative data. Qualitative research, uses techniques including interviews, focus groups, conversational analysis, and observation to obtain and test textual data (Olds, Moskal, & Miller, 2005;. Creswell, Clark, Gutmann, & Hanson, 2003). In the same vein, Leedy and Ormrod (2019), indicates that qualitative researchers create interpretive narratives from their data to capture the complexity of the phenomena being studied.

Informed by a continual literature review of the use of emergent learning technologies, the lived experience of e-Learning students, lecturers, and other involved stakeholders was utilised as the basis for the first data collection (see Figure 4.2). This study used a mixed-methods approach to capitalise on the strengths of each method to give insight into the statistical occurrences of the components in the construction of a sustainable e-Learning environment. However, the quantitative technique is dominant in this study.

4.3.5 Time Horizons

The fourth layer of the research onion emphasises the time range over which the study was conducted. The current study used a cross-sectional research technique to identify the perspectives of a diverse group of people. The research was carried out over a period of 3 years and conducted in 3 phases. The first phase comprised the administration of the questionnaire to students, while the second phase involved the administration of the questionnaire to lecturers. The final stage was interviews with three staff members in the Department of ITN, two staff members from TLDC, five middle management (HoD), and two senior management (Deans of faculties). This was intended to provide multiple perspectives into the phenomenon under study.

4.4 Sampling

Sampling is the process of selecting a percentage of the total number of units to make general generalisations about the full group (Neuman, 2003). Sampling is essential since it is challenging to investigate every single member of a group. Purposive sampling of individuals was utilised in this study to find the people who were most suited to engage in the study, that is, those who were regarded best positioned and capable of providing trustworthy and rich data. For this study, 835 students and 97 lecturers in the faculty of Engineering, Management Sciences and Natural Sciences represent the sample for the questionnaire survey. Three senior staff members in the Department of ITN, two senior staff members from TLDC, five middle management (HoD) and two senior management (Deans of faculties) also represent the sample of the interviews of the current study.

Students (835) were used in phase one of the current study. The closed-ended questionnaire instrument was used to collect data in this phase. Students sampled represented a cross-section of age, level of study and faculty of choice. The researcher used the open-ended questionnaire instrument in collecting data for phase two of this study from lecturers (97). This was to give them an opportunity to substantiate their choices in the questionnaire. The lecturers (97) were randomly selected for phase two of the current study and were teaching at different levels and have varying experience in teaching using technology. The third and final phase of the study consisted of the interview instrument administered to ITN staff members (3), TLDC staff members (2), HoDs (5) and Deans (2) of faculties that were also randomly selected based on their involvement in the promotion and development of e-Learning in the university under study.

The requirement for this research to collect material rich in its contributions to the research questions drove the goal of being selective with the sample. The major sample for the questionnaires and interviews was selected based on a key criterion of students and lecturers who were using technology in learning and teaching, since the researcher had knowledge of the demographic and the e-Learning arena of the participating institution in the current study. This was done to guarantee that the research's goal and questions could be answered.

Purposive sampling has been criticised by researchers for relying on the researcher's subjectivity, which might lead to bias. One option to address the possibility of bias was to distribute the survey to all responders in the participating university. These responders were individuals who had the capacity to employ technology in learning and teaching, giving them a reasonable chance of being chosen.

It was expected that each participant in the present research's phase three (qualitative method), would have their own ideas and beliefs, and that the qualitative sample size in this study should be large enough to capture most or all those opinions and beliefs.

4.5 Data Collection Process

Data collecting makes up the fifth and deepest layer of Saunders' research onion. The approach used at this point in the study significantly increases the overall validity and reliability of the results (Saunders et al., 2009). This layer describes how the research data was gathered and analysed. Data collection is an important aspect of the research process and necessitates the use of equipment known as instruments.

For the collection of data in the present study, three phases were used. These were closed ended students' questionnaires, open ended lecturers' questionnaires, and semi-structured interviews. According to Saunders, Lewis, and Thornhill (2016), there are three techniques to building a questionnaire: adopting questions from prior research, modifying questions from other similar studies, and inventing your own questions. Data collection involved the gathering of data in an established systematic manner, that enabled the researcher to answer research questions. The process involved identifying and selecting individuals, obtaining permission to study them, gathering information through asking questions (Creswell, 2012). The goal for data collection was to capture in-depth quality e-Learning environment interactive evidence that would translate into rich data analysis. This allowed for the building of a convincing and credible answers to research questions that were posed. The next sub-sections discuss the instruments used in each of the three phases in details.

4.5.1 Phase 1: Students' Questionnaire

Because questionnaires had been used in prior research on the acceptance and use of technology, the researcher believed they were a viable instrument for data collection in this phase (Ntemana & Olatokun, 2012). Based on the conceptual model anchoring the present study, a questionnaire for students was created. The students' questionnaire comprises Section A and B (see appendix A). Section "A" includes seven items showing demographic data such as gender, age, current registration, faculty of registration, area of Grade 12 school, extent of technology uses pre-Covid-19, and extent of lecturers' expectations for students using technology pre-Covid-19.

Section B of the students' instrument is the closed-ended questionnaire, which provides respondents with a list of several options from which to choose (Saunders & Tosey, 2012). Due to the respondents' (students) limited time to complete an unstructured questionnaire, the questionnaire's items were closed-ended to assure standardisation, facilitate straightforward coding of data, and facilitate data analysis. Section B included 20 statements to measure students' experiences in the integration of technology in higher education learning and teaching with distributed items into four constructs: Use of technology in learning (five items); Access to technology in learning (five items); Provisioning of training to technology (five items); and Provisioning of infrastructure for technology (five items). To determine the opinions of the participants in the questionnaire, a Likert scale with 5 points was used with (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree and (5) Strongly Agree.

4.5.2 Phase 2: Lecturers' Questionnaire

The lecturers' questionnaire was also developed based on the conceptual model anchoring the present study in chapter 3, section 3.3, and Figure 3.3. The lecturers' instrument comprises of Section A and B (see appendix B). Section A consists of eight items showing demographics data such as gender, highest academic qualification, faculty, higher education teaching experience, level of subjects currently teaching, teaching using technology experience, level of use of technology pre-Covid-19, and use of learning management system pre-Covid-19.

Section B of the lecturers' instrument is an open-ended questionnaire. The open-ended questionnaire was chosen for lecturers so that they could also provide responses in their own words (Clark-Carter, 2010). Section B had 20 statements to measure lecturers' experiences in the integration of technology in higher education, distributed items into four constructs: Use of technology (five items); Access to technology (five items); Provisioning of technology training (five items); and Provisioning of technology enhanced infrastructure (five items). The items in the questionnaire were rated based on a 5-point Likert scale which are (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree and (5) Strongly Agree.

The questionnaires were created using Google Forms, and the survey invitation link was sent via the Blackboard learning management system. The researcher also explored using social media, such as each department's WhatsApp group, which was coordinated by the departments' coordinators. Every ten days, two reminders were issued to increase the number of participants. On the opening page of each electronic survey for both students and lecturers, a covering letter was included explaining the goal of the current study, emphasising its importance and significance, and encouraging respondents to participate. The participants were given about a month to complete the survey. Then, using different tactics such as personal visits, phone calls, and sending consecutive reminders, the researcher in the current study followed up with the relevant people to persuade them to finish the questionnaires so they could be collected on time.

4.5.3 Phase 3: Interviews

Semi-structured interviews were employed in the phase 3 of the current study to gather qualitative data. Like structured interviews in that the themes or questions to be asked are pre-planned, semi-structured interviews utilise open-ended questions as opposed to closed ones. Semi-structured interviews were developed and employed in this study because they allowed for flexibility in the order in which subjects were discussed, and because they allowed participants and the researcher to bring up topics that weren't covered in a predetermined interview agenda (Silverman 2011). Additionally, with semi-structured interviews, the open-ended character of the question specifies the subject under examination while simultaneously giving the interviewer and interviewee time to explore a particular subject in the interview in detail Phase 3 of the present research, used purposive sampling for the interviews participants. An advantage of using purposeful sampling is that it can be applied to small groups of participants as was the case in this study (Merriam, 2009).

The selected participants for the semi-structured interview procedure were contacted to set up an interview day, time, and venue. The interviews lasted anything from 45 minutes to an hour and a half. These were performed utilising the Ms Teams platform in English. Following the introductions, the aim of the interview was described, as well as the proper length of the interview. The responders were also given a copy of the letter approving the research. Respondents were first asked whether they accepted being interviewed, and then asked if they agreed to the interviews being recorded. The responders' anonymity was guaranteed. Ms Teams generated a physical copy of each respondent's interview transcript as the interview continued, which could be printed at the end of the interview session. The interview on the Ms Teams platform allowed the researcher to have a dialogue with the responders utilising leads, as well as probe them further for more information and, in certain cases, clarification. The semi-structured interview's flexibility allowed the researcher to rephrase or explain queries.

Following the conceptual framework underpinning the present study, two different sets of interview questions were developed. The first set of questions were for ITN and TLDC staff members and is attached as Appendixes C, D and E. These sets of questions focused on infrastructure, systems, and support services constructs respectively. The 5 interview questions in Appendix C were designed to assess the extent to which participants perceive the contribution of technology infrastructure to the effective use of technology in the higher education sector. The 6 interview questions in Appendix D were used to raise problems with electronic systems in this study. To better understand the level of technological support services provided to lecturers and students during the implementation of the online system at this university, 5 questions in Appendix E were asked of interviewees to determine the level of support services provided to lecturers and students with the goal of improving the system. By recognising patterns and similarities in snippets from the interview transcripts, concepts for codes were developed.

In the present study, a diverse group of three specialists from the Information and Technology Network Department (ITN) and the Teaching and Learning Development Centre (TLDC) were invited to participate, with two senior staff members responsible for e-Learning development. To request an interview, all interested participants received an introduction letter and consent form. The researcher used Ms Teams to conduct the individual interviews which lasted 60 minutes per person. With each individual participant’s agreement, all interviews were recorded using Ms Teams, and notes were collected throughout the interviews. A technical area with three constructs was included in the interview schedule (Infrastructure, Systems and Support Services).

The second sets of questions were for HoDs and Deans of faculties and are attached as Appendixes F, G and H. These questions focused on strategy, leadership, and culture constructs respectively. To take part in the qualitative data collection, five middle management (HoDs) were contacted. HoDs who agreed to participate were requested to respond via email within a week and to accept the consent form. The inclusion of HoDs was regarded as crucial for the development of the thoughts and the accomplishment of the investigation. The participation of HoDs in the current study was intended to obtain deeper data, which would strengthen the study results. Finally, 2 senior management (Deans of Faculty) were also invited to participate in the third and final means of data collection. They were considered because they are actively involved in the promotion of the e-Learning system, budgeting and policy development, strategic planning, management, and acquisition of necessary technology equipment. The objective of using the interview schedule with them was to collect information from some decision makers in the participating UoT with a view to supplement the quantitative method and gain a better understanding of the problem (Tashakkori & Creswell, 2007; Ali, Hossain, & Ahmed, 2018; Creswell & Zhang, 2009).

The seven interview questions in Appendix F were given to participants (middle and senior management) so they could express their perspectives on the strategy construct. This construct focused on how the university's strategy on teaching and learning with e-Learning and policy promote pedagogical strategies in the online system. All seven questions in the constructs had to be answered by the participants. The interview questions given to participants to express their perspectives on the Leadership are listed in Appendix G. The issue of effective leadership within institutions is one of the most important factors, not only to encourage, enable, and reward the adoption of e-Learning, but also to develop a level of strategic thinking and planning for the university as it adapts to both external and internal pressures and opportunities. In this construct, respondents were requested to provide feedback on how the university ensures quality and efficiency, a management-oriented governance structure that emphasises the importance of strong local leadership, as well as incentives and outcomes control on e-Learning. Appendix H is a final series of interview questions designed to assess Deans' and HoDs' opinions on the university culture of e-Learning acceptance and adoption, and its impact on learning and teaching using technology. Given the impact culture has on how students and lecturers think, it was reasonable to assume that culture has an impact on how they both view technology. Cultural elements might be regarded to impact how students and lecturers think and behave because the primary core of culture consists of traditional concepts and their associated values.

4.6 Data Analysis

The process of deriving meaning from data and interpreting that meaning is known as data analysis (Creswell, 2009). In the present study, quantitative and qualitative data was analysed. R-programming was used for quantitative data while the thematic analysis approach was followed for the qualitative data. After the data was collected and captured, data analysis began to make sense of the research, and reach specific conclusions (Field, 2013).

The summary of data analysis according to research questions is given in Table 4.1 below.

Table 4. 1: Data analysis according to research questions

Research Question (RQ)	Method of data collection	Instrument	Participants	Data analysis
RQ1	Survey	Questionnaire	835	R Programming
RQ2	Survey	Questionnaire	97	R Programming
RQ3	Interviews/focus group	Focus group structured interviews	Group 1 (5) Group 2 (7)	Atlas.ti version 8.0

4.6.1 Analysis of Quantitative Data

The quantitative data obtained from students and lecturers was subjected to computer analysis with the assistance of a skilled statistician to make the data display understandable. Tables, graphs, and figures were created from the data, which was translated to percentages. The quantitative data was analysed using the R statistical computer software, 2020, version 3.6.3, in accordance with the research questions presented earlier in the study.

In this study, descriptive statistics were used to summarise biographical information surveys from both students and lecturers. During the analysis, frequency tables were used to display and analyse the research data. According to Smyth (2009), frequency tables show the distribution of individual scores and are counted based on the number of respondents who received each score, provided each response, or fell into each category. All sections of the surveys were statistically evaluated using these frequency distributions since the data may be presented as tables or graphs. These graphs and tables assist the researcher in visualising the results and gaining a basic knowledge of the data's characteristics (Neuman, 2006).

The present study also made use of the Likert scale questionnaire, commonly referred to as a "rating scale". It is a method for scaling responses frequently used in quantitative research (Liddell & Kruschke, 2018). In its final form, the scale is a five (or occasionally seven) point scale that is utilised to allow the individual/interviewee to express the levels of agreement or disagreement with a given positive statement associated with the aims and objectives of a particular study (Heiberger & Robbins, 2014). Since attitudes are anchored on a continuum from strongly agree to strongly disagree, it is assumed that the strength or/and intensity of an attitude is linear. It assumed that individual attitudes can be measured. In this process, each of the 5 responses was given a numerical value which would be utilised in the measurements of one's attitude/s related to the investigation. Thereafter, the responses to each set of questionnaires were categorised into five equal range levels indicated in Table 4.2.

Table 4. 2: Distribution of categories

Description	Extent of Means
Strongly Disagree	1.00 - 1.80
Disagree	1.81 – 2.60
Neutral	2.61– 3.40
Agree	3.41 – 4.20
Strongly Agree	4.21 – 5.00

The mean, item-rest correlation, and Alpha if item deleted of the data were also determined as part of the descriptive statistical analysis. The Pearson correlation coefficient for pairs of scores, where one item is an item score and the other is the overall test score, is called the item-rest correlation (Aller & Garcia-Subirats, 2013). The item-rest correlations, or the correlation between an item and the scale created by all other items, were used to assess the scales' internal consistency (Kallen & Kirk, 2014). When an item is eliminated from the scale, the Cronbach's alpha reliability coefficient for internal consistency is represented by the term "Alpha-if-item deleted." (Aller et al., 2013).

In this investigation, correlation analysis was employed to investigate the relationship between various numerical data (the constructs). The findings of the regression were summarised as univariate (unadjusted) and multiple (completely adjusted) odds ratios. Furthermore, adjusted odds ratios were reported for the most relevant explanatory factors exclusively from the stepwise regression. The significance threshold for all inferential statistical analysis tests were set at 5%. The following tests of statistical significance, commonly known as inferential statistics, were used in this study: Analysis of Variance (ANOVA), Chi Square test, Fisher's exact test, Rank Sum test, and Kruskal Wallis test. The sections below give account on each inferential statistics and their application is found in Chapter 5.

ANOVA

Once one or more independent variables and a parametric dependent variable are present, an ANOVA test is applied. ANOVA is a statistical test used for identifying differences in group means (Sawyer, 2009). The ANOVA test was applied for normally distributed measurements in this study to evaluate the mean difference of numerical variables across at least three levels of a categorical variable.

Chi-Square test

In the present study, a Chi-Square test was implemented to establish the relationship between categorical variables. A Chi-Square statistic is a test that determines how well a model matches actual data. It assesses the size of any discrepancies between the anticipated and actual results (Franke, Ho, & Cristie, 2012).

Fisher's exact test

In this study, Fisher's exact test was applied when the cross-tabulation distribution had an anticipated value of under-five, considering the sample size and the number of variables in the association. Despite being frequently utilised in the analysis of small samples, Fisher's exact test is appropriate for all sample sizes (Bewick, Cheek, & Ball, 2004). When more than 20% of cells have projected frequencies of less than 5, the Fisher test is often performed as the approximation technique is insufficient.

Rank Sum test

The Rank sum test has been used in the present study since is stronger when compared to other nonparametric tests that are useful when simply assessing median values (Békés & Doorn, 2020). It has been shown empirically that there needs to be five or more observations in the sample (Kim, Yoon, & Kim, 2021).

Kruskal-Wallis's test

A non-parametric technique used to determine if samples came from the same distribution is the Kruskal-Walli's test. The null hypothesis of the test is the mean ranks of the groups that are the same (Mbukusa, 2018). Kruskal-Wallis has been described as one of the simplest designs in quantitative research as it involves the random allocation of a sample of several individuals (n) to different groups. In the current study, Kruskal Wallis was used for assessing the median difference of the non-normally distributed measurements.

4.6.2 Analysis of Qualitative Data

To determine the significance of the participants' words, the content analysis method known as thematic analysis was utilized (Vaismoradi, Jones, Turunen, & Snelgrove, 2016). The research questions requested and the themes that resulted from the data of the current study agreed. Because it is useful for analysing trends across qualitative participant data, thematic analysis was used in this study.

Data from interviews were first gathered and collected as part of the process. The technique includes developing themes by examining the word choice and sentence construction of the notes. The goal was to make sense of the raw data by extracting information from it. To make the data's components easier to interpret, it was divided into understandable themes, patterns, trends, and linkages.

Following the semi-structured interviews, all interviews were transcribed. The Ms Teams platform was used to transcribe the interviews. Version 8.0 of Atlas.ti was used for coding, and a theme analysis was conducted. Then, data were thematically tagged to allow for the extraction of insightful information. Finding meaning-filled sections in the data and labeling them with a code is a process known as coding (Linneberg & Korsgaad, 2019). This was accomplished by utilizing a brief phrase or word to record visual information. Data may be organized through coding in a way that helped identify emerging themes and the connections between them (Kivunja, 2018).

4.7 Reliability of Instruments

The stability and consistency of the measurement instrument utilised is referred to as reliability (Cooper, Schindler, & Sun, 2006). Reliability assesses a study's consistency, accuracy, and reproducibility (Cooper & Schindler, 2014). It reveals how free of bias it is, ensuring that measurements are constant across time and across the numerous elements in the instrument. It is plainly unlikely that the same results will be achieved repeatedly due to variations in the length of time the measuring instrument is operated, as well as changes in the population and sample. Reliability in quantitative research is the consistency, stability, and reproducibility of outcomes. For instance, if consistent findings were attained under similar but distinct situations, a researcher's conclusion would be considered reliable(Mohajan, 2017). On the other hand, a significant positive correlation between the measurements made by the measuring instrument suggests reliability.

4.7.1 Quantitative Data

The quantitative data instrument was pilot tested with 100 students and 30 lecturers from the faculties of Engineering, Management Sciences, and Natural Sciences to see how long it take them to complete the questions. The pre-test was required to assess whether the questionnaire's instructions and questions were clear and intelligible to the respondents, as well as what was expected of them. Participants provided feedback on the instrument in the form of comments on how they understood each question and their choices. During this period, questions that looked difficult to grasp or had many meanings, were observed. An online system provided questions to both students and lecturers. Based on the results, it was decided that the questionnaire would be amended. The pilot study taught the researcher that human follow-up with respondents is essential for a good response.

The dependability of scales used in empirical research is evaluated using a variety of techniques. Internal consistency tests, alternate forms, and test-retest reliability are the methods that are most frequently used. Internal consistency checks may be performed in three distinct ways (split-half, item total correlations, and alpha reliability coefficient). Test-retest reliability was applied in this investigation.

4.7.1.1 Test-Retest Reliability

The consistency of the findings produced when the measuring equipment is used on the same sample group on different occasions is known as test-retest reliability (Sürücü & Maslakçi, 2020) . To ensure test-retest reliability in the current study, a sample group of students and lecturers were given questionnaires to test the measuring instrument's reliability using the test-retest technique. The identical student and lecturer surveys were then administered to the same sample group after 1–2-week intervals. Although there are differing viewpoints in the literature on how to interpret the collected results, in this investigation, the widespread consensus indicating a correlation value of 0.80 or above indicates test-retest reliability for the measuring instrument was followed (Whiston, 2005). The Cronbach Alpha values for my instruments are in Table 4.3 and 4.4 below.

4.7.1.2 Methods of Internal Consistency

The accuracy of the measuring instrument's expressions is related to internal consistency. The measuring device evaluates the object consistency as well as the precision with which it captures a certain behaviour or attribute. The correlation of each component that makes up the measurement device establishes its internal consistency. In previous research, several alternative strategies for measuring reliability based on internal consistency were utilised. Split-half, item-total correlations, and Alpha coefficient are the most used approaches (English & Keeley, 2015). However, of the known approaches, determining internal consistency using the Cronbach's alpha value is the most popular and commonly used. The dependability of the scales and the relationship between the measuring instruments may both be determined using correlation.

In the current study, the Item-Total Correlations are utilised to describe how closely each item's score relates to the overall score for all components of the measurement device. Items with values in this range are regarded as suitable, since the item-total correlations for the items in the measuring instrument are anticipated to be in the range of 0.30 and 0.80. The item-total correlation matrix was analysed in the primary research to see if there was any connection on items with values less than 0.3, which do not represent the conceptual framework. This was considered to raise the reliability scale. For the students' and lecturers' data in the current study, item-total correlations were well within the range 0.30 and 0.80. Before deleting an item with a lower threshold value than 0.3, the effect of the deleted item on the alpha value was first investigated. For the alpha value of the item that had little increasing effect, it was preferable not to remove it from the questionnaire. Subsequently in the instruments, the researcher did not do this exercise as all instruments were within the recommended range. In general, when utilising the item-total correlations approach to verify the reliability of a measuring instrument, it is advantageous to assess the correlation after removing the item's contribution to the overall correlation (Sürücü & Maslakçi, 2020).

The Cronbach's Alpha coefficient indicated in Table 4.3 is used to evaluate the validity of the questionnaires utilised in this study. The most popular method for evaluating internal consistency in research is to calculate the alpha coefficient. The Cronbach's alpha coefficient developed by Cronbach (1951) and named for the researcher who originated it, is generally recognised despite this disparity in the literature. It typically falls between 0 and 1, with 0 denoting no relationship between scale parts and 1 denoting complete internal consistency (Tavakol & Dennick, 2011). Alpha values above 0.7 are often considered acceptable and sufficient, above 0.8 are considered quite good, and above 0.9 are considered to indicate great internal consistency (Cronbach, 1951). According to Bryman (2006), Cronbach's Alpha, which merely computes the average of all probable split-half reliability coefficients, is a commonly used indicator of internal reliability. Although there are several interpretations of Cronbach's Alpha in the literature, the commonly accepted method is shown in the table below (Field, 2013).

Table 4. 3: The Classification of Cronbach's Alpha Coefficient

Cronbach's Alpha Coefficient	Interpretation of Cronbach's Alpha Coefficient
$\alpha \geq 0.9$	The scale's internal consistency is excellent or high.
$0.7 \leq \alpha \geq 0.9$	The scale has internal consistency.
$0.6 \leq \alpha < 0.7$	The scale's internal consistency is acceptable.
$0.5 \leq \alpha < 0.6$	The scale's internal consistency is poor.
$\alpha < 0.5$	The scale is inconsistent internally.

The reliability of the students' and lecturers' questionnaires used in the present study was assessed using the Cronbach's Alpha coefficient. The reliability for the students' questionnaire is displayed in Table 4.4., and the lecturers' questionnaire in Table 4.5.

Table 4. 4: Reliability Statistics for the constructs in the students' questionnaire

Section	Constructs	Number of items	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	Cronbach Alpha Value Descriptor
B	Use of technology	5	0.523	0.536	Poor
C	Access to technology	5	0.801	0.803	Good
D	Provisioning of technology training	5	0.837	0.839	Good

E	Provisioning of technology enhanced infrastructure	5	0.879	0.879	Good

After running reliability tests, as indicated in Table 4.4, the construct (Use of technology) does not have sufficient reliability since its Cronbach Alpha value rating is 0.523. This result is accepted as it is because there is no change in the Cronbach's Alpha coefficient even after increasing or decreasing the number of items. The reliability statistics for the lecturers' questionnaire indicated that measuring instrument had sufficient reliability.

Table 4. 5: Reliability Statistics for Lecturers questionnaire

Section	**Constructs**	**Number of participants**	**Cronbach's Alpha**	**Cronbach Alpha Value Descriptor**
B	Use of Technology	97	0.869	Good
C	Access to technology	97	0.674	Acceptable
D	Provisioning of technology training	97	0.786	Good
E	Provisioning of technology enhanced infrastructure	97	0.814	Good

4.7.2 Qualitative Data

The interview questions were initially put through a pilot test to see if they were clear and suitable to the study ideas. Interviewees were requested, for example, to explain the existing ICT infrastructure provisioning at the participating university of technology to support teaching, learning, and assessment, as well as academic administration and support services. They also had to explain the Wi-Fi coverage and signal strength on campus. In addition, respondents were asked whether they had any recommendations for improving technology integration through an e-Learning system. To request an interview, participants received an introduction letter and consent form. To acquire rich interview data, the researcher attempted to set the tone appropriately by first stating the research's goal, the expected duration of the interview session, and that the respondents were free to ask questions. According to Cohen, Manion, and Morris (2011), and Denzin and Lincoln (2011), it is the interviewer's role to create rapport with the participants to get authentic data. The researcher gently probed the participants' responses, followed up on their ideas, and asked open-ended questions flexibly to keep the conversation flowing, while also gaining a better understanding of how each group of respondents viewed the students’ and lecturers' experiences with technology integration in, HE learning and teaching, as well as the uptake of e-Learning platforms in general. Probes are an important aspect of semi-structured interviews because they allow respondents to explain their responses and add more to the answer, addressing concerns such as response comprehensiveness (Cohen et al., 2011; Creswell, 2013). This can take the form of a researcher seeking clarification on a notion that is not adequately expressed.

4.8 Validity of Instruments

When a measuring tool accurately captures the behaviour or quality that it is intended to evaluate, it is said to be valid (Sürücü & Maslakçi, 2020). Validity is determined by the appropriate and appropriate interpretation of the data obtained from the measuring device because of the analysis.

4.8.1 Quantitative Research Validity

While validity in quantitative research refers to the extent to which any measuring instrument measures what it is meant to, validity in qualitative research happens when a researcher employs certain processes to check the correctness of the study findings (Thatcher, 2010; Creswell, 2013). Validity tests are used in this situation to see whether the scale's expressions offer accurate measures for the study's purpose. The measuring device must accurately measure what it promises to for the research to be meaningful (Middleton, 2020). The accuracy of the results generated by the analyses is ensured using approved measuring equipment.

Numerous validity categories have been proposed in the literature to evaluate the accuracy of the measuring devices (Oluwatayo, 2012). Content validity and construct validity are two forms of validity that are frequently acknowledged as being essential in the literature. Content validity is the degree to which the test's questions and their results accurately reflect any possible questions about the subject matter or competence (Creswell, 2012). According to Sürücü and Maslakçi (2020), construct validity describes how effectively an instrument evaluates the concept, behaviour, or quality that it purports to measure.

To fulfil the criterion of validity in the present study, the researcher carried out pilot research using both questionnaires (100 students and 50 lecturers) and interview questions as the current study uses both quantitative and qualitative research design. During the pilot, the questionnaire could be assessed on its length or whether it was difficult to read, gave clear and standard instructions, ensured that all options were provided, presented questions in the correct order, and presented measurement instruments such that there was no ambiguity that could cause the instrument to be misinterpreted by participants. Furthermore, he developed the questionnaire in accordance with the theoretical framework that underpins the current study. A sample group that was sufficiently representative of the population in the sense that the sample group included in the current study was made up of different stakeholders involved in the creation of a sustainable e-Learning environment at the UoT under study was used. The validity of a questionnaire was obtained, according to Cohen et al., (2011), when participants completed surveys to the best of their ability. Questionnaire validity was also obtained by doing repeated follow-up rounds to seek questionnaire returns from participants. It was essential to emphasise the value and advantages of the questionnaire, make personal phone calls to follow up on questions, keep characteristics of the questionnaire, and promote third-party involvement (Hudson & Miller, 2006). The researcher emphasised the relevance of the surveys and their advantages to the participants who were the respondents for this study. Participants were encouraged to complete the questionnaire honestly and accurately. The response rate for the students' questionnaire was 84% and that of lecturers' questionnaire 84.3%.

4.8.2 Qualitative Research Validity

Contrary to quantitative research, which focuses on establishing and using rigorous approaches to ensure the findings' credibility, qualitative research is more concerned with ensuring the validity and reliability of study findings. The following procedures for respondent validation in the qualitative research component of this study to ensure validity was used. In order to acquire rich interview data, set the tone appropriately by first stating the research's goal, the expected duration of the interview session, and that the respondents were free to ask questions was essential to do. The participants' responses were gently probed, followed up on their ideas, and asked open-ended questions flexibly to keep the conversation flowing while also gaining a better understanding of how each group of respondents views the students' and lecturers' experiences with technology integration in higher education learning and teaching, as well as the uptake of e-Learning platforms in general. Probes are an important aspect of semi-structured interviews because they allow respondents to explain their responses and add more to the answer, addressing concerns such as response comprehensiveness (Cohen, Manion &

Morris, 2011; Creswell, 2013). This can take the form of a researcher seeking clarification on a notion that is not adequately expressed.

Participants were asked to comment on the interview transcript and if the concepts and themes that were ultimately generated accurately portrayed the events that were the subject of the inquiry. The explanation to all respondents that the objective of the current research was to benefit students, lecturers, and the university under study was done, so that they would offer true responses. To ensure enough depth and relevance of data collection and analysis, staff members directly involved with the creation of a sustainable e-Learning environment were engaged for identifying sample biases and ongoing critical reflection on methodology. Staff from the Department of Information and Network Technology, the Teaching and Learning Development Centre, middle management (Heads of Departments), and senior management (Deans of faculties) were among those who participated in the semi-structured interviews. By keeping complete records, demonstrating a clear decision-making process, and ensuring that data interpretations were consistent and open, I also contributed to the validation of interviews. Finally, clarity in terms of thinking processes throughout data processing was given and subsequent interpretations, by constructing a comparison case/seeking out similarities and differences between narratives to ensure that diverse views were represented.

4.9 Measures of Trustworthiness

The researcher concentrated on four issues that come from a qualitative method to research as indicators of data trustworthiness. These include dependability, dependability, confirmability, and believability (Korstjens & Moser, 2018). The next paragraphs provide a detailed explanation of how these were ensured.

4.9.1 Credibility

The veracity of research findings affects research's credibility. The degree of trust that can be put in the veracity of study findings (Korstjens & Moser, 2018; Moon, Brewer, Januchowski-Hartley, Adams, & Blackman, 2016). Credibility shows that the topic has been appropriately identified and explained. It also shows that the research was done in a way that is open to the public (Nowell, Morris, White, & Moules, 2017). In other words, credibility determines whether the research's findings are based on the participants' original data. Member checking was used by the researcher to confirm the credibility of this study, by sharing a summary of the study with the participants. Participants were given access to the data after it had been analysed so they could determine whether the researcher's conclusions matched what they had said in interviews. To support the claims, the analysis includes quotes from the participants to represent their viewpoints. Participants' involvement at this stage assisted in removing discrepancies.

4.9.2 Transferability

Transferability is another factor in a qualitative method's credibility. The researcher explicitly described the procedures and environments of this study to make sure it could be repeated in another setting. This required the researcher to clearly explain each step of the research process, including data collecting, the study's context, and the creation of the final report (Houghton, Dymphia, & Shaw, 2013). We refer to this as dense description. It aids in the replication of the study under similar circumstances and yields comparable outcomes in other settings by other researchers. Students, instructors, department heads, faculty deans, and support staff from a South African university of technology made up the study's population. As a result, the other researchers could decide whether the research findings can be applied to their studies. So implies that a subsequent researcher could be able to duplicate the study with identical participant demographics or at a different research location and produce the same outcomes (Lemon & Hayes, 2020). This is only possible, though, provided the contexts meet the same requirements. The researcher believes that given the characteristics of the phenomena under study, its replication at a later period might produce outcomes that are influenced by technical developments.

4.9.3 Dependability

By maintaining an audit trail, the study's dependability criteria were met. To verify the data, this required a review of the inquiry's methodology and result. To demonstrate how the data were gathered, documented, and analysed, the researcher provided an overview of all study decisions and activities (Moon, Brewer, Januchowski-Hartley, Adams, & Blackman, 2016). The computer was used to save the interview tapes, but a password was used to prevent unauthorized users from accessing them. An external hard disk was used to store the audio files so they could not be easily lost or damaged.

4.9.4 Confirmability

By consulting research on the use of e-learning in other nations and maintaining an audit trail, the confirmability of this study was ensured. The researcher gave a trace of the data's source such that the clear reasoning used to analyse the data could be seen and explained how findings and interpretations were formed (Kyngas, Kaariainen, & Elo, 2020; Moon, Brewer, Januchowski-Hartley, Adams, & Blackman, 2016). The researcher recognized some moral standards as being crucial in regulating the conduct between the research participants and the researcher, in addition to trustworthiness serving as one of the research's guiding principles. The discussion of these moral issues follows.

4.10 Ethical Issues

The significance of ethics in social science research has been emphasised by several researchers (Bhattacherjee, 2012; Neuman, 2003; LaFollette, 1994a). Furthermore, these researchers point to qualities of ethical behaviour such as intended involvement, harmlessness, secrecy, confidentiality, and disclosure of the study's objective, outcome, and value to respondents, as examples of ethical behaviour.

For the current study, all procedures regarding ethical issues were followed and an ethical clearance certificate was obtained from the UKZN Ethics Committee, prior to the commencement of data collection. A gatekeeper letter was also acquired from the participating university of technology to urge the population to participate. To maintain secrecy, letters to the participants outlining the study's overall goal and survey instructions were sent. Participants were informed in the letters that their participation was voluntary and that they might withdraw at any time without penalty. Furthermore, the participants were informed that all data obtained as part of this study would be kept confidential, and they granted their consent for the material to be published as long as their professional positions and identities were not revealed.

The privacy and confidentiality of the information provided to respondents were likewise guaranteed. Heads of Department with access to lecturers, and lecturers with access to students were asked for permission and approval. The participants were given the option of participating or declining in the study, and confidentiality was protected by not revealing the individuals' names in the research records. Finally, when reporting the findings, there were no allusions or phrases used to identify them. Instead, each respondent was allocated an alphanumeric code to safeguard their identities.

The participants' right to privacy was respected, thus following all ethical guidelines, including informed permission, anonymity, and secrecy, before, during, and after data collection (BERA 2011). Respondents were asked for their voluntarily informed agreement to participate in the study and be recorded prior to the interviews.

4.11 Limitation of the Study

The data collected from the participants of the current study were adequate to continue with this study in the case of the chosen University of Technology context in South Africa. However, a larger and more diversified group size may provide more insight into strategies for students and lecturers in the learning and teaching using technology. A study that compares students and lecturers using e-Learning platforms in other universities and faculties, for instance, may provide commonalities and differences with the participants in other institutions, and the strategies they have found to overcome barriers. Perceptions may vary from students and lecturers of other faculties and universities of technology. As a result of these limitations, findings from this study could not be generalised. As a result, their perceptions will only be based on what they think is happening in the UoT under study.

4.12 Chapter Summary

This chapter went into great length discussing the research study's methodology and design. The methodology of the study was explained at the beginning of the chapter, along with a philosophical discussion of quantitative and qualitative research. A mixed-methods approach was used to collect the data, which included semi-structured interviews and a questionnaire. The chapter also provided an overview of the data presentation and analysis process. The validity and reliability of the data collection procedures were examined. The ethical concerns raised by the study were then examined.

CHAPTER 5: Analysis of Data from Students' Questionnaire

5.1 Introduction

In this chapter, the findings of the analysis of the information gathered from the student questionnaire is discussed. Students were asked to participate by answering an online survey form. Their questionnaire survey covered the demographic background of respondents and four constructs, namely: use of technology; access to technology; provisioning of training to technology, and provisioning of infrastructure/environment to technology. The students' questionnaire was almost identical to that of the lecturers in terms of dimensions and their associated items. The questionnaire intended to establish a deeper exploration of students' perceptions and experiences on factors impeding their access and use of an e-Learning system. Eight hundred and thirty-five out of one thousand sampled students participated in the current study giving rise to a response rate of 84%.

5.2 Demographic Profile of Student Participants

This section presents Section A of the students' questionnaire survey consisting of demographic information in the current study as indicated in Figure 5.1. The demographic information included gender, age group, qualification type, Faculty they registered in, matriculation education environment, use of technology for learning pre-Covid-19, and their lecturers influence on their use of technology. The participants of the current study are University students who are learning using blended mode, meaning face-to-face combined with technology which is an expected characteristic in most Universities of Technology (UoT) in developing countries like South Africa (SA). In this current study, we indicate the population size by N and the sample size by n.

From the total population (N = 835) based on gender, there are 453 male respondents with a percentage of 54.3% as compared to only 382 female respondents with 45.7% in the current study. From the total population based on the age group the highest frequency of respondents is between the age group (18 – 24) years with a total of 733 (87.8%) followed by >24 years with 93 (11.1%). This is a positive indication of higher education (HE) in a developing country like SA. From the total population based on qualification type (current registration), the majority, 793 (95.0%) of students in this University are registered for a Diploma programme followed by 17 (2.0%) students that are registered for a postgraduate programme. From the results based on the students' Faculty registration, the majority, 539 (58.1%) respondents were from Faculty of Engineering followed by 183 (21.9%) students from Faculty of Natural Sciences. Generally, from this University, Faculty of Management Sciences has the largest number of registered students every year, followed by the Faculty of Engineering. From the overall population based on the type of area their Grade 12 schools are located, the present study's findings showed that the majority, 539 (64.6%) were from the rural school area.

Figure 5. 1: Students Demographics

Also, in Section A of the questionnaire, students were requested to comment about the degree to which they used technology for learning purposes before the Covid-19 pandemic. They were also asked about the extent to which they thought their lecturers expected them to use technology. The results for the two questions are indicated in Figure 5.2. The number of total responses e.g., from the total number of 835 student responses, 331 (39.6%) of respondents responded that they were expected by their lecturers to use technology about half of the time. About 234 (28.0%) of respondents indicated that they were expected by their lecturers to use technology almost always. There were 219 (26.2%) students who indicated that their lecturers expected them to use technology less than half of the time. Only 51 (6.1%) of the students responded that they had never been requested or expected by their lecturers to use technology for learning pre-Covid-19.

Figure 5.2 further indicates the estimation by students of the extent of their use of technology pre-Covid-19 at this institution. Students had to choose from 5 options: very low, never, medium, low, and high. The highest frequency of respondents with a total of 261 (31.3%) indicated that their use of technology before Covid-19 was medium. The second highest group of students with a total 178 (21.3%), indicated that their use of technology pre-Covid-19, was very low, followed by 177 (21.2%) who show that their technology usage before Covid-19 was high. Also, 146 (17.5%) of students indicated that their use of technology pre-Covid-19 was low and only 73 (8.7%) of respondents show that they had never used technology before the start of Covid-19. It is a concern that more than a quarter of the respondents said they did not use technology at all, or their usage was very low. This implies that the students' learning would have been fully dependant on lecture notes and books.

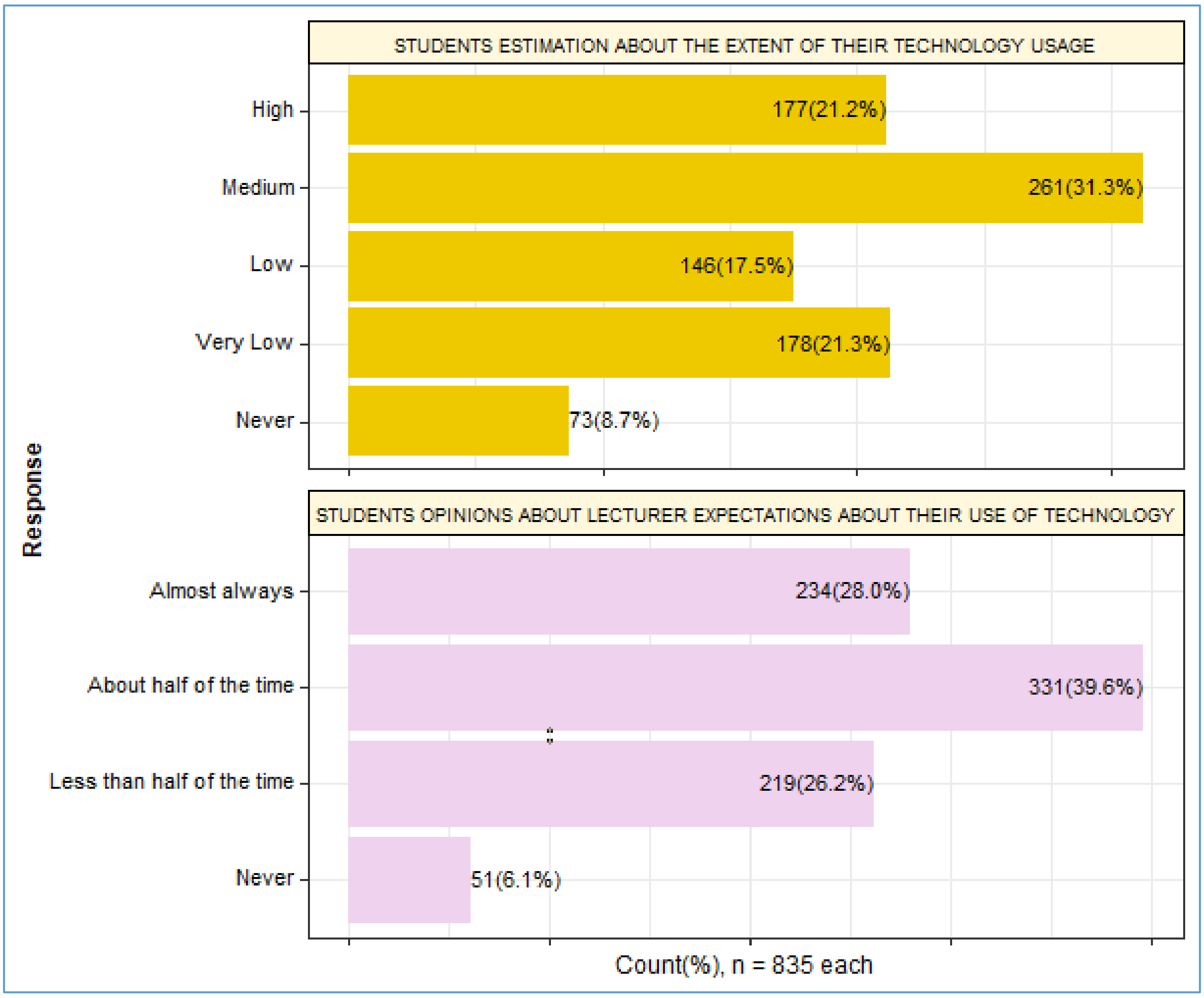

Figure 5. 2: Students Demographics Profile

5.3 Reliability Analysis for Student Questionnaire

For each dimension, Cronbach's coefficient Alpha was calculated to assess the instrument's internal consistency (Devon, Block, Moyle-Wright, Ernst, Hayden, & Lazzara, 2007). Table 5.1 demonstrates Alpha values for the constructs in the students' questionnaire, namely: use of technology, access to technology, provisioning of technology training, and provisioning of technology-enhanced infrastructure to be 0.523, 0.801, 0.837, and 0.879 respectively, which are acceptable levels. In Table 5.1, the reliability test shows the result of Alpha value of the four dimensions range between 0.5 to 0.9. Use of technology dimension has a low reliability value with Cronbach's Alpha value of 0.536 as shown in Table 5.1. In the use of technology construct, students were asked about the extent to which they agree or disagree with each of the five statements with regards to their use of technology in higher education learning and teaching over the past year or so. The Cronbach Alpha in this construct has shown that the 5 statements were not consistently measuring this construct (use of technology) to an acceptable level (i.e., Alpha if Item deleted > 0.40). Similarly, the correlations of each statement with the rest of the other statements were also mostly below the threshold (i.e., r = 0.3). It may have been that the students did not associate their use of technology in social media with their learning and so their interpretations of the statements were not consistent. That is, the responses to the 5 statements do not agree in the assessment of the use of technology in their learning, meaning that other more relevant statements should be developed so that they all together paint a better picture on the use of technology construct.

The reliability of a group of scale, or test items may be assessed using the Cronbach's Alpha metric (Cronbach, 1951). To offer a gauge of a test's or scale's internal consistency, Lee Cronbach created Alpha in 1951; it is represented as a number between 0 and 1. Internal consistency, which measures how closely each item in a test measures the same idea or concept, is connected to how closely the test's components are related to one another. Before a test is utilised for research, its internal consistency should be evaluated to guarantee validity. Additionally, reliability valuations indicate the amount of measurement error in a test.

Table 5. 1: Reliability Statistics for the constructs in the students' questionnaire

Section	Constructs	Number of items	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items
B	Use of technology	5	0.523	0.536
C	Access to technology	5	0.801	0.803
D	Provision of training for technology	5	0.837	0.839
E	Provision of infrastructure for technology	5	0.879	0.879

5.4 Use of Technology

In section B of the questionnaire, students were asked about the extent to which they agree or disagree with each of the statements in Table 5.1 with regards to their use of technology in higher education learning and teaching over the past year or so. Table 5.2 shows that the 5 statements that were considered for assessment of the use of technology did not consistently measure this construct (use of technology) to an acceptable level (i.e., Alpha if Item deleted > 0.40). Similarly, the correlations of each item with the rest of the other items were also mostly below the threshold (i.e., r = 0.3). It may have been that the students did not associate their use of technology in social media with their learning and so their interpretations of the items were not consistent. That is, the responses to the 5 statements do not agree in the assessment of the use of technology in their learning, meaning that other more relevant statements should be developed so that all together they paint a better picture on the use of technology. More research needs to be done to find out more. The items that were grouped together in one construct are expected to be correlated. The Item-rest correlation indicated in Table 5.2, gives a measure of how each item is correlated to the rest of the other items in that construct. This provides a measure of how the item consistently agreed with the other items in the construct. The relationship between an item's score and the sum of the scores on the other items is defined by the item-rest correlation. Higher item-rest correlations indicate that each item does not contribute something unique to the concept, implying multi-dimensionality, whereas low item-rest correlations imply non-discriminating items.

For each item, the Alpha-if-deleted value is also presented. This value was obtained by calculating the coefficient alpha for the dimension when that item is deleted. Each of alpha-if-deleted values was assessed one by one to see if removal of each item at a time would help improve the overall alpha. Hence, if all the alpha values against each item are lower than the overall alpha, then it means that improvement was done to the maximum possible level. In this case, if item B1, is dropped, the overall alpha for the construct will be 0.416 (Table 5.2) which is lower than the current overall alpha of 0.523 (See Table 5.1); hence it is not worth removing the item. It can be concluded that the inclusion of item B1 increases the reliability of the construct. Hence, even if the current overall is 0.5 and lower than acceptable 0.7, we will not do anything further to improve its Cronbach Alpha. An attempt to drop any item will lower the current highest achieved Alpha of 0.5, because all alpha values corresponding to each item are what the overall will be if that item is dropped.

Table 5. 2: Use of Technology

Section B	Statements	Item-rest correlation	Alpha if Item deleted
B1	I have used technology for learning purposes	0.328	0.416
B2	I have used social networking technologies. (Facebook, Twitter) for learning purposes	0.202	0.494
B3	I have used WhatsApp for learning purposes	0.284	0.440
B4	I have regularly made use of computers in the University's open labs	0.332	0.405
B5	I have regularly logged into the WIFI on campus	0.248	0.467
	Overall	-	0.500

Figure 5.3 indicates the response to the statements about the extent to which students used technology for their learning over the past year or so from the quantitative results. Evidence in Figure 5.3 clearly indicates that the majority, (73%) of the respondents had used WhatsApp for learning purposes, followed by (66%) which indicated that they used technology for learning as well. As can be seen from Figure 5.3, (51%) regularly used University computers for learning purposes. Most respondents, (34%) disagreed with the use of social networking technologies (Facebook, Twitter) for learning purposes together with, (34%) who indicated that they did not regularly log into campus Wi-Fi. The lack of experience in using social networking technologies and failure to log on to campus Wi-Fi could be because of poor students' technology skills, which eventually could seriously affect their attitudes and perspectives to the integration of technology to learning.

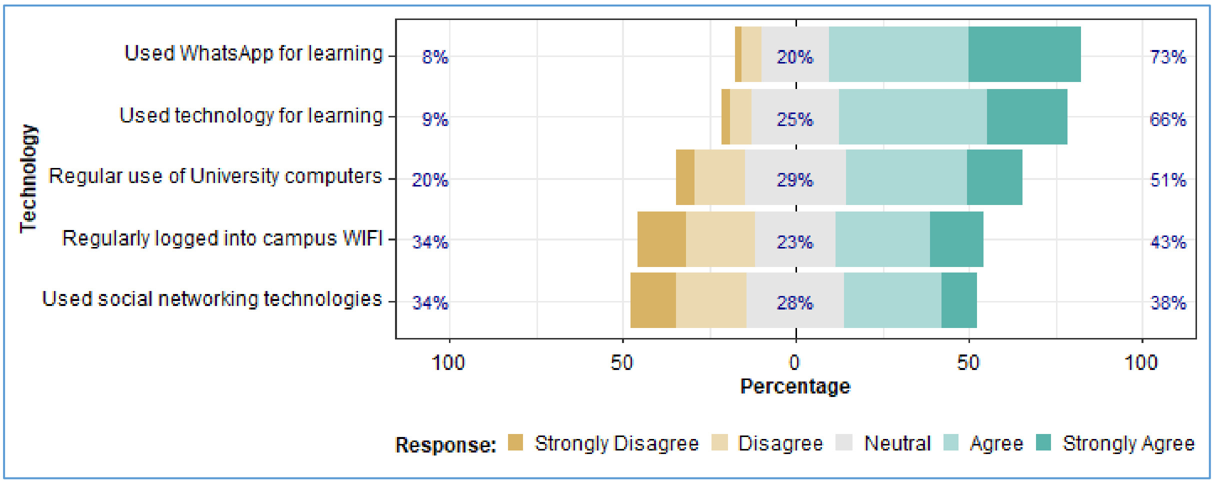

Figure 5. 3: Students' experiences in the use of technology in learning and assessment

In general, students agreed to having used technology for learning, and to using WhatsApp for learning purposes as reflected in Figure 5.4. However, regular use of university computers, and use of social networking technologies were rated as neutral. Of the 5 items that were used to assess the use of technology from the students' quantitative data, the most popular response was "Agree" amounting to 42.4% (mean = 3.78) of the participants who were in support of using technology for learning. This was followed by 40.2% (mean = 3.95) of participants who also agreed that they had used WhatsApp for learning purposes. However, the highest proportion aggregating to 28.9% (mean = 3.41) and 28.0% (mean = 3.02) of participants were neutral regarding the regular use of university computers and using social networking technologies respectively. "Regular use of university computers" had the highest mean value (3.41). Therefore, this is the most cited barrier or enabling factor for the successful integration of technology through the e-Learning system.

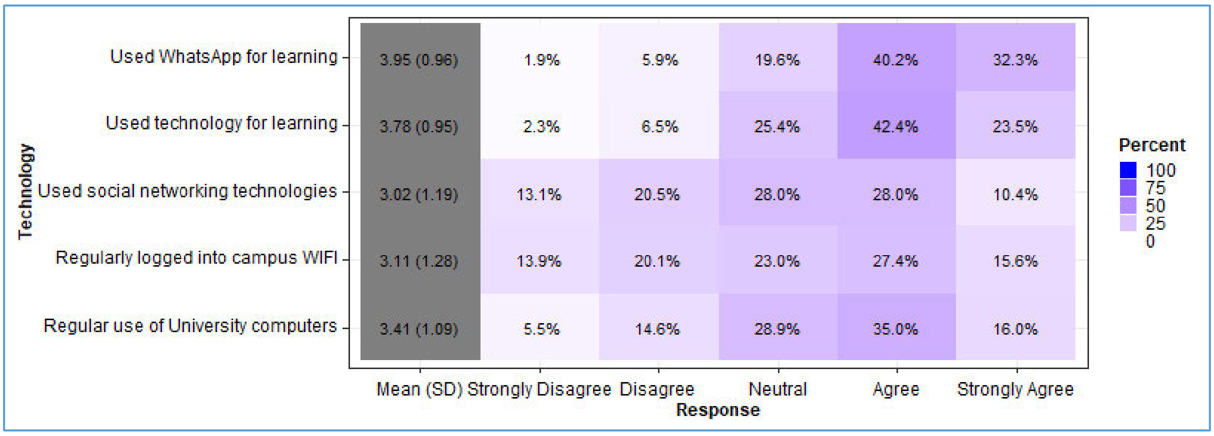

Figure 5. 4: Heat map on the use of technology in learning and assessment

5.5 Access to Technology

In section C of the questionnaire, students are given an opportunity to comment on the degree to which they agree or disagree with each of the statements in Table 5.3 based on their access to technology. The results of the analysis of participants in Table 5.3, shows that the 5 statements considered for assessment of the access to technology consistently measured this construct (use of technology) to an acceptable level (that is, Alpha if Item deleted > 0.70). Similarly, the correlations of each item with the rest of the other items were all above the threshold (that is, r > 0.3). That is, all 5 statements agree in the assessment of the access to technology, meaning that all the statements agree with each other and therefore indicate a better picture on the access to technology.

Table 5. 3: Access to technology

Section C	**Statements**	**Item-rest correlation**	**Alpha if Item deleted**
C1	My university has made the resources (adequate computers, and Internet connectivity for students) available.	0.565	0.759
C2	There is sufficient access to the Internet in lecture rooms.	0.532	0.769
C3	Our university has available space (Lecture rooms or dedicated computer laboratories with Internet access for students).	0.635	0.735
C4	There is sufficient access to ICT resources including hardware and software.	0.607	0.747
C5	My university has made sufficient provision for	0.539	0.766

	uninterruptible power supply for use during power cuts.		
	Overall	-	0.794

Data analysis on students' access to technology when they were asked to indicate their extent of agreement and or disagreement with each of the 5 statements is depicted in Figure 5.5. Concerning access to technology in higher education teaching and learning environment, most, (44%) students reported that they had adequate computers and Internet connectivity at the University. About, (43%) students at this University reported that they have access to technology available in their lecture and computer rooms. Interestingly, most, (47%) strongly disagree that they have sufficient Internet access in their lecture rooms. In addition, (40%) of students at the University reported that there was interruptible power supply during power cuts.

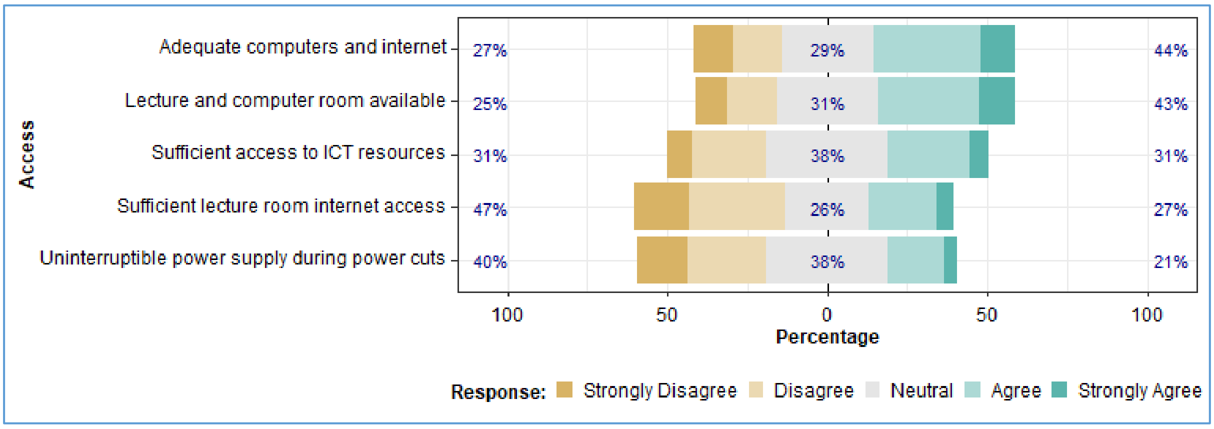

Figure 5. 5: Students access to technology in the institution

Most students were neutral on all the 5 statements in Figure 5.6 since their average mean was close to 3 from the left of 3. Their level of ambiguity, however, differed per item. The highest mean proportion amounting to 33.7% (mean = 3.16) of participants, agreed with adequate computers and Internet. Hence, it is considered as the most cited barrier or enabling factor for the successful integration of technology through the e-Learning system. The most popular response was "Neutral," which accounted for 38.2% (mean = 2.69) of the participants who were uncertain about uninterruptible power supply during power outages, followed by 38.1% (mean = 2.98) of participants who were uncertain about sufficient access to ICT resources.

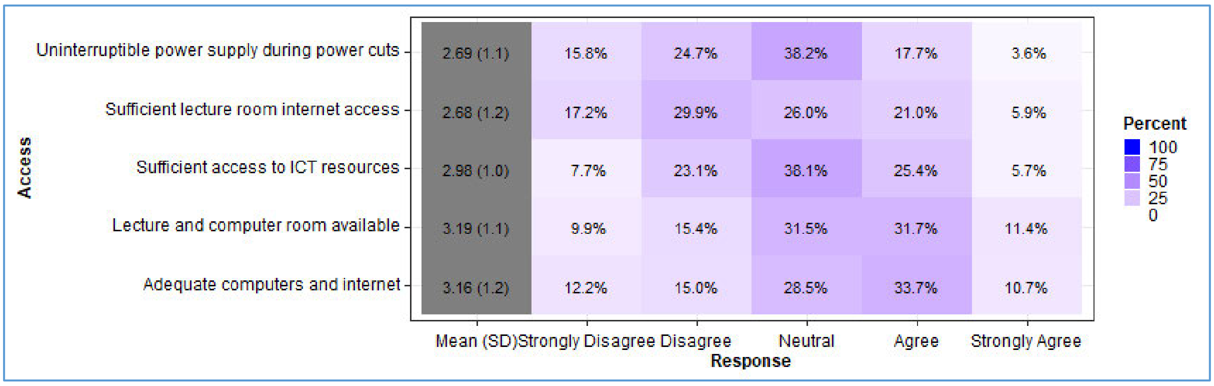

Figure 5. 6: Heat map on the access to technology in learning and assessment

5.6 Provisioning of technology training for students

In section D of the questionnaire, students were asked about the extent to which they agree or disagree with each of the statements in Table 5.4 regarding the provision of technology training. The results revealed that the 5 statements considered for assessment of the provision of technology training for students were reliable (that is, Alpha if Item deleted > 0.70). Similarly, the correlations of each item with the rest of the other items were also mostly above the threshold (that is, r > 0.3). That is, all 5 statements agreed in the assessment of the provision of training to technology for students.

Table 5. 4: Student provisioning of training on technology

Section D	**Statements**	**Item-rest correlation**	**Alpha if Item deleted**
D1	Our university does not offer adequate training and/ or support in using Internet to search for learning materials.	0.537	0.826
D2	Training courses in new devices, modern technologies using e- Learning is lacking at the university.	0.660	0.792
D3	There is a lack of training in using university learning management systems such as (Blackboard, Moodle, Google classroom etc.	0.659	0.791
D4	There is lack of training on usage of social media for learning.	0.679	0.786
D5	There is lack of training on how to use technology devices for learning (Cell phone, IPads, Laptops, etc.).	0.631	0.799
	Overall	-	0.832

Figure 5.7 presents students' reflection on the provision of technology training when they were requested to indicate their extent of agreement and or disagreement with each of the 5 statements. The results analysis shows that the majority, (56%) of respondents indicated that there was a lack of training in the e-Learning system. Similarly, most, (45%) of respondents indicated that training in social media for learning was lacking. Training in the use of a learning management system available at this University was lacking based on (44%) of the respondents. Following on this, (43%) of respondents indicated a lack of training on how to use technology devices for learning (Cell phone, IPads, Laptops, etc.).

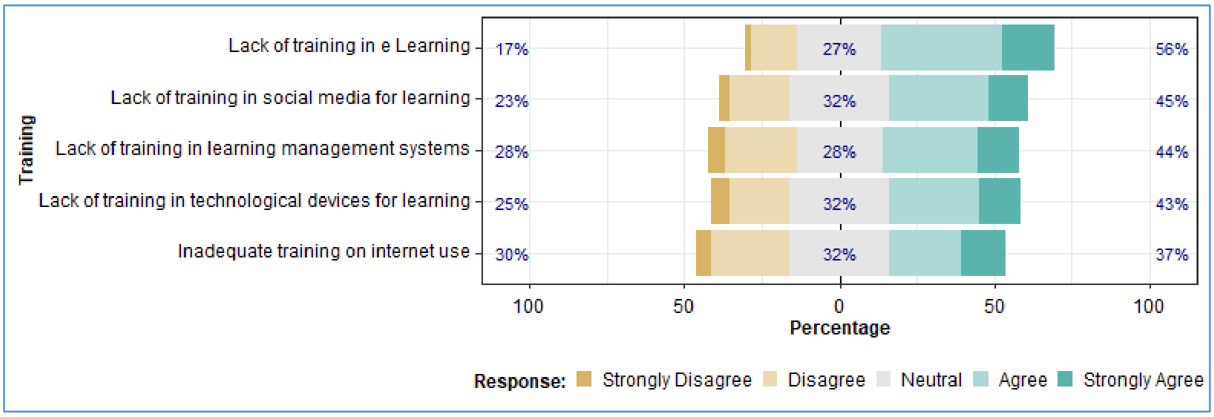

Figure 5. 7: Provisioning of technology training for students

The shortage of training courses in new devices, modern technology, and e-Learning was generally agreed upon by students at this university. On the other hand, a lack of training in using technical devices for learning, inadequate Internet training, and the lack of training in using social media for learning were assessed as neutral. The most popular response among the five items used to assess the students' provisioning of technology training construct from quantitative data was "Agree" which accounted for 39.2% (mean = 3.54) of the participants in favour of a shortage of training courses in new gadgets, contemporary technologies, and e-Learning. In addition, the biggest percentages of participants aggregating to 25.4% (mean = 3.16) and 23.1% (mean= 3.23) disagreed with inadequate Internet training and a lack of training in learning management systems, respectively. "Lack of training in the e-Learning system" has the highest mean value (3.54). Therefore, it is considered the most cited factor. However, "Inadequate training on Internet use" had the least mean value (3.16) which is the least cited barrier and enabler factor for the successful integration of technology in the e-Learning system.

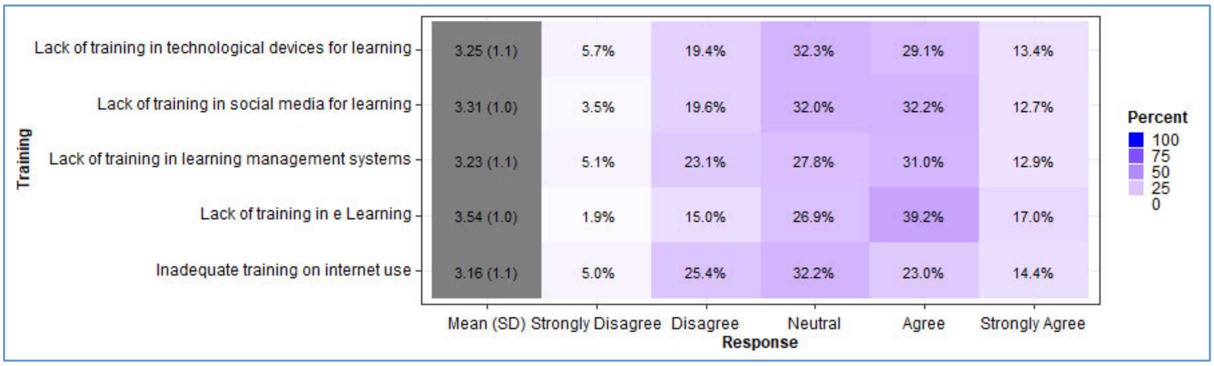

Figure 5. 8: Heat map on the students' provision of training to technology

5.7 Provisioning of Technology Enhanced Infrastructure for Students

Section E in the students' questionnaire, was the final section. Students were asked about the extent to which they agree or disagree with each of the statements in Table 5.5 regarding their provisioning of technology-enhanced infrastructure. Table 5.5 reveals that the 5 statements considered for assessment of the provision of technology infrastructure for students consistently measured this construct to an acceptable level (that is, Alpha if Item deleted > 0.80). Similarly, the correlations of each item with the rest of the other items were also mostly above the threshold (that is, r > 0.3). That is, all 5 statements do agree in the assessment of the provision of technology infrastructure to students.

Table 5. 5: Provisioning of technology enhanced infrastructure for students

Section E	**Statements**	**Item-rest correlation**	**Alpha if Item deleted**
E1	I am satisfied with the availability of computer labs/classrooms.	0.733	0.841
E2	Classrooms are configured in a way that promotes learning using technology.	0.715	0.846
E3	I am satisfied with the range of technologies available for learning.	0.774	0.833
E4	Computers in the labs/classrooms are always working and are in good condition.	0.671	0.856
E5	I am satisfied with the printing functionality available for students.	0.634	0.866

	Overall	-	0.875

Figure 5.9 shows the frequency of participants who indicated the extent to which they agree or disagree with each of the 5 statements on the provisioning of infrastructure as a potential obstacle to implementing an e-Learning system. According to Figure 5.9, majority, (51%) indicated that there is no printing functionality available for students' use followed by (46%) of respondents who indicated that computer labs and classrooms are not always in good working condition. About, (45%) of respondents were unsatisfied with the technologies available for learning purposes in this University.

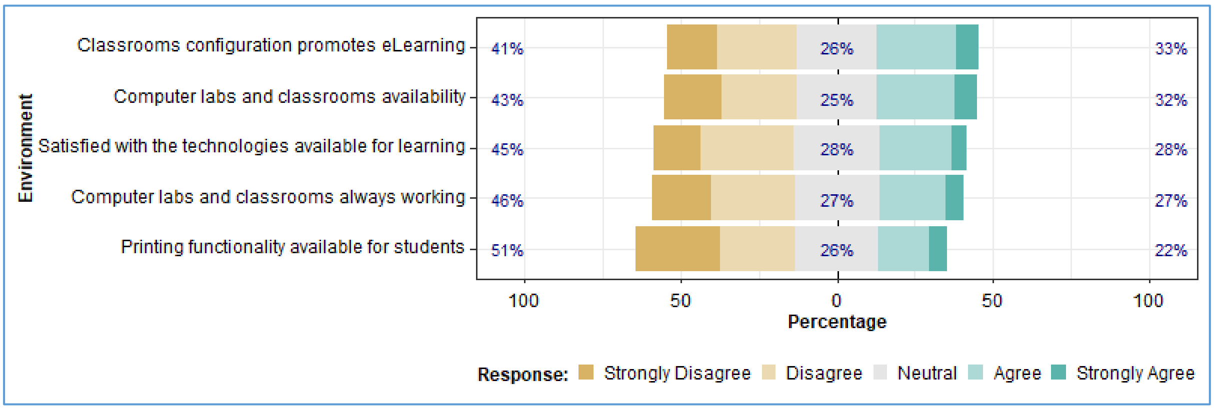

Figure 5. 9: Provisioning of technology enhanced infrastructure for students

Essentially in all 5 items in Figure 5.10, students were neutral. Their level of disbelief, however, differed by item. The most popular response to the 5 items used to assess the provisioning of technology enhanced infrastructure to students construct from the student's quantitative data was "Disagree". This represented 29.7% (mean = 2.73) of the participants who were dissatisfied with the technologies available for learning, followed by 26.6% (mean = 2.68) who indicated that computer labs and classrooms are not always in a good working condition. It can be concluded from the data in Figure 5.10 that among all the respondents, "Classrooms configuration promotes e-Learning" has the highest mean value (2.83). Therefore, it is considered as the most cited barrier and enabler factor. "Printing functionality available for students" having the least mean value (2.49) is the least cited barrier and enabler factor for the successful integration of an e-Learning system.

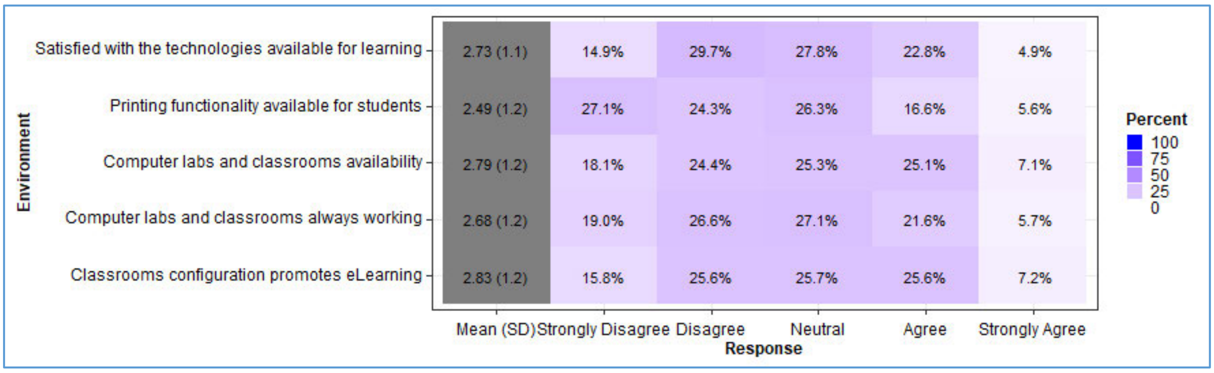

Figure 5. 10: Heat map on the provisioning of technology enhanced infrastructure

5.8 Probability of Students Satisfied with the Technologies Available for Learning

To identify risk factors in terms of unadjusted odds ratios (OR), statistical analysis was performed. Table 5.6 shows several important criteria that influence the integration of technology in learning and teaching, as well as the acceptability of an e-Learning platform. A logistic regression analysis was performed to investigate the main independent factors impacting technology integration, and numerous elements were identified as the most important indicators affecting technology integration**.** The odds ratio (OR) is a measurement of the strength of the correlation between an exposure and a result. If the OR is greater than one, there is a stronger correlation between the exposure and the result. There is no correlation between exposure and outcome if the OR is equal to one. If the OR is less than one, the exposure and outcome are less likely to be connected.

Table 5. 6: Predicting likelihood of students satisfied with the technologies available for learning = Agree

Explanatory	OR(CI,p-value)Unadj	OR(CI,p-value)FullAdj	OR(CI,p-value)BackStep
Gender Male	1.23 (0.87-1.73, p=0.237)	1.16 (0.48-2.82, p=0.742)	-
Age>24yrs	0.48 (0.24-0.88, **p=0.024**)	2.20 (0.47-9.69, p=0.303)	-
Current registration Diploma	0.13 (0.03-0.40, **p=0.001**)	0.02 (0.00-12.64, p=0.611)	0.02 (0.00-18.59, p=0.681)
Current registration Degree	0.09 (0.01-0.52, **p=0.014**)	0.00 (0.00-0.27, p=0.269)	0.00 (0.00-0.40, p=0.369)
Faculty Management Sciences	0.56 (0.35-0.87, **p=0.012**)	2.14 (0.78-6.09, p=0.144)	2.25 (0.85-6.17, p=0.107)
Faculty Natural Sciences	0.27 (0.15-0.45, **p<0.001**)	0.37 (0.07-1.66, p=0.219)	0.32 (0.06-1.38, p=0.148)
Grade 12 location Rural	0.94 (0.67-1.34, p=0.750)	0.35 (0.14-0.84, p=0.021)	0.32 (0.13-0.73, **p=0.008**)

Used technology for learning Agree	2.90 (1.94-4.44, **p<0.001**)	18.11 (6.00-63.73, p<0.001)	17.31 (6.09-56.34, **p<0.001**)
Used social networking technologies Agree	1.88 (1.34-2.65, **p<0.001**)	0.69 (0.28-1.64, p=0.410)	-
Used WhatsApp for learning Agree	1.92 (1.27-2.97, **p=0.002**)	2.97 (0.97-10.06, p=0.067)	3.11 (1.06-10.14, **p=0.047**)
Regular use of university computers Agree	1.77 (1.26-2.51, **p=0.001**)	0.43 (0.18-1.02, p=0.060)	0.42 (0.18-0.96, **p=0.043**)
Regularly logged into campus WIFI Agree	1.28 (0.91-1.80, p=0.148)	0.47 (0.19-1.13, p=0.096)	0.43 (0.19-0.95, **p=0.041**)
Adequate computers and Internet Agree	5.67 (3.91-8.36, **p<0.001**)	11.35 (4.41-33.00, p<0.001)	11.19 (4.57-30.65, **p<0.001**)
Sufficient lecture room Internet access Agree	4.19 (2.92-6.01, **p<0.001**)	1.60 (0.67-3.85, p=0.291)	-
Lecture and computer room available Agree	3.63 (2.56-5.20, **p<0.001**)	0.25 (0.10-0.59, p=0.002)	0.28 (0.11-0.64, **p=0.003**)
Sufficient access to ICT resources Agree	6.57 (4.57-9.50, **p<0.001**)	2.29 (0.95-5.67, p=0.069)	2.42 (1.08-5.54, **p=0.033**)
Uninterruptible power supply during power cuts Agree	4.10 (2.81-5.98, **p<0.001**)	1.03 (0.39-2.63, p=0.953)	-
Inadequate training on Internet use Agree	0.68 (0.47-0.97, **p=0.038**)	2.36 (0.79-7.57, p=0.134)	2.05 (0.77-5.70, p=0.157)
Lack of training in e Learning Agree	0.51 (0.36-0.72, **p<0.001**)	0.62 (0.24-1.60, p=0.328)	-
Lack of training in learning management systems Agree	0.56 (0.39-0.79, **p=0.001**)	0.41 (0.15-1.11, p=0.085)	0.39 (0.16-0.92, **p=0.035**)
Lack of training in social media for learning Agree	0.76 (0.54-1.07, p=0.124)	0.63 (0.22-1.74, p=0.378)	-
Lack of training in technological devices for learning Agree	0.75 (0.53-1.05, p=0.097)	1.48 (0.54-4.19, p=0.454)	-
Computer labs and classrooms availability Agree	46.52 (28.43-79.62, **p<0.001**)	123.36 (42.05-441.86, p<0.001)	102.54 (36.77-346.26, **p<0.001**)
Classrooms configuration promotes eLearning Agree	28.59 (18.33-45.94, **p<0.001**)	42.31 (15.52-139.40, p<0.001)	45.28 (17.40-140.17, **p<0.001**)
Computer labs and classrooms always working Agree	9.81 (6.73-14.45, **p<0.001**)	8.45 (3.38-23.23, p<0.001)	7.76 (3.38-19.03, **p<0.001**)
Printing functionality available for students Agree	11.93 (8.05-17.87, **p<0.001**)	17.06 (6.48-50.51, p<0.001)	17.55 (7.03-48.60, **p<0.001**)

5.9 Exploring Differences in Perceptions according to the Factors of Age, Gender, Qualification and Faculty

The likelihood of students being satisfied with the learning technologies provided at the participating university, was calculated using an odd ratio as shown in Table 5.6. In this section we do not necessarily focus on one dimension, however, the angle at which the odds look at just happen to need (and makes sense with), the singled-out variable which happens to have been in the dimension related to satisfaction. The main idea behind the odds ratio in the current study is to ascertain the likelihood of the participants being satisfied. In essence, the odds look at the factors associated with satisfaction. It must be noted that the structural equation model (SEM) is concerned with the constructs and the odds is a different angle that has nothing to do with constructs. Basically, the odds add another layer of robustness in interrogating our data. The odds tell another story that complements the limitation of the SEM.

5.9.1 Odds Ratio (OR) < 1

Odds ratio **(OR) < 1** is interpreted as less likely, e.g, OR = 0.67 means 33% less likely. Please note that if the OR < 1, it is interpreted in percentages. The 0.67 is the same as 67% but for OR<1 we look at how much the 67% has dropped from 100%. That drop, which is 33%, is what we interpret. It is important that we first look at the p-value before any interpretation. For a p-value > 0.05, it means there is no significant difference in the odds being compared. That is, for p-value > 0.05, the OR is not significantly different from 1.

Based on Table 5.6, the chances for males and females being satisfied with the available technologies for learning are not significantly different (p = 0.237). Students above the age of 24 years were 52% less likely to be satisfied with the available technologies for learning when compared to those under the age of 24 years [OR (95%CI, p-value) = 0.48 (0.24-0.88, p=0.024)]. When compared to the Faculty of Engineering students, the students from the Management Sciences Faculty were 44% less likely to be satisfied [OR(95%CI,p-value) = 0.56 (0.35-0.87, p=0.012)] with the technologies available for learning, whilst those from the Faculty of Natural Sciences were 73% less likely to be satisfied [OR(95%CI,p-value) = 0.27 (0.15-0.45, p<0.001)]

5.9.2 Odds Ratio (OR) = 1.q

Odds ratio **(OR) =** 1.q: where q is just digits after the coma, for example, 1.92 the digits after the coma are 92 which are then referred to as q. To interpret the 1.92, we simply focus on the 92 and that means, 92% more likely.

The students' results analysis in Table 5.6, shows that students who used WhatsApp for learning were 92% more likely to be satisfied with available technologies [OR (95%CI, p-value) = 1.92 (1.27-2.97, p=0.002)] than those who did not use WhatsApp. It further indicates that the students at the University who felt that the computers and Internet connectivity were adequate, were also almost 6 times more likely to be satisfied with the available technologies [OR (95%CI, p-value) = 5.67 (3.91-8.36, p<0.001)] than those who felt that the computers and

Internet connectivity were not adequate. The students who were currently registered for a degree programme have 91% chance to be unsatisfied [OR (95%CI, p-value) = 0.09 (0.01-0.52, p=0.014)] than the certificate. Please note that the current programme registration was collapsed into three categories (certificate, diploma and degree) with certificate being the reference.

5.9.3 Odds Ratio (OR) > 1:

Odds ratio **(OR)** > 1 simply implies more likely.

The analysis of students' results in Table 5.6 shows that participants who agreed on the availability of computer labs and classrooms were almost 47 times more likely to be satisfied with the technologies available for learning, than those who did not agree. Without adjusting for other factors, as expected, the students who agreed on the computer labs and classrooms availability were 47 times more likely to be satisfied by overall technology resources on campus learning [OR (95%CI, p-value) = 46.52 (28.43-79.62, p<0.001)]. Upon adjusting for the other factors under investigation, the same group of students who agreed, were 123 times more likely to be satisfied with the overall technology resources learning [OR (95%CI, p-value) = 123.36 (42.05-441.86, p<0.001)]. However, upon adjusting for the most important factors, it turns out that the students who were happy about the availability of computer labs and classrooms, were actually 103 times more likely to be satisfied with the overall setting of the technology resources at university participating in this study [OR (95%CI, p-value) = 102.54 (36.77-346.26, p<0.001)]. Similarly, some participants agreed that their classroom configuration promotes an e-Learning system. Without adjusting for other variables, students who were content with their classroom technology layout were 29 times more likely to be satisfied with the overall classroom arrangement [OR (95 % CI, p-value) = 28.59 (18.33-45.94, p<0.001)]. After controlling for the other variables, the same group of students who agreed, were 42 times more likely to be satisfied with the overall classroom arrangement that encourages e-Learning [OR (95 % CI, p-value) = 42.31 (15.52-139.40, p<0.001). When the most important factors were taken into account, it was discovered that students who were happy with the classroom configuration were 45 times more likely to be satisfied with the overall setting of the classroom configuration at the university participating in this study [OR (95 % CI, p-value) = 45.28 (17.40-140.17, p<0.001)].

The level of differences in participants' perceptions in the four constructs is considered in relation to the factors mentioned above. Each construct consisted of five items each measured on a Likert scale. The options ranged from "Strongly Disagree" = 1 to "Strongly Agree" = 5, such that the highest possible score is 25 where a participant would have responded with a "Strongly Agree" for each of the 5 items in a dimension. That is, the higher the score for a dimension, the higher the possibility that the participants agreed with the items of that dimension. For the reason that the data was believed to be regularly distributed, the Rank-sum test and Kruskal-Wallis's test was preferred for determining the strength of the link between variables.

The Rank sum test has been described as an instrument used in hypothesis testing when two independent samples are drawn from the same population. This is a non-parametric test used when the outcome is not normally distributed. The test process leads to the tests comparing the medians and the distributions of the two independent samples (Békés & Doorn, 2020). The Kruskal-Wallis's test is a non-parametric method utilised as a test for discovering whether samples originated from the same distribution. Kruskal-Wallis's test does not assume a normal distribution of the underlying data (Richardson, 2018). The Kruskal–Wallis one-way analysis of variance by ranks has been developed to be utilised in situations in which one or more of these assumptions is/are not met**.** It is important that the researcher is aware of a number of different conditions that need to be met during the planning and implementation of the test. The samples drawn from the population need to be independent of each other.

5.9.2 Differences in Perceptions According to Age Group

In the University of Technology context, there is a wide range of age group because many students enrol after they have already been in the world of work. They usually get sponsored to join the university education. The researcher in the present study was therefore interested to check whether maturing (age) made a difference to the outcome. Table 5.7 shows the total score of the Likert scale for each participant. In looking at differences according to age, two groups of students were considered: those who were less than or equal to 24 years old and those who were over 24 years old. The results show that there are no statistically significant differences by age group for the constructs: use of technology and provisioning of technology training, with the median score of 15.0 and 14.0 respectively, out of the maximum possible 25. There are statistically significant differences in the total scores between male and female participants for the constructs: access to technology (p = 0.001) and provision of technology enhanced infrastructure (p = 0.001).

Table 5. 7: Significant differences by age

Age	<=24yrs (N=742)	>24yrs (N=93)	p-value	Overall (N=835)
Use of technology			0.259	
Median(Q1-Q3)	17.0(15.0-19.8)	17.0(15.0-20.0)	Ranksum	17.0(15.0-20.0)
Min-Max	5.00-25.0	10.0-25.0		5.00-25.0
Access to technology			<0.001	
Median(Q1-Q3)	15.0(12.0-17.0)	13.0(10.0-16.0)	Ranksum	15.0(12.0-17.0)
Min-Max	5.00-25.0	5.00-24.0		5.00-25.0
Provisioning of technology training			0.053	
Median(Q1-Q3)	17.0(14.0-19.0)	18.0(15.0-20.0)	Ranksum	17.0(14.0-19.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced infrastructure			<0.001	
Median(Q1-Q3)	14.0(10.0-17.0)	11.0(8.00-15.0)	Ranksum	14.0(10.0-17.0)
Min-Max	5.00-25.0	5.00-24.0		5.00-25.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

The parallel plot in Figure 5.11 indicates the experiences of students' $\leq$ 24 years of age and those > 24 years of age indicated their experiences on measured attributes. Students $\leq$ 24 years of age, mostly agreed on items on environment, access and technology. Conversely, this was not true for students > 24 years who were mostly not in support.

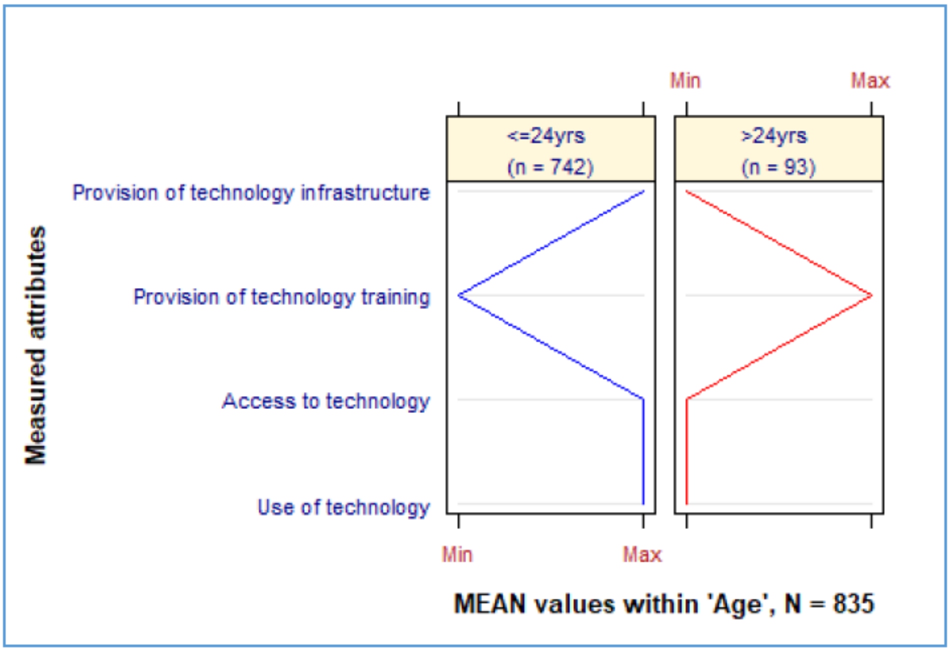

Figure 5. 11: The parallel plot for the mean values with students' age

5.9.2 Differences in Perceptions According to Gender

In investigating, the participants were mainly in agreement with the items on 'Use of technology' and 'Provisioning of technology training' (median score = 17.0/25) followed by 'Access to technology' and 'Provisioning of technology enhanced infrastructure' (median score = 15.0 and 14.0 respectively out of a maximum possible 25). However, for the dimensions: access (p=0.008), there was a statistically significant difference in total scores between male and female participants.

Table 5. 8: Statistically significant differences by students' gender

Gender	Male (N=453)	Female (N=382)	p-value	Overall (N=835)
Use of technology			0.038	
Median(Q1-Q3)	18.0(16.0-20.0)	17.0(15.0-19.0)	Ranksum	17.0(15.0-20.0)
Min-Max	5.00-25.0	7.00-25.0		5.00-25.0
Access to technology			0.008	
Median(Q1-Q3)	16.0(12.0-18.0)	15.0(12.0-17.0)	Ranksum	15.0(12.0-17.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of Technology training			0.113	

Gender	Male (N=453)	Female (N=382)	p-value	Overall (N=835)
Median(Q1-Q3)	17.0(14.0-20.0)	17.0(14.0-19.0)	Ranksum	17.0(14.0-19.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced infrastructure			0.095	
Median(Q1-Q3)	14.0(10.0-17.0)	13.0(10.0-17.0)	Ranksum	14.0(10.0-17.0)
Min-Max	5.00-25.0	5.00-24.0		5.00-25.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

In Figure 5.12, analysis of the students' results based on gender regarding their perception on the 'Utilisation of technology in learning' indicates that females are not satisfied with 'Provisioning of technology enhanced infrastructure', 'Provisioning of technology training', 'Access to technology' and Use of technology'. In contrast, of the 835 participants, the 453 male students were satisfied.

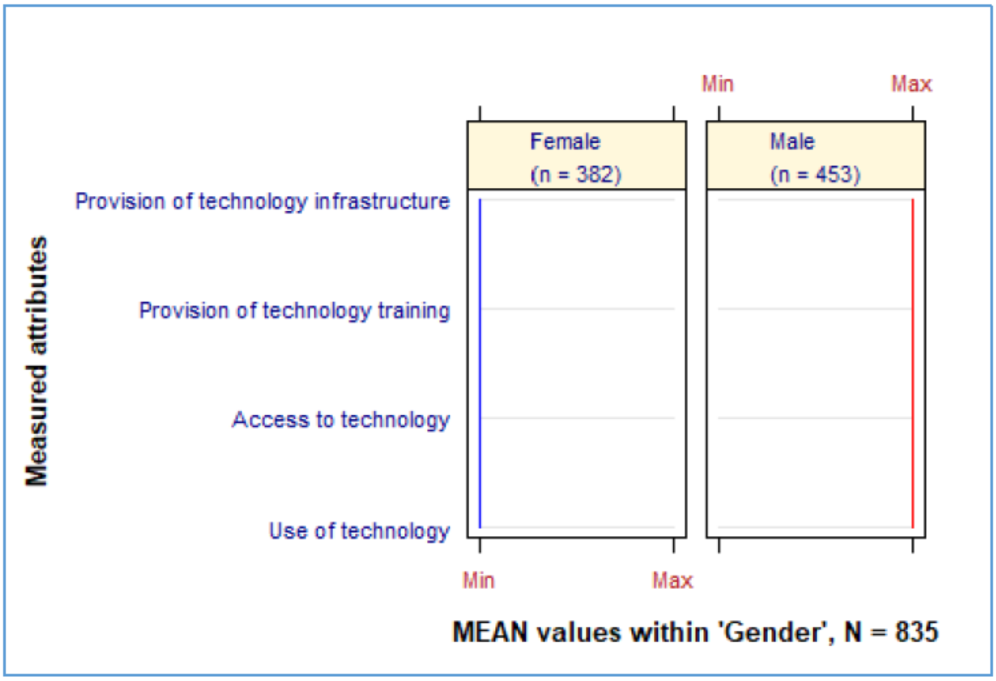

Figure 5. 12: The parallel plot for the students means values within gender

5.9.3 Differences in Perceptions According to Grade 12 Location

Results in Table 5.9 shows that participants from urban and rural areas were mostly in agreement with the items on ‘Use of technology’ and ‘Provisioning of technology training’ (median score = 17.0/25), followed by ‘Access to technology’ and ‘Provisioning of technology enhanced infrastructure’, with the median score of 15.0 and 14.0 respectively, out of the maximum possible 25. There was no statistically significant difference in the total scores between the participants from urban and rural areas for the dimensions: use of technology (p=0. 706), access to technology (p = 0.116), provisioning of technology training (p = 0.811) and provisioning of technology enhanced infrastructure (p = 0.066).

Table 5. 9: Statistically significant differences in students Grade 12 location

Grade 12 location	Urban (N=296)	Rural (N=539)	p-value	Overall (N=835)
Use of technology			0.706	
Median(Q1-Q3)	17.0(15.0-20.0)	17.0(15.0-19.0)	Ranksum	17.0(15.0-20.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Access to technology			0.116	
Median(Q1-Q3)	15.0(11.0-17.0)	15.0(12.0-17.0)	Ranksum	15.0(12.0-17.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology training			0.811	
Median(Q1-Q3)	17.0(14.0-19.0)	17.0(14.0-19.0)	Ranksum	17.0(14.0-19.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced infrastructure			0.066	
Median(Q1-Q3)	13.0(10.0-16.0)	14.0(10.0-17.0)	Ranksum	14.0(10.0-17.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

5.9.4 Differences in Perceptions According to the Qualification Type (current registration)

The entire Likert scale score for each participant is displayed in Table 5.10 with “Strongly Disagree” = 1 and “Strongly Agree” = 5, giving a maximum score of 25 if a participant answered “Strongly Agree” for each of the five dimensions. That is, the higher the score for a dimension, the higher the possibility that the participants agreed with the items of that dimension. The results in Table 5.10 reveal that the participants are mostly in agreement with the items on 'Use of technology' and 'Provisioning of technology training' (median score = 17.0/25) each followed by 'Access to technology' and 'Provisioning to technology enhanced infrastructure', with a median score of 15.0 and 14.0 respectively out of the maximum possible 25. However, there was a statistically significant difference in the total scores in the students' current registration for the constructs: access to technology ($p = 0.006$) and provision of technology infrastructure ($p < 0.001$).

Table 5. 10: Statistically significant differences in students' current registration

Current registration	Certificate (N=13)	Diploma (N=805)	Degree (N=17)	p-value	Overall (N=835)
Use of technology				0.373	
Median(Q1-Q3)	18.0(16.0-25.0)	17.0(15.0-19.0)	19.0(15.0-20.0)	Kruskal	17.0(15.0-20.0)
Min-Max	13.0-25.0	5.00-25.0	13.0-24.0		5.00-25.0
Access to technology				0.006	
Median(Q1-Q3)	18.0(14.0-25.0)	15.0(12.0-17.0)	16.0(15.0-21.0)	Kruskal	15.0(12.0-17.0)
Min-Max	13.0-25.0	5.00-25.0	9.00-22.0		5.00-25.0
Provisioning of technology training				0.149	
Median(Q1-Q3)	18.0(15.0-25.0)	17.0(14.0-19.0)	15.0(12.0-18.0)	Kruskal	17.0(14.0-19.0)
Min-Max	10.0-25.0	5.00-25.0	10.0-23.0		5.00-25.0
Provisioning of technology enhanced infrastructure				<0.001	
Median(Q1-Q3)	18.0(14.0-25.0)	13.0(10.0-17.0)	18.0(13.0-20.0)	Kruskal	14.0(10.0-17.0)
Min-Max	11.0-25.0	5.00-25.0	9.00-25.0		5.00-25.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

Students' experiences and perceptions regarding environment provisioning, sufficient training, access, and technology are given in Figure 5.13. Students involved in the certificate programme (n = 13) were overwhelmingly unsupportive of the measured attributes. However, degree students (n = 17) indicated that there was a lack of training, and partly agreed with environment and access. In addition, those doing the diploma course (n = 805), revealed that they were mostly unsatisfied with the environment, access, and technology.

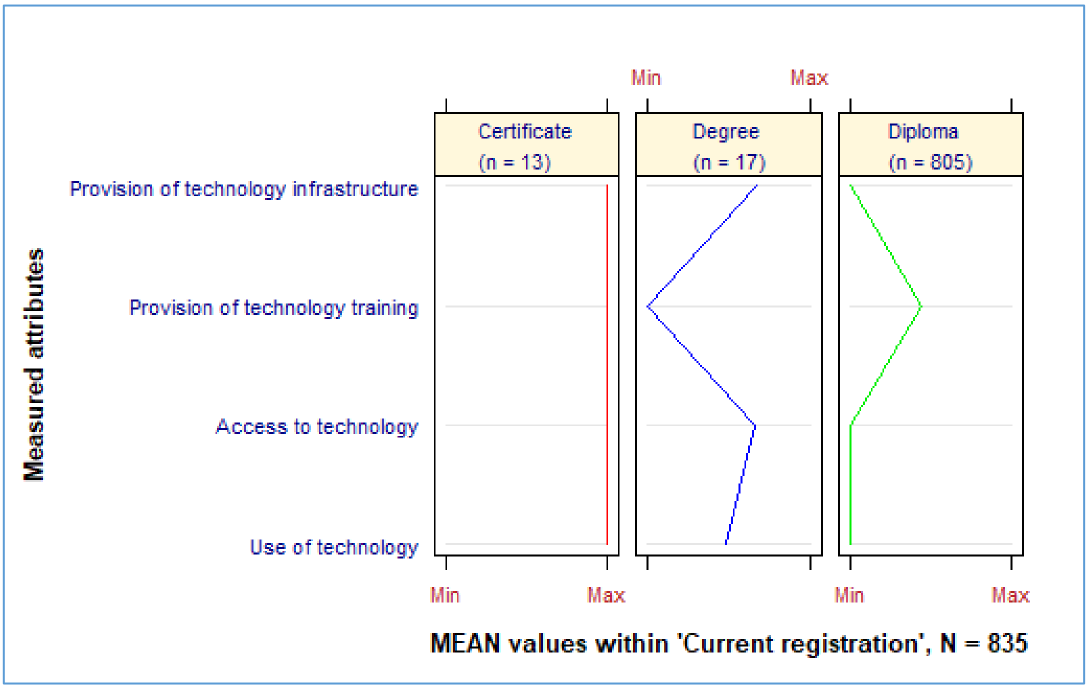

Figure 5. 13: The parallel plot for the mean values within students' current registration

Table 5.11 shows that there is a statistically significant difference in the total scores between the Certificate and Diploma qualifications for the access to technology (p = 0.049), while the scores of the Certificate and Degree, together with Diploma and Degree, have no statistically significant. Provisioning of technology enhanced infrastructure indicates a highly statistically significant difference (p = 0.009) between Certificate and Diploma qualifications. In addition to this combination, there is also a statistically significant difference (p = 0.042) between Diploma and Degree qualifications.

Table 5. 11: Significance difference

outcome measure	group1	group2	p.adj	p.adj.signif
Access to technology	Certificate	Diploma	0.049	*
Access to technology	Certificate	Degree	0.748	ns
Access to technology	Diploma	Degree	0.070	ns
Provisioning of technology enhanced infrastructure	Certificate	Diploma	0.009	**
Provisioning of technology enhanced infrastructure	Certificate	Degree	0.657	ns
Provisioning of technology enhanced infrastructure	Diploma	Degree	0.042	*
Use of technology	Certificate	Diploma	0.444	ns
Use of technology	Certificate	Degree	0.845	ns
Use of technology	Diploma	Degree	0.633	ns
Provisioning of technology training	Certificate	Diploma	0.468	ns
Provisioning of technology training	Certificate	Degree	0.199	ns

Provisioning of technology training	Diploma	Degree	0.382	ns

5.9.5 Differences in Perceptions According to the Faculty

Table 5.12 shows the total score of the Likert scale for each participant. The "Strongly Disagree" = 1 and "Strongly Agree" = 5 such that the highest possible score is 25 where a participant would have responded "Strongly Agree" for each of the 5 items in a dimension. That is, the higher the score for a dimension, the higher the possibility that the participants agreed with the items of that dimension. The results in Table 5.12 indicates that the participants are mostly in agreement with the items on 'Use of technology' and 'Provisioning of technology training' (median score = 170/25), each followed by Access to technology, and Provisioning of technology enhanced infrastructure, with the median score of 15.0 and 14.0 respectively out of the maximum possible 25. There was however a high statistically significant difference in the total scores among the three faculties of participants for the dimensions: 'Use of technology' ($p < 0.001$), 'Access to technology' ($p < 0.001$), 'Provisioning of technology training' ($p < 0.001$), and 'Provisioning of technology enhanced infrastructure' ($p < 0.001$).

Table 5. 12: Statistically significant differences by students' Faculty

Faculty	Engineering (N=485)	Management Sciences (N=167)	Natural Sciences (N=183)	p-value	Overall (N=835)
Use of technology				<0.001	
Median(Q1-Q3)	17.0(15.0-20.0)	16.0(15.0-18.0)	18.0(17.0-20.0)	Kruskal	17.0(15.0-20.0)
Min-Max	5.00-25.0	5.00-25.0	10.0-25.0		5.00-25.0
Access to technology				<0.001	
Median(Q1-Q3)	16.0(13.0-18.0)	14.0(11.0-17.0)	13.0(11.5-16.0)	Kruskal	15.0(12.0-17.0)
Min-Max	5.00-25.0	5.00-23.0	5.00-25.0		5.00-25.0
Provision of technology training				<0.001	
Median(Q1-Q3)	16.0(14.0-19.0)	19.0(16.0-20.0)	16.0(13.0-19.0)	Kruskal	17.0(14.0-19.0)
Min-Max	5.00-25.0	5.00-25.0	5.00-25.0		5.00-25.0
Provision of technology infrastructure				<0.001	
Median(Q1-Q3)	15.0(10.0-18.0)	13.0(10.0-16.0)	12.0(9.00-15.0)	Kruskal	14.0(10.0-17.0)
Min-Max	5.00-25.0	5.00-21.0	5.00-25.0		5.00-25.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

The parallel plot in Figure 5.14 shows that when compared to Engineering, Management Sciences and Natural Sciences faculties, the students in the Faculty of Engineering mostly agreed on the items on environment and access. Conversely, this was in direct opposite for the Faculty of Management Sciences. However, for the Faculty of Natural Sciences, students were mostly dissatisfied with the environment, training, and access.

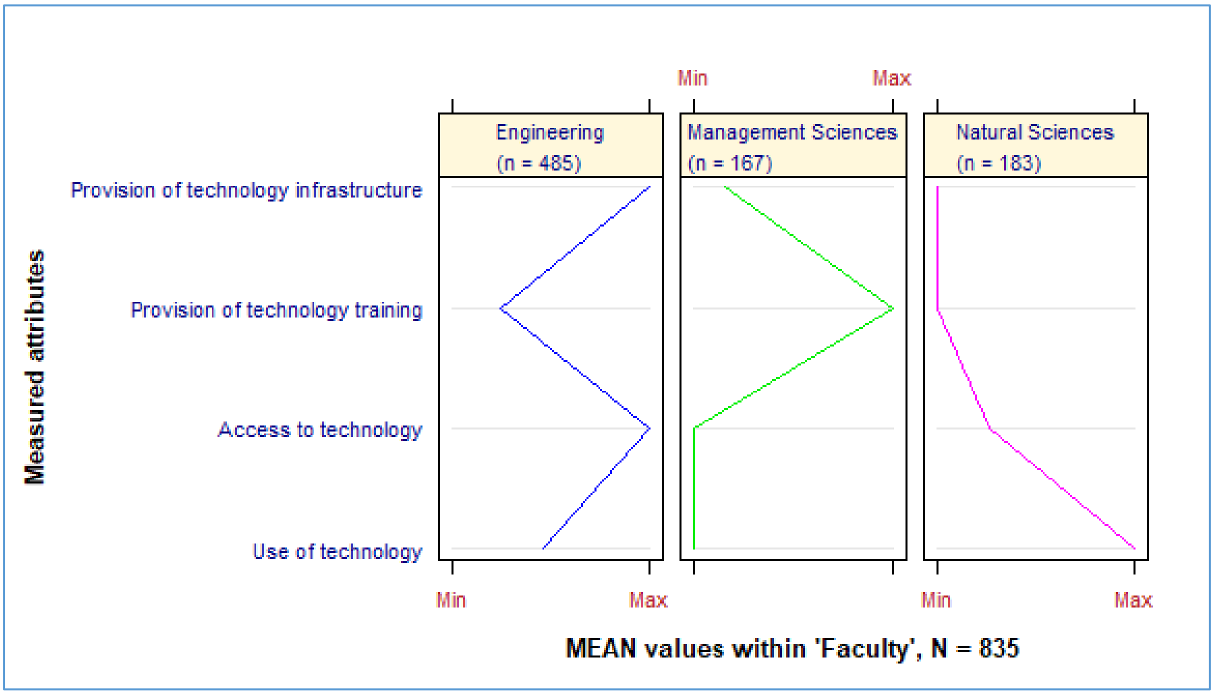

Figure 5. 14: The parallel plot for the mean values within the 3 faculties

Students from the Faculty of Engineering, regarding access to technology, show a highly statistically significant difference ($p < 0.001$) for both Management Sciences and Natural Sciences. Provisioning of technology enhanced infrastructure revealed that there is a highly statistically significant difference ($p < 0.001$) between Faculty of Engineering with both Management Sciences and Natural Sciences. ‘Use of technology’ indicates a statistically significant difference between Engineering and Management Sciences. In addition to this, there was a highly statistically significant difference ($p < 0.001$) between Engineering and Natural Sciences and between Management Sciences and Natural Sciences. ‘Provisioning of technology training’ indicates there is a highly statistically significant difference ($p < 0.001$) between Engineering and Management Sciences as well as Management Sciences and Natural Sciences.

Table 5. 13: Significant Difference

outcome measure	group1	group2	p.adj	p.adj.signif
Access to technology	Engineering	Management Sciences	<0.001	****
Access to technology	Engineering	Natural Sciences	<0.001	****
Access to technology	Management Sciences	Natural Sciences	0.482	ns
Provisioning of technology enhanced infrastructure	Engineering	Management Sciences	<0.001	****
Provisioning of technology enhanced infrastructure	Engineering	Natural Sciences	<0.001	****
Provisioning of technology enhanced infrastructure	Management Sciences	Natural Sciences	0.882	ns
Use of technology	Engineering	Management Sciences	0.010	**
Use of technology	Engineering	Natural Sciences	<0.001	***
Use of technology	Management Sciences	Natural Sciences	<0.001	****
Provisioning of technology training	Engineering	Management Sciences	<0.001	****
Provisioning of technology training	Engineering	Natural Sciences	0.444	ns
Provisioning of technology training	Management Sciences	Natural Sciences	<0.001	****

5.10 Confirmatory factor Analysis of Students: Phase One of the Research Study

Figure 5.15 indicates the confirmatory factor analysis of students in the current study. The purpose of correlation analysis in research is to better understand the nature of correlations between two numeric variables or dataset. A high correlation denotes a close link between the two variables, whereas a low correlation denotes an unsatisfactory relationship. The two variables have a positive connection when a rise in one lead to an increase in the other. On the other side, a negative correlation implies that if one variable rises, the other falls, and vice versa. In this part, we define r as the coefficient correlation, which assesses how closely the variables we are comparing are related. Table 5.14 indicates the distribution categories, and extent of correlations followed in the current study.

Table 5. 14: Distribution of categories

Description	Extent of correlations
Strong negative correlation between 2 variables	-1.00 to -0.67
Moderate negative correlation between 2 variables	-0.66 to -0.34
Weak negative correlation between 2 variables	-0.33 to 0.00
Strong positive correlation between 2 variables	0.67 to 1.00
Moderate positive correlation between 2 variables	0.34 to 0.67
Weak positive correlation between 2 variables	0.00 to 0.33

5.10.1 Negative Correlations

This section tries to identify negative correlations that is found in Figure 5.15. In technology (use of technology) and training (provision of training to technology), there is a weak negative correlation ($r = -0.17$) between technology and training. As such, the higher the score for technology, the lower the scores for training and vice-versa. Hence, the lack of training results in less opportunity for students to use the technology. However, it has more impact to environment (provision of technology infrastructure) ($r = -0.29$) than technology. That is, the more the lack of training, the less conducive is the environment. In addition, the training has an equal impact to access, where training and access have shown to have a weak negative correlation($r = -0.23$). The more we have lack of training, the less students have access to technology.

5.10.2 Positive Correlations

There is a strong positive correlation ($r = 0.72$) in Figure 5.15 between access (access to technology) and environment (provision of technology infrastructure) with e3 ($r = 0.78$) (satisfied with the technologies available for learning) being the most contributing factor to environment. That is, the more conducive the environment is, the more students have access to the Internet and e-Learning platform. The provisioning of various technology platforms at the University will increase students' integration of technology in learning. Similarly, there is a weak positive correlation ($r = 0.38$) between environment and technology (use of technology) with b4 ($r = 0.64$) (regular use of computers in the University's open labs), followed by the correlation ($r = 0.54$) between technology and access with c3 ($r = 0.73$) (available lecture rooms or dedicated computer laboratories with Internet access for students. Therefore, the technology enhanced environment has a positive impact on the use and access to technology by students in the University. The students rely on the University facilities to adopt and accept the use of an e-Learning platform which is an indication that they do not have their own laptops, Smartphone's and IPads to use.

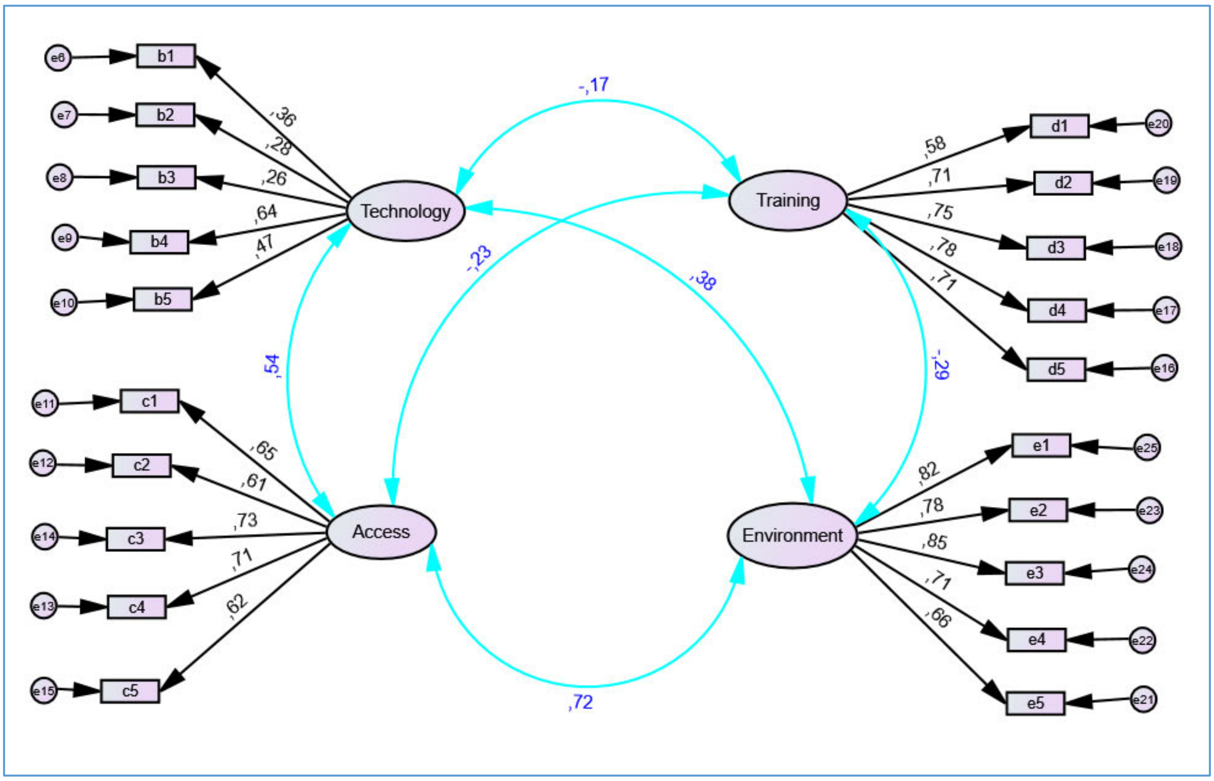

Figure 5. 15: Students Correlation Analysis

5.11 Chapter Summary

The findings about the students' use of technology indicate that students have a reasonable amount of experience and confidence in learning using technology at their disposal. However, they were uncertain about using social media for learning purposes. In addition, they were able to use technology without serious challenges in terms of training although they appreciate skills development in this regard. The results also indicate that there are significant differences in terms of students' age, gender, and Grade 12 location with respect to the use of technology.

Although it reveals that access to computers and uninterrupted Internet connectivity is not a serious challenge to students at the researched university, some felt there are still problems. Lecture rooms were identified as having insufficient Internet access. One of the key issues leading to the success of students in terms of the processes and outcomes of integration of technology in the institution of higher learning, is the possession of Internet connections and access to hardware. This is one characteristic most likely separating the university students who possess these two, from those who do not. Those in the latter category are mostly located in semi-rural and rural areas and the poor locations of predominantly African townships and informal settlements. The realities of these categories of students are distinguished in the current study. It was evident in the students' responses that there was no feasibility of innovations in teaching and learning, principally because there is not enough access to adequate resources. Because of this reality, the lecturers' efforts will always be unsuccessful, possibly because of the lack of sufficient computer labs,

The key issue associated with the challenges students face in the processes of integrating technology in teaching and learning as identified in this study, was on provisioning of training and infrastructure to technology. The students' perceptions on the two dimensions are both directly and indirectly related to the reality facing the university in question in terms of fundamentals, such as organisational operations, resources and funds, and the best paths forward in the efforts to train all students in the use of existing and new technological systems, structures, and processes (Ndevu 2020).

The reality of poor and lower middle-class students enrolled by the researched university, is bound to experience negative learning efforts and Internet connectivity challenges when they could be forced to leave the university campuses for home due to the Covid-19 pandemic or any other undesirable circumstances. Working in an environment sharing limited technology enhanced spaces and the lack of continuous development programmes on the use of e-Learning, could lead to serious connectivity problems (Ndevu 2020).

CHAPTER 6: Analysis of Data from Lecturers' Questionnaire

6.1 Introduction

The investigation of lecturers' experiences incorporating technology into learning and teaching is presented in this chapter in the context of an ICT-Challenged environment. The lecturers' experiences in the integration of technology are determined through quantitative analysis based on the open-ended questionnaire. To answer research questions and test research hypotheses for the present study, quantitative data was collected from lecturers teaching in the 3 Faculties, namely: Faculty of Engineering, Management Sciences and Natural Sciences with a reasonable amount of teaching experience in the higher education sector. The open-ended questionnaire's results are presented in this chapter along with a critical analysis of each outcome. It focuses on data analysis and conclusions related to lecturers' experiences with the integration of technology in learning and teaching in an ICT-Challenged context. Additionally, based on the structured interviews with 3 senior staff members from the Information and Technology Network (ITN); 2 senior staff members from the Teaching and Learning Development Centre (TLDC); 2 Deans of faculties and 5 Heads of Departments, this chapter gives a qualitative analysis. The goal of data analysis is to assist the researcher in answering research questions and confirming the interaction between variables.

6.2 Descriptive Statistics: Demographics Profile of Lecturer Participants

The demographic profile of the lecturers who participated in the current study is summarized in Figure 6.1. The demographic profile of respondents was collected through using Section A of the research instrument. Data about the demographics of the research population was gathered in this portion of the questionnaire. This was done to understand the general background characteristics of lecturers in terms of gender, teaching experience, use of technology experience, use of technology for teaching over a year or so (pre-Covid-19), use of learning management system for teaching over a year or so (pre-Covid-19), faculty and highest academic qualification. Ninety-seven out of 115 sampled members of academic staff participated in the study, giving rise to a response rate of 84.3%. In this current study, the population size is indicated by N and the sample size by n. The results are displayed in Figure 6.1

The first question in section A of the research instrument sought to establish the gender of the participants. From the overall population (N = 97), the majority, 68.0% ($n = 66$) of lecturers who participated in the current study were males, compared to only 32.0% (n = 31) female respondents. Participants surveyed are professionals who are required to use e-Learning to raise their quality of instruction in the higher education (HE) sector. The second question sought to detail the academic qualification levels of the participants. The results analysis demonstrates that almost half of the lecturers, 49.5% (n=48), have the highest degree at master's level. The second most common qualification among these lecturers was a doctoral degree 32.0% (n=31), followed by those holding a qualification below a master's degree 18.6% (n=18). The third question sought to establish the faculty in which lecturers participating in the current study are currently located. The results reveal that most, 41.2% (n=40) were from Natural Sciences followed by Engineering 30.9% (n=30), and the least from Management Sciences 25.8% (n=25). The fourth question of the survey requested the research participants to indicate their experience in teaching at HE level. In general, 29.9% (n=29) of the lecturers have taught in the HE sector for 10 – 15 years; followed by 28.9% (n=28) with at least 15 years; whilst those with 5 – 10 years constituted 23.7% (n=23). The least 17.5% (n=17) group of lecturers had taught in the higher education sector for under 5 years. The fifth question sought participants to indicate their period of use of technology in teaching, learning and assessment in previous years. The results revealed that most, 46.4% (n=45) of the lecturers had <5 years of teaching experience using the e-Learning platform. This was followed by those with 5 – 10 years, accounting for 28.9% (n=28), 10 – 15 years, 10.3% (n=10) and a share of 8.2% (n=8) for those who have been exposed to e-Learning for at least 15 years. Despite the demand for experience in technology advancement in the 21st century, the result further indicated that 6.2% (n=6) had never used technology in the learning and teaching environment in the HE sector.

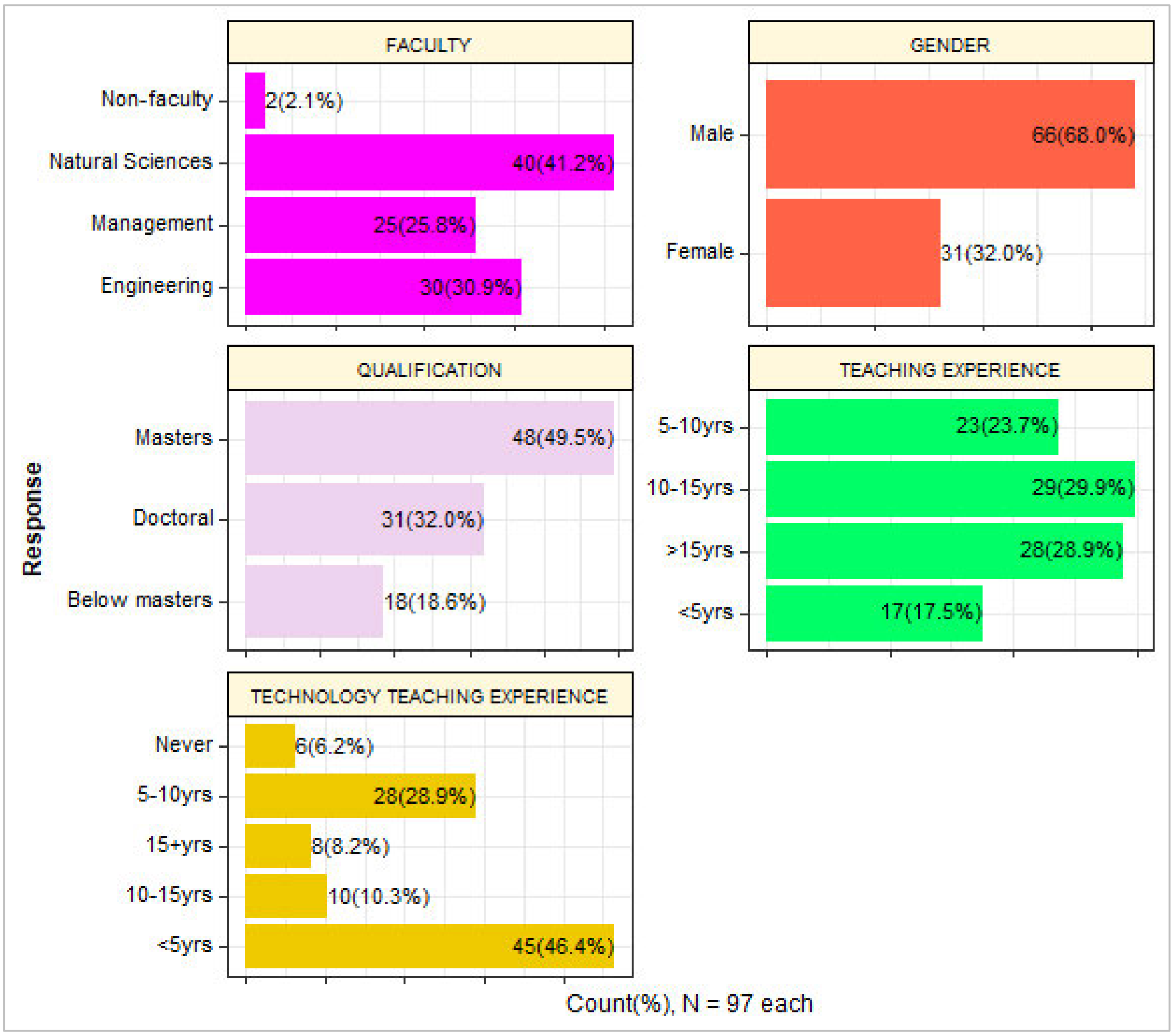

Figure 6. 1: Demographic academic staff members' data

Figure 6.2, shows the level of courses the lecturers teach, excluding combinations. The results reveal that the majority, 81.2% (n=78) of the lecturers in this University teach Diploma levels followed by, 22.9% (n=22) of the academic staff members teaching only post graduate Diploma and B-Tech. The results further indicate that there are, 5.2% (n=5) lecturers teaching a master programme.

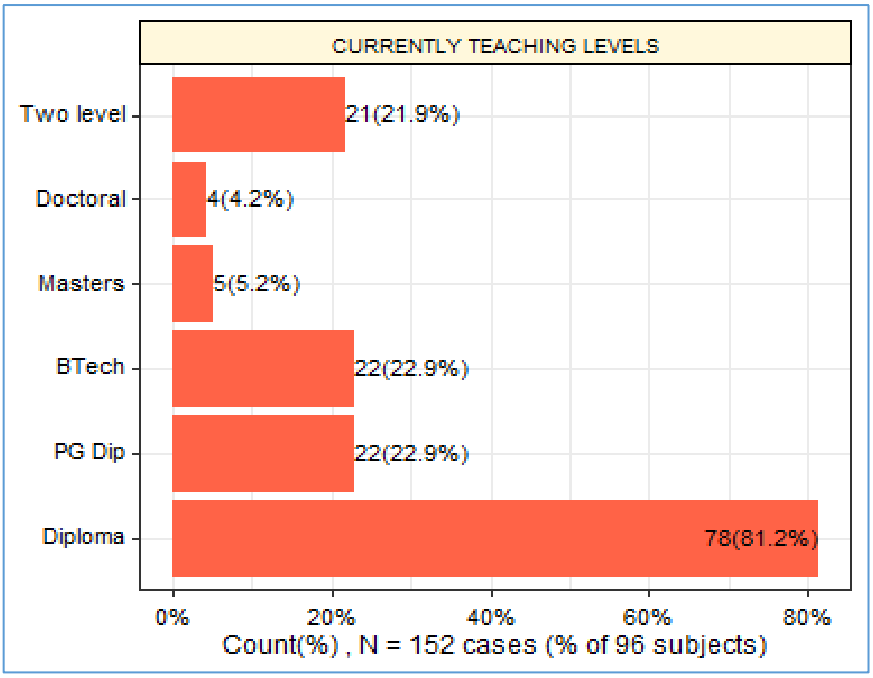

Figure 6. 2: Current teaching levels

Figure 6.3 indicates the responses to both questions seven and eight from the survey instrument. In question seven, respondents were asked to indicate their use of technology over a year or so before the Covid-19 pandemic, most, 67.0%, indicated that they used technology almost daily. Only a quarter of the participants, 25.8%, indicated that did not use technology for teaching, learning, and assessment despite the opportunities available at university level for training on using technology for teaching purposes.

With regards to the use of learning management systems (LMS) (Blackboard or Moodle) for teaching over a year or so (pre-Covid-19) as indicated in Figure 6.3, the majority, 55.7%, revealed that they had medium use of LMS. However, 33% indicated that they used it every now and then.

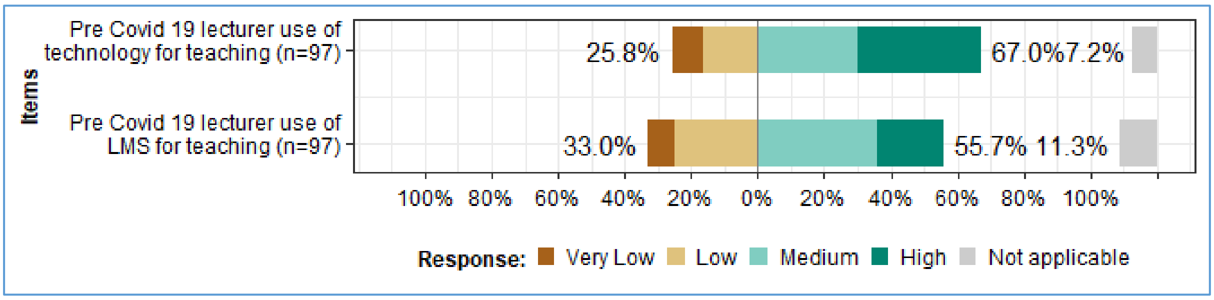

Figure 6. 3: Likert plot on the use of technology for teaching pre-Covid 19

6.3 Descriptive Statistics: Lecturers Experiences in the Integration of Technology in HE Teaching and Learning

The responses to the statistical components of the questionnaire are presented in this chapter's section. This includes the reliability analysis of the perceptions of the use of technology, access to technology, provisioning of technology training, and provisioning of technology enhanced infrastructure statements.

6.3.1 Reliability analysis for lecturer questionnaire

The reliability test is essential because it examines the characteristics of the measuring scale and confirms internal consistency (Hair, Black, Babin, & Anderson, 2010). In this study, the reliability of Likert scale survey items was assessed using Cronbach's alpha, a frequently used measure of reliability. Table 6.1 displays the individual Cronbach's alpha values for each of the constructions. The data shown here was compiled by the researcher using R, a statistical computing software version 3.6.3 developed by the R Core Team in the year 2020. Cronbach's alpha reliability values greater than 0.71 imply excellent internal consistency, whereas values between 0.41 to 0.71, suggest moderate scale reliability (Sekaran & Bougie, 2013). Cronbach's alpha scores of 0.70 to 0.90 are above the acceptable limit (Taber, 2018). For the lecturers' questionnaire, Cronbach's alpha in Table 6.1, is between 0.70 to 0.90, showing good and satisfactory construct dependability and acceptance as research tools that can be used for future investigation. The reliability test for this study is done section by section, which covers sections B, C, D, and E of the lecturers' questionnaire survey.

Table 6. 1: Reliability Statistics for Lecturers' questionnaire

Section	Constructs	Number of participants	Cronbach's Alpha
B	Use of Technology	97	0.869
C	Access to technology	97	0.674
D	Provisioning of technology training	97	0.786
E	Provisioning of technology enhanced infrastructure	97	0.814

6.3.2 Use of Technology

Section B of the questionnaire asked lecturers to indicate their level of agreement or disagreement with each of the assertions in Table 6.2 regarding their usage of technology in HE learning and teaching during the past year or so. Table 6.2 shows the five statements used to evaluate the use of technology consistently measured this construct (use of technology) to an acceptable level, (that is, Alpha if Item deleted > 0.8). Similarly, the correlations between each item and the remainder of the items were much higher than the threshold (r > 0.3). For example, the responses to the five statements strongly concur in their perception of the use of technology in their instruction, indicating that no more statements are necessary. It is assumed that the items that were grouped together in one construct will be associated. The item-rest correlation, as shown in Table 6.2, is a measure of how each item is related to the remainder of the construct's components. This provides a measure of how well one item agreed with the other elements in a construct on a consistent basis. The connection between an item's total score and the total of the scores of the other items is known as the item-rest correlation. A test's overall coefficient increases as item-rest correlations are greater.

The researcher has also included the Alpha if Item deleted value for each item, which is calculated by subtracting the coefficient alpha for the dimension when that item is removed. We evaluate them one by one to determine if removing each item one at a time can enhance the overall alpha. If it does, it signifies that the alpha has been improved to the maximum extent feasible.

Consider item B1. If we delete it, the overall alpha for the construct will be 0.833 (Table 6.2), which is only a little lower than the present overall alpha of 0.869 (See Table 6.1), therefore it is not worth removing this item. It can be concluded that item B1 improves the construct's reliability. As a result, even if the current total score is higher than the acceptable 0.7, we will not take any additional steps to improve. The current highest attained alpha of 0.869 will be lowered if any item is dropped, because all the alpha values pertaining to each item are what the overall will be if that item is dropped.

Table 6. 2: Use of technology in teaching

Section B	Statements	Item-rest correlation	Alpha if Item Deleted
B1	I have enough experience to use technology for making course materials available to students.	0.723	0.833
B2	I have enough experience to use technology for designing general learning activities (quizzes, tutorials, tests) examinations.	0.784	0.817
B3	I have enough experience to use technology for designing and administering formal assessments.	0.707	0.839
B4	I have enough experience to use technology in responding to students' content questions outside of the classroom.	0.708	0.837
B5	I always foster students' ability to use technology for learning through facilitating teaching using technology.	0.562	0.871
	Overall	-	0.869

Figure 6.4 indicates the response of the lecturers to the statements about the degree to which they used technology in HE teaching, over the past year or so. Although there are a few lecturers (31%) who showed they are struggling with designing learning activities and designing and administering formal assessments (38%), the majority, (70%), strongly agreed that lecturers always foster students' ability to use technology for learning through facilitating teaching using technology. As can be seen from Figure 6.4, (68%) respondents indicated they have enough experience to use technology in responding to students' content questions outside of the classroom, followed by (65%) who also agreed they have enough experience to use technology to make course materials available for students as well. These results suggest that more attention and capacity development is needed in areas of designing learning activities (quizzes, tutorials, and assessment) using technology, since having satisfactory skills on using technology in learning and teaching is one of the critical factors that increases use of e-Learning with the intention to improve students' development.

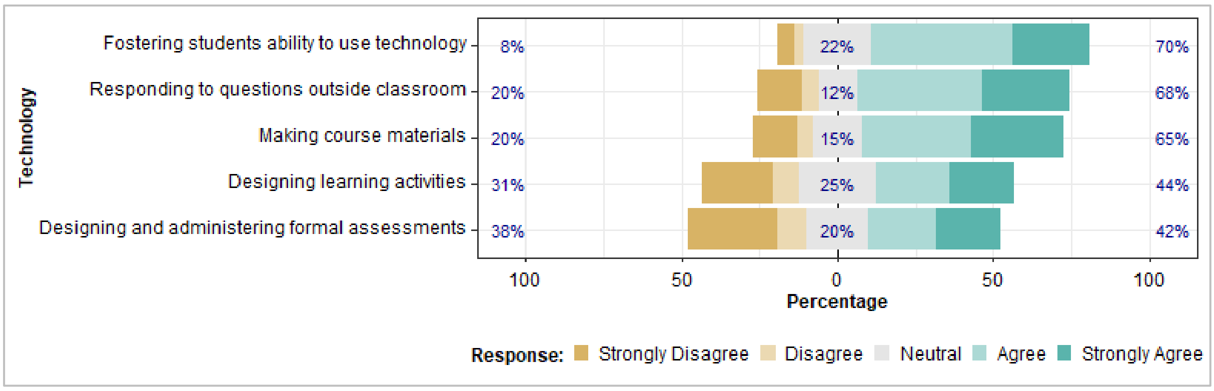

Figure 6. 4: Lecturers' experiences in the use of technology in teaching

The results of the analysis of participants in Figure 6.5 indicate that most lecturers agreed with most of the statements. However, designing learning activities was rated as neutral. Of the 5 statements that were used to assess the use of technology from the lecturer's quantitative data, the most popular response was "Agree," amounting to 45.4% (mean= 3.81) who were in support of fostering students' ability to use technology. This was followed by 40.2% (mean=3.62) of participants who also agreed to having responded to students' questions outside the classroom. However, designing and administering of formal assessments had the highest proportion 28.9% (mean = 2.96) of participants who were not satisfied. It is also evident from Figure 6.5, that the 28.9% (mean = 2.96) of participants strongly disagreed with designing and administering formal assessments, which indicates that most lecturers lack skills and knowledge in this aspect, and this needs to be attended to. It can be concluded from Figure 6.5 that "Fostering students' ability to use technology" has the highest mean value (3.81). Therefore, it is considered the most cited barrier and enabler factor in the integration of technology. "Designing and administering formal assessments" having the least mean value (2.96), is the least significant factor.

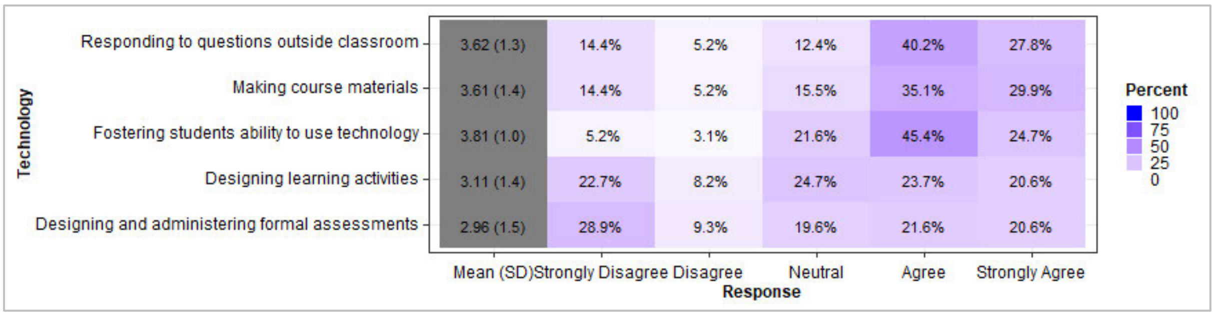

Figure 6. 5 : Heat Map on the lecturers' use of technology in teaching

Despite the growing demand from higher education institutions for lecturers to integrate technology into their teaching, they are accustomed to conventional chalk and duster methods (Harrell & Bynum, 2018). When they must shift to a new paradigm and make use of technical devices, this has the potential to generate frustrations for them. However, in the current study, the effort necessary to integrate technology was recognised by lecturers as a significant consideration (Mac Callum et al., 2014). One of the participants in the open-ended questions indicated:

> "I am trying year by year to improve my teaching by utilising technology as a teaching and learning tool."

With most responders favouring the use of technology, there is no doubt that the Covid-19 epidemic significantly changed teaching strategies and how students engage in the classroom. For example, one participant stated:

> "I am familiar with using technology in teaching, and I would like to encourage the management to improve the computer labs and make them available for use by students at all times so that teaching and learning using the e-Learning platform can be meaningful, especially during the Covid-19 period."

It is therefore essential for every higher education institution at the embryonic stage of ICT implementation to recognise and develop the skills required by users (Moon, Rhee, & Rho, 2010). Before introducing any virtual teaching environment, it is important for the lecturers and the institution to resolve all required impediments and student-related learning problems using e-Learning (Hameed, Fathulla, & Thomas, 2009). Many lecturers who already integrate technology in their teaching pedagogies have recognised the ability of online tools to help support University teaching and learning development initiatives.

6.3.3 Access to Technology

In section C of the questionnaire, lecturers are asked to rate how much they agree or disagree with each of the statements in Table 6.3 based on their access to technology for higher education teaching. The findings of the participants' analysis revealed that the 5 statements investigated for assessing access to technology, consistently measured this construct (access to technology) to an acceptable level (that is, Alpha if Item deleted > 0.60). Similarly, the correlations between each statement and the other assertions were all above the threshold (r > 0.3). That is, all 5 statements agreed in the judgement of technological access. This is an indication that they are in accord with one another and hence provide a more accurate picture of technology access. However, we may tweak the statements to boost the alpha value and make the instrument more dependable.

Table 6. 3: Access to technology in teaching

Section C	Statements	Item-rest correlation	Alpha if Item Deleted
C1	I have sufficient Internet access on campus.	0.400	0.638
C2	I have sufficient Internet access off campus.	0.496	0.591
C3	I have sufficient access to an instructional designer who assists and supports me in developing my courses.	0.430	0.623
C4	I have sufficient access to eLearning resources whenever necessary in the classroom.	0.352	0.655
C5	Technical support is readily available if lecturers are faced with difficulties.	0.468	0.607
	Overall	-	0.674

Data analysis on lecturers' experiences of access to technology at the University when they were asked to indicate their extent of agreement or disagreement with each of the 5 statements is depicted in Figure 6.6. The results revealed that the majority lecturers, (68%) have sufficient Internet access on campus and, (61%) of the respondents indicated they have sufficient Internet access off campus. In the academic year 2020, during the Covid-19 pandemic, all lecturers were given data and laptops so that they were able to teach remotely. This could be the reason why most indicated that they have internet access. In contrast, (51%) of respondents revealed they have insufficient access to e-Learning resources whenever necessary in the classroom. This group of respondents were followed by the most, (41%) who indicated they have insufficient access to an instructional designer to assist and support them in developing their course materials. About (38%) of the respondents reported whenever they were faced with technology difficulties, they did not receive immediate technical support. This finding suggests that access to technical support, instructional designers, and e-Learning resources should be prioritised so that lecturers are able to appreciate the value of the system in their facilitation of content.

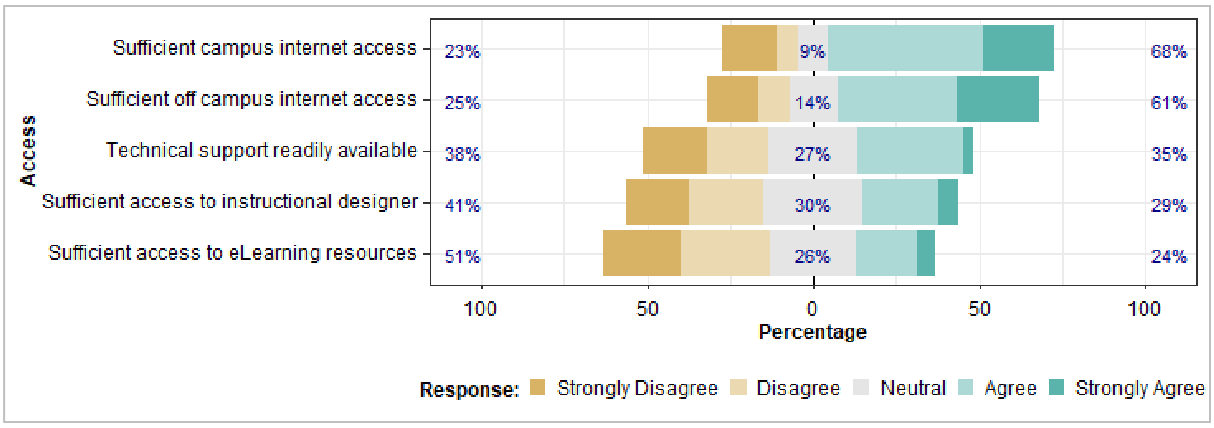

Figure 6. 6: Lecturers' experiences of access to technology

The results analysis revealed that most lecturers agreed, 46.4% (mean = 3.51) with the statement, "sufficient campus and off-campus Internet access" which was also the most popular response as reflected in Figure 6.7. Similarly, 36.1% (mean = 3.45) was obtained for the statement, "Sufficient off campus Internet access" which demonstrates that lecturers agreed with this statement. However, with regards to sufficient access to instructional designer, 18.6% (mean = 2.75) and readily available technical support 19.6% (mean = 2.80), lecturers were not satisfied. Of the five statements used to assess the access of technology construct, "Sufficient access to e-Learning resources," had the highest proportion 23.7% (mean = 2.55) of participants who were not satisfied. Notably, Figure 6.7 shows that "Sufficient campus Internet access" has the highest mean value (3.45). Therefore, it is considered as the most cited barrier and enabler factor for the successful integration of technology through the e-Learning system.

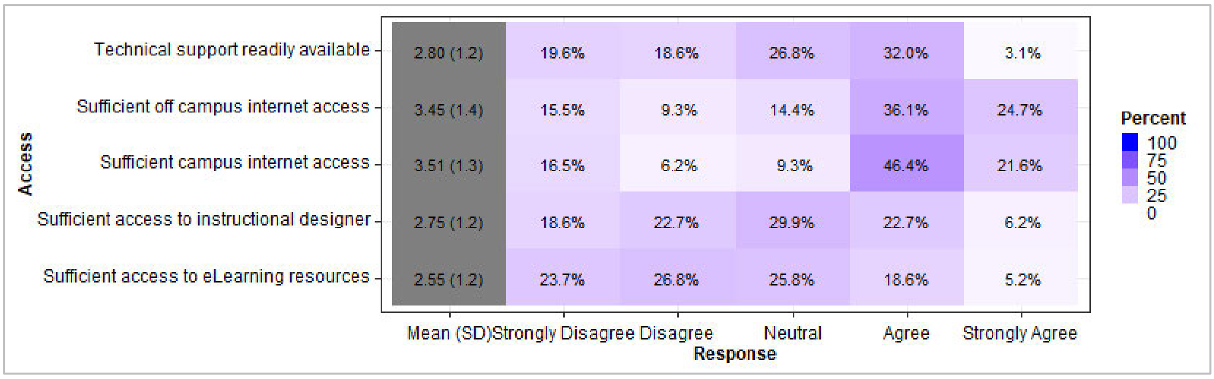

Figure 6. 7: Heat map of lecturers' experiences of access to technology

Although Figure 6.6 and Figure 6.7 data analysis indicate that lecturers agree with Internet access both in and outside the campus, one participant in the open-ended questions indicated:

> "There are few lecture venues which have reliable Internet access and suitable infrastructure to support an e-Learning system."

Similarly, one participant revealed:

> "Internet access and networking in the university is a problem. Now and again, one is told by technicians that the network system is down."

While poor Internet access is indicated by most respondents to be a challenge to their access to technology experience, others indicated through the open-ended question that:

> "Lecture rooms do not have projectors, they do not have working electrical plugs, and they do not have projector screens."

Based on the responses to open ended questions in this section, there is no way that lecturers can have satisfactory experiences using the e-Learning platform under such conditions. Universities have a responsibility to provide technology enhanced infrastructure so that users can experience the value of using an e-Learning system in learning and teaching. Classrooms need to be fitted with the necessary equipment that promotes the integration of technology. To support technological education, the bulk of e-Learning tools, including computers and Internet access, need reliable energy supplies.

6.3.4 Provisioning of Technology Training for Lecturers

In section D of the questionnaire, lecturers were asked to rate how much they agree or disagree with each of the statements in Table 6.4 regarding the provisioning of technology training. The results analysis of the Item-rest correlation and Alpha if Item deleted for each statement on provisioning of technology training are presented in Table 6.4. The results showed that the 5 statements considered for assessment of the provisioning of technology training for lecturers were reliable (that is, Alpha if Item deleted > 0.7). This indicates the satisfactory reliability of the statements, and they are accepted as research instruments for this construct. Similarly, the correlations of each statement with the other statements were also way above the threshold (that is, r > 0.3). That is, all 5 statements agree in the assessment to the provision of training to technology for lecturers.

Table 6. 4: Provisioning of technology training for lecturers

Section D	Statements	Item-rest correlation	Alpha if Item Deleted
D1	I have adequate training and support in using the learning management system.	0.676	0.707
D2	There is enough training and professional development provided for lecturers about the use of e-Learning in teaching.	0.706	0.696
D3	I have sufficient time for attending eLearning training.	0.407	0.796
D4	I have training on presenting lectures to students remotely (i.e. When I am off-campus.)	0.569	0.744
D5	There is sufficient training to use emerging technologies for teaching.	0.472	0.774
	Overall	-	0.786

The results analysis of the lecturers' responses on the provision of training to technology where they were requested to indicate their extent of agreement and or disagreement with each of the 5 statements, are presented in Figure 6.8. The results revealed that the majority, (52%) of lecturers received enough training and professional development regarding the use of e-Learning in teaching. Similarly, most, (42%) respondents showed they had adequate training and support in using the LMS. In contrast, (38%) of lecturers reported that they received insufficient training to use emerging technologies for teaching. This impediment, identified on the provision of training to technology, has a potential to affect the integration of technology by lecturers in the learning and teaching facilitation.

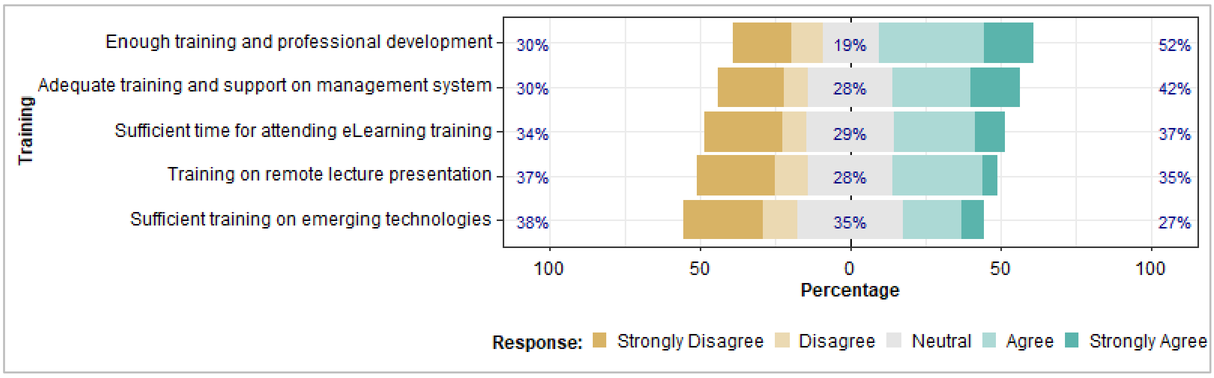

Figure 6. 8: Provision of technology training for lecturers

Training on remote lecture presentation, sufficient training on emerging technologies, sufficient time for attending e-Learning training, enough training and professional development, and adequate training and support on management system, were assessed as strongly disagree. Of the 5 statements that were used to assess the lecturers' experiences on provision of training to technology construct, the most popular response was "Agree", which accounted for 35.1% (mean = 3.19) of the participants who were in support of the enough training and professional development. Although the lecturers were in disagreement on most statements, sufficient training on emerging technologies, 26.8% (mean = 2.69), sufficient time for attending e-Learning training, 25.8% (mean = 2.88), and training on remote lecture presentation, 25.8% (mean = 2.77) had the highest proportion, of participants who were not satisfied with each of the items. While getting the quantitative results through survey, it was found in Figure 6.9 that "Training and professional development" has the highest mean value (3.19). Therefore, it is considered the most cited barrier and enabler factor for the successful integration of technology. Conversely, "Training on emerging technologies", having the least mean value (2.69), is the least significant barrier and enabler.

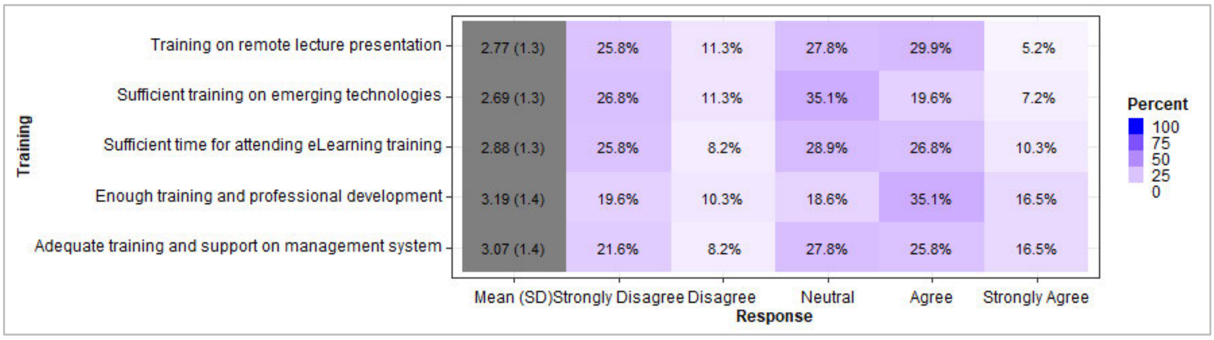

Figure 6. 9: Heat map analysis of lecturers' experiences in training

Through open ended questions on the provisioning of training for teaching and learning, lecturers highlighted several issues hindering their experiences on the training of technology. For example, one lecturer said:

> "I do not recall opportunities in provisioning of training to technology advertised at the University"

In the same vein, another respondent indicated:

> "We were trained on how to use LMS; but for me training we received was not adequate since I cannot use it as an assessment tool".

In addition, two participants notably captured their frustration of the provisioning of training to technology in this institution. One enthusiastically shared her hindrances to the training as follows:

> "Training is limited therefore it has not been adequate to foster confidence. Training of e-Learning needs to be done during the registration of students where the workload for lecturers is less".

This section raised difficulties such as inadequate training, instructional methods that don't suit academics' personal preferences, and a lack of hands-on experience. In order to enable academics to perform their duties successfully, whether it be administering online discussion forums, or detecting pedagogical needs among students, proper training should be provided (Allan et al., 2012). Training is essential, and lecturers must understand all the facets of employing technology if they are to use the e-Learning system effectively, adjust learning styles in their material production, and appropriately use the e-Learning platform capabilities.

6.3.5 Provisioning of Technology Enhanced Infrastructure for Lecturers

The last section of the lecturers' questionnaire was Section E. The degree to which each of the propositions was accepted or disagreed with by lecturers, regarding their provisioning of technology enhanced infrastructure at the University is shown in Table 6.5. The 5 statements used to evaluate the supply of technology infrastructure for lecturers consistently measured this construct to an acceptable level (Alpha if Item removed > 0.70). Similarly, the correlations of each statement with the rest of the other statements were far above the threshold (that is, r > 0.3). That is, all 5 statements agree in the assessment of the provisioning of technology enhanced infrastructure to lecturers.

Table 6. 5: Provisioning of technology enhanced infrastructure for lecturers

Section E	Statements	Item-rest correlation	Alpha if Item Deleted
E1	The University has high quality equipment available for integration technology in teaching.	0.499	0.817
E2	The ICT facilities (computers, Wi-Fi and Internet) in the University are well functioning.	0.541	0.806

E3	Lecture rooms have necessary ICT infrastructure for teaching.	0.763	0.739
E4	The Internet connectivity in the classrooms is fast and reliable.	0.669	0.764
E5	The current design of the lecture rooms supports ICT in teaching.	0.655	0.766
	Overall	-	0.814

The results of the analysis for lecturers' experiences on the provision of technology infrastructure to enhance teaching and learning are presented in Figure 6.10. According to Figure 6.10, majority, (79%) of respondents indicated that they do not agree that Internet connectivity in the classroom is fast and reliable, followed by (78%) of lecturers who indicated that lecture rooms in this University do not have the necessary ICT infrastructure for teaching. Furthermore, (75%) of respondents pointed out that the current design of lecture rooms does not support ICT in teaching. About, (64%) of respondents revealed that the University has no high-quality equipment available for integration of technology in teaching.

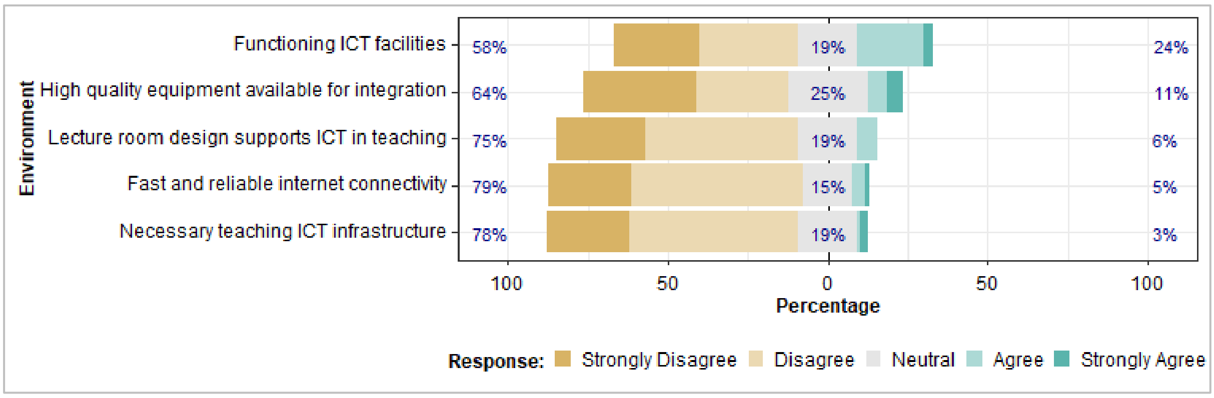

Figure 6. 10: Provision of technology infrastructure for lecturers

In general, lecturers disagreed that the university provided fast and reliable Internet connectivity, 53.6% (mean = 2.01), necessary teaching ICT infrastructure, 52.6% (mean = 2.01), and lecture room design supporting ICT in teaching, 47.4% (mean = 2.03). Their level of disagreement, however, differed by item. For example, high quality equipment available for integration, was rated as "Neutral", which represented 27.7% (mean = 2.18) of participants who were dissatisfied. The most popular response to the 5 statements used to assess the lecturers' experiences on the provisioning of technology enhanced infrastructure to lecturers construct from the lecturer's quantitative data was, "Strongly Disagree". This amounted to 53.6% (mean = 2.01) of the participants who were dissatisfied with fast and reliable Internet connectivity, followed by 35.1% (mean = 2.18) which revealed they did not believe high quality equipment was available for integration of technology by lecturers. It can be concluded from the data in Figure 6.11 that among all the respondents, "Functioning ICT facilities" has the highest mean value (2.42). Therefore, this seems to be a crucial barrier or enabling factor.

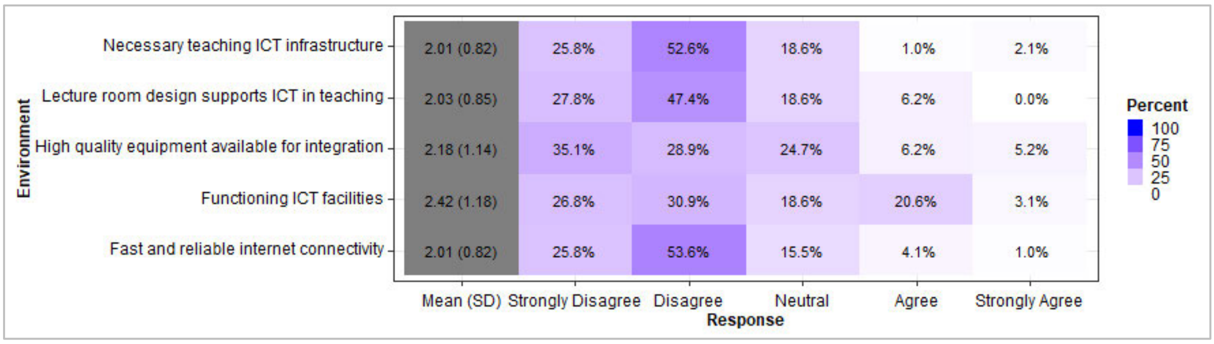

Figure 6. 11: Heat map analysis of lecturers' experiences on provision of technology infrastructure

Major difficulties were cited by professors as being due to inadequate ICT infrastructure, which is tied to unstable local area networks, unpredictable Internet connections, and frequent power outages. Some respondents, through open ended questions, indicated:

> "Lecture rooms where I teach do not have infrastructure for technology, except one electric plug and it is hardly working. The lecture rooms need to be equipped with infrastructure that supports the technology (ICT)."

Another participant lamented:

> "The Internet Wi-Fi connection in the lecture rooms is impossible. Technology infrastructure is not at all friendly to either cell phones or laptops. You need to get out of the classroom and look for the hotspot so that you can connect your gadget".

The current study's findings demonstrate that the university's ICT infrastructure is inadequate, which is connected to its unstable local area network, unpredictable Internet connection, and poor Internet connectivity in its classrooms. This suggests that the university's e-Learning system is not being used consistently under an enabling condition in a positive and meaningful way. To allow lecturers and students to use the e-Learning system for learning and teaching, it is crucial to develop an ICT infrastructure.

6.4 Exploring Differences in Perceptions according to the Factors of Gender, Qualification, Faculty

In this section, the researcher looks at whether participants' perceptions in the four dimensions differed according to the factors mentioned above. Each dimension consisted of 5 items, each measured on a Likert scale. The options ranged from, Strongly Disagree = 1 and Strongly Agree = 5 such that the highest possible score is 25 where a participant would have responded with a "Strongly Agree" for each of the 5 items in a dimension. That is, the higher the score for a dimension, the higher the possibility that the participants agreed with the items of that dimension. Because the data was believed to be regularly distributed, the Rank-sum test and t-test was preferred for determining the strength of the link between variables.

The Rank sum test is described as an instrument used in hypothesis testing when two independent samples are drawn from the same population. This is a non- parametric test used when the outcome is not normally distributed. The test process leads to comparing the medians and the distributions of the two independent samples (Békés & Doorn, 2020). A t-test is used for comparing the difference between means for two groups, whilst the Analysis of Variance (ANOVA) is applicable when comparing the means for at least three groups. In both cases, the numerical measurement is normally distributed (Huck, 2006).

6.4.1 Gender

Table 6.6 shows the total score of the Likert scale for each participant. The "Strongly Disagree = 1" and "Strongly Agree = 5" such that the highest possible score is 25 where a participant would have responded with a "Strongly Agree" for each of the 5 statements in a dimension. That is, the higher the score for a dimension, the higher the possibility that the participants agreed with the items of that dimension. The results revealed that participants were mostly in agreement with the statements on the Use of technology (median score = 18.0/25), followed by Access to technology, and Provisioning of technology training for lecturers, each with a median score of 15.0 out of the maximum possible 25. There was no statistically significant difference in the total scores between female and male participants for the dimensions: use of technology (p=0.137), access to technology (p = 0.248), provisioning of training to technology (p = 0.981), and provisioning of enhanced technology infrastructure, (p = 0.256).

Table 6. 6: Significance difference by Gender

Gender	Female (N=31)	Male (N=66)	p-value	Overall (N=97)
Use of Technology			0.137	
Median(Q1-Q3)	17.0(12.5-19.0)	19.0(13.3-21.0)	Ranksum	18.0(13.0-21.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Access to technology			0.248	
Mean±SD(CV%)	15.8±3.71(23.5)	14.7±4.31(29.3)	t-test	15.1±4.14(27.5)
Median(Q1-Q3)	15.0(13.0-18.5)	14.0(11.0-18.0)		15.0(12.0-18.0)
Min-Max	9.00-25.0	5.00-24.0		5.00-25.0
Provisioning of technology training			0.981	
Mean±SD(CV%)	14.6±4.55(31.2)	14.6±5.03(34.5)	t-test	14.6±4.86(33.3)
Median(Q1-Q3)	15.0(11.5-18.0)	15.0(11.3-18.8)		15.0(11.0-18.0)
Min-Max	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced Infrastructure			0.256	
Median(Q1-Q3)	10.0(9.00-14.0)	10.0(8.00-11.0)	Ranksum	10.0(9.00-12.0)
Min-Max	5.00-22.0	5.00-22.0		5.00-22.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

The parallel plot in Figure 6.12 represents a comparison of the mean values within gender. The results revealed that when compared to males, females mostly agreed on the items on technology infrastructure and access to technology. Conversely, this was true for provision of training to technology and use of technology, where the males were mostly in support.

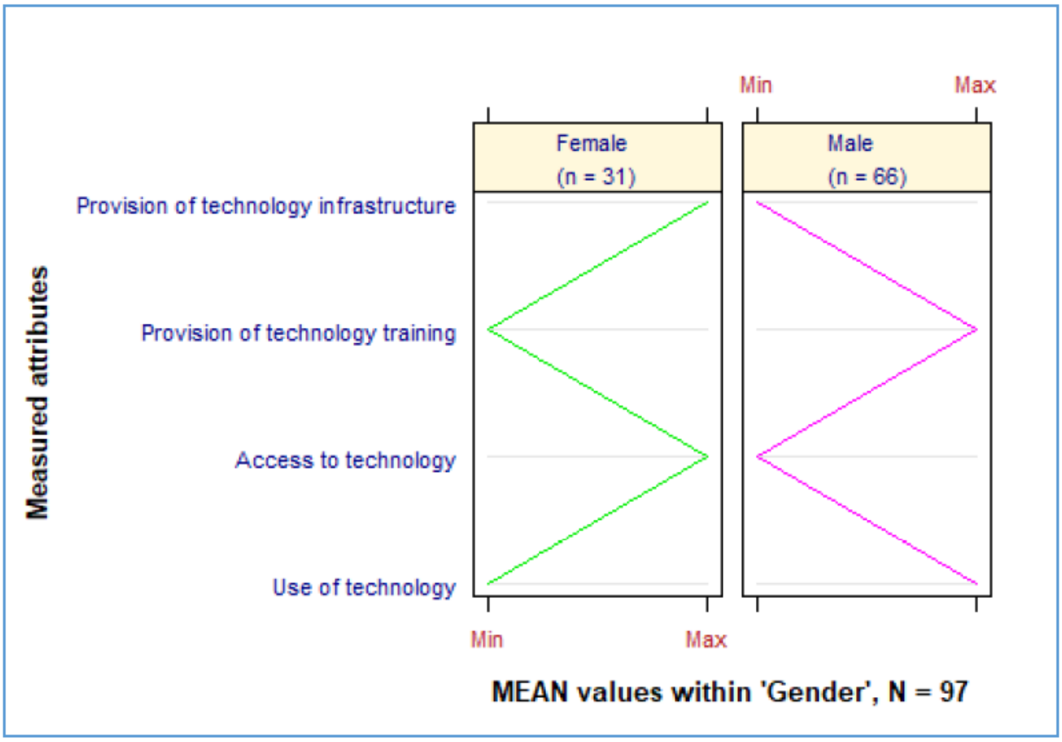

Figure 6. 12: The parallel plot of the mean values within gender

6.4.2 Qualification

In probing for differences in participants' perceptions for the various constructs according to qualification, the results show there is statistically substantial evidence for ($p = 0.008$) a variation in the average score of the provisioning of technology training dimension across the levels of education. That is, those participants possessing a qualification below masters seem to be dissatisfied with the training compared to either those with masters or doctoral degrees. There was, however, no statistically significant difference in the total scores among the educational levels for the use of technology ($p = 0.278$), access to technology ($p = 0.701$), and provisioning of technology enhanced infrastructure ($p = 0.282$).

Table 6. 7: Significance difference by qualification

Qualification	Below masters (N=18)	Masters (N=48)	Doctoral (N=31)	p-value	Overall (N=97)
Use of Technology				0.278	
Median(Q1-Q3)	18.5(11.3-20.0)	17.5(13.0-20.0)	19.0(15.5-23.0)	Kruskal	18.0(13.0-21.0)
Min-Max	5.00-25.0	7.00-25.0	7.00-25.0		5.00-25.0
Access to technology				0.701	

Qualification	Below masters (N=18)	Masters (N=48)	Doctoral (N=31)	p-value	Overall (N=97)
Mean±SD(CV%)	14.9±4.06(27.2)	14.8±3.95(26.7)	15.6±4.55(29.2)	ANOVA	15.1±4.14(27.5)
Median(Q1-Q3)	14.0(11.3-17.8)	14.0(12.0-18.0)	17.0(12.5-18.5)		15.0(12.0-18.0)
Min-Max	10.0-21.0	6.00-25.0	5.00-24.0		5.00-25.0
Provisioning of technology training				0.008	
Mean±SD(CV%)	11.8±4.92(41.8)	14.6±4.87(33.3)	16.2±4.17(25.8)	ANOVA	14.6±4.86(33.3)
Median(Q1-Q3)	11.0(8.00-15.0)	14.5(12.0-18.3)	17.0(14.5-18.0)		15.0(11.0-18.0)
Min-Max	5.00-20.0	5.00-25.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced infrastructure				0.282	
Median(Q1-Q3)	10.0(8.25-16.8)	10.0(9.00-11.0)	10.0(8.00-10.0)	Kruskal	10.0(9.00-12.0)
Min-Max	5.00-22.0	5.00-22.0	5.00-16.0		5.00-22.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

The parallel plot in Figure 6.13 presents a comparison of mean values within qualifications. The results of data analysis show that when compared to lecturers having qualifications below masters, masters, and doctoral, those below master's qualification agreed only with the provisioning of technology enhanced infrastructure. Conversely, those with doctoral qualifications mostly agreed on provision of training to technology, access to technology, and use of technology. Regarding those with master qualifications, they mostly disagreed with almost all the measured attributes.

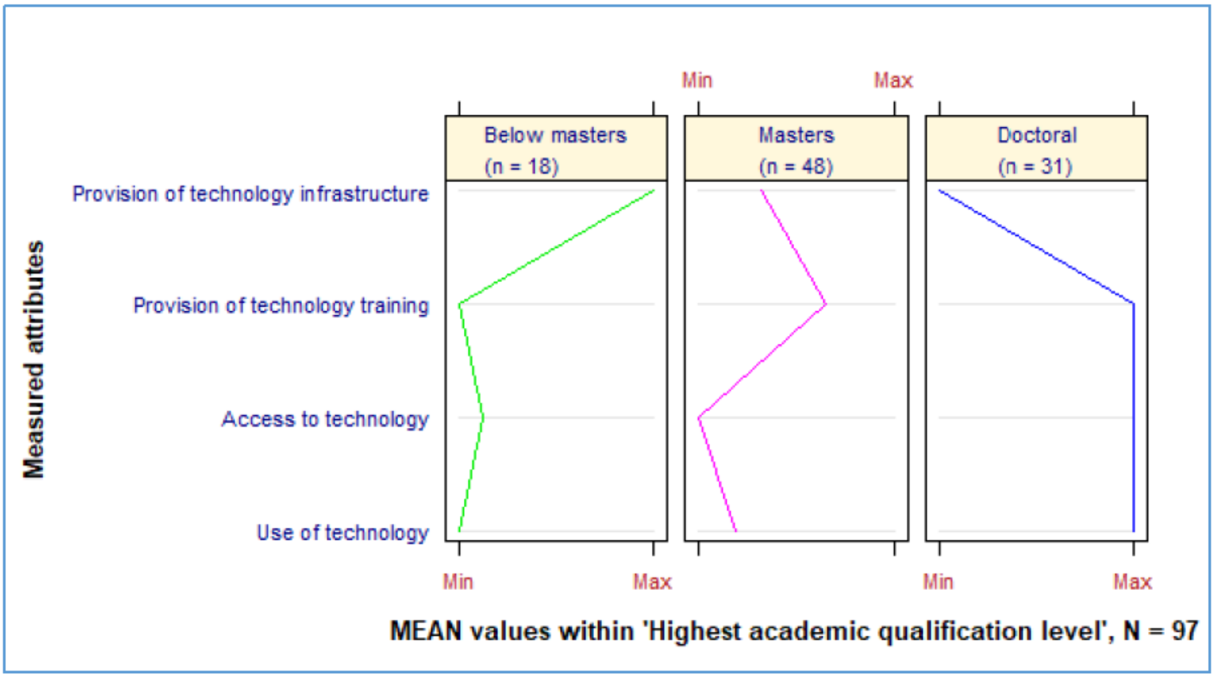

Figure 6. 13: The parallel plot of the mean values within qualifications

6.4.3 Faculty

With respect to the lecturers' Faculty of location, the findings in Table 4.8 indicate that the participants were mostly in agreement with the items on use of technology (median score = 18.0/25), followed by provisioning of technology training, with the median score of 15.0 out of the maximum possible 25. The overall scores did not differ statistically significantly amongst the Faculty of Engineering, Management Sciences, and Natural Sciences participants for the dimensions: use of technology (p=0.787), access to technology (p = 0.406), provisioning of technology training (p = 0.134), and provisioning of technology enhanced infrastructure (p = 0.372).

Table 6. 8: Significance difference of Faculty

Faculty	Engineering (N=30)	Management (N=25)	Natural Sciences (N=40)	p-value	Overall (N=95)
Use of Technology				0.787	
Median(Q1-Q3)	19.0(14.5-20.8)	17.0(14.0-19.0)	18.0(11.0-20.3)	Kruskal	18.0(13.0-20.0)
Min-Max	6.00-25.0	10.0-25.0	5.00-25.0		5.00-25.0
Access to technology				0.406	
Mean±SD(CV%)	15.8±3.95(25.0)	14.3±3.69(25.8)	14.8±4.51(30.6)	ANOVA	15.0±4.13(27.6)

Median(Q1-Q3)	16.0(13.0-18.8)	14.0(12.0-17.0)	14.0(11.8-18.0)		14.0(12.0-18.0)
Min-Max	9.00-24.0	9.00-21.0	5.00-25.0		5.00-25.0
Provisioning of technology training				0.134	
Mean±SD(CV%)	13.7±5.22(38.2)	16.0±3.78(23.6)	14.0±4.78(34.2)	ANOVA	14.4±4.74(32.9)
Median(Q1-Q3)	14.5(9.00-18.0)	17.0(15.0-18.0)	13.5(10.8-18.0)		15.0(11.0-18.0)
Min-Max	5.00-22.0	5.00-21.0	5.00-25.0		5.00-25.0
Provisioning of technology enhanced infrastructure				0.372	
Median(Q1-Q3)	10.0(8.00-14.0)	10.0(9.00-10.0)	10.0(9.00-11.3)	Kruskal	10.0(9.00-11.5)
Min-Max	5.00-21.0	5.00-19.0	5.00-22.0		5.00-22.0

| P-values based on non-missing cases only | Ranksum test | Kruskal-Wallis test | Chisq. test | Fisher's exact test |

In Figure 6.14, the lecturers' results analysis based on the faculty regarding the integration of technology in teaching indicates that lecturers in the Faculty of Engineering tend to agree that the provision of technology infrastructure, access to technology and use of technology were adequate. Conversely, participants from the Faculty of Natural Sciences were generally not satisfied with the provision of training to technology, access to technology and use of technology. Similarly, those from the Faculty of Management Sciences were not satisfied with access to technology and provision of technology infrastructure.

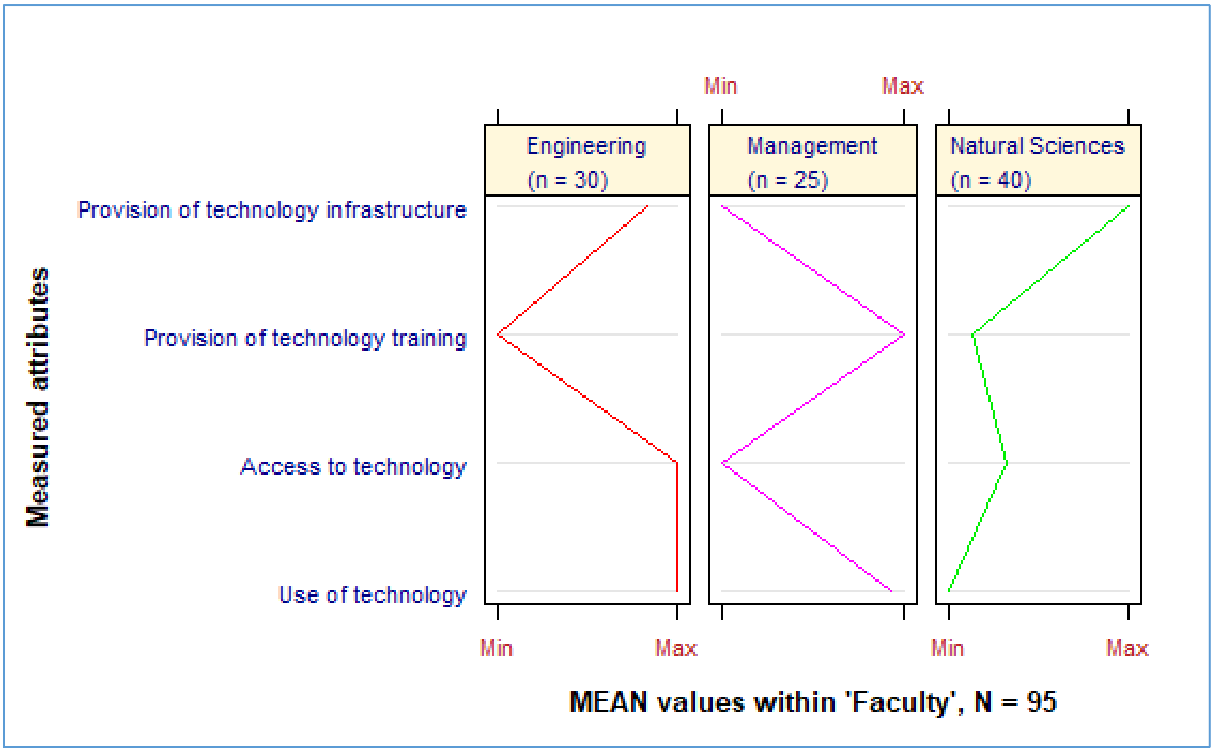

Figure 6. 14: The parallel plot of the mean values within Faculty

6.4.4 Correlation Analysis for the Lecturers' Data

A significant positive association exists ($r = 0.66$) between technology and training with b2 ($r = 0.86$) (experience to use technology for designing general activities) being the most contributing factor to the technology dimension. That is, the more training opportunities are available in the University, the more lecturers can use technology in the e-Learning platform. The use of technology training skills required by lecturers will improve lecturers' intrinsic motivation, acceptance of technology, and increase the uptake of integration of technology for teaching and learning. Similarly, a weak positive association exists.($r = 0.32$) , between technology and environment with e3 ($r = 0.91$) (lecture rooms have necessary ICT infrastructure for teaching), and this is followed by the moderate positive correlation ($r = 0.37$) between technology and access with c3 ($r = 0.64$) (sufficient access to an instructional designer who assists and supports lecturers in developing their courses).

Access to technology, and provisioning of technology training to lecturers have a strong positive correlation (r=0.68), whilst access and environment indicated a weak positive correlation (r=0.29) vice versa. The poor infrastructure affects the access of technology and may even result in lecturers not accepting and adopting the e-Learning platform. It is essential for an institution of higher learning to upgrade the technology infrastructure so that it speaks to the current needs of its users. The correlation analysis for the lecturers further revealed that there is a weak positive correlation (r=0.33) between environment and training and vice versa.

Therefore, the technology enhanced infrastructure has a positive impact on the use and access to technology, together with necessary training received by lecturers on a continuous basis as technology changes constantly. The technology enhanced University facilities have the potential to change the attitude and culture towards adoption and acceptance of the use of an e-Learning platform.

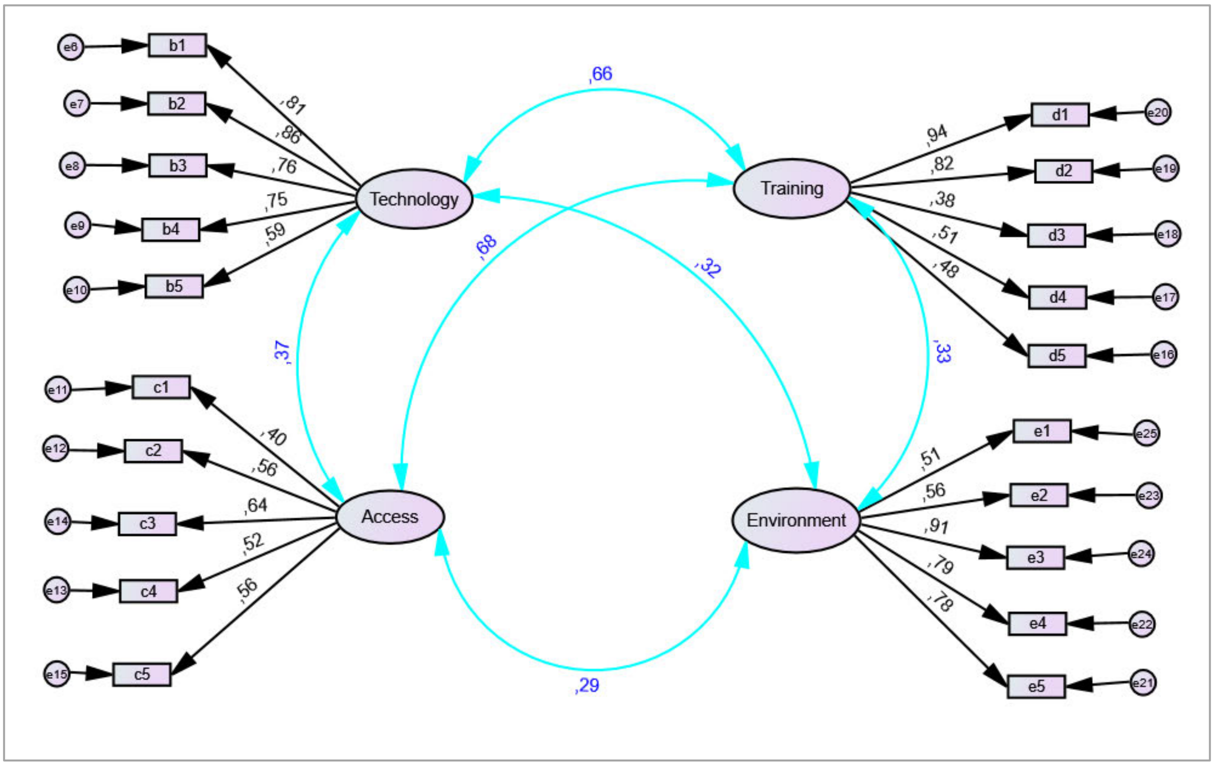

Figure 6. 15: Lecturers Correlations analysis: blue

6.5 Chapter Summary

The results analysis on lecturers' experiences and expectation on the use of technology, access to technology, provisioning of technology training, and provisioning of technology enhanced infrastructure is discussed in this chapter. The findings show that the right infrastructure to allow resource sharing, and how lecturers teach is key for any university to achieve the desired outcome on the implementation of an e-Learning system. The provision of stable and uninterrupted Internet access on and off campus, adequate training, and resources to enhance lecturers learning and teaching activities, and appropriate expertise in students' materials development to provide a sufficient technical staffing to support e-Learning, is of critical importance.

The results of the current study in this chapter, also suggests that for lecturers to effectively incorporate ICT into educational practice, they must have suitable pedagogical abilities in addition to fundamental ICT knowledge skills. Ndevu's empirical research amongst academics in three South African universities, including one University of Technology, shows that interviewees with one exception, indicated categorically that they were not adequately supported at all levels, of the new responsibilities associated with digital teaching and learning. Many of the above realities had serious negative effects on all lecturers responsible for teaching students using online platforms, especially in Universities of Technology who struggle to adapt to the online system due to financial, technical, and social issues. In the next chapter, data analyse, including data obtained from semi-structured interviews is presented.

CHAPTER 7: Presentation and Discussion of the Semi-structured Interview Data

7.1 Introduction

In this chapter, the analysis of qualitative data gathered through semi-structured focus group interviews with two distinct groups that was recorded using Microsoft Teams is discussed. The responses of Group 1 are made up of three senior staff members in the Department of Information and Technology Network (ITN) and two senior members of staff in the Teaching and Learning Development Centre (TLDC) for the participating university. The interviews were designed to elicit their perceptions regarding the three main constructs of interest in this study (Infrastructure, Systems and Support Services), and were organised accordingly in Sections 7.2-7.5. This is followed by an analysis of the responses of Group 2 in the participating university, which is made up of the two Deans of faculties and five Heads of Departments (HoD). The interviews were designed to focus on their perceptions related to the three main constructs of interest in this study (Strategy, Leadership and Culture) in Sections 7.6-7.8.

7.2 Perceptions of ITN and TLDC Staff about the Infrastructure

There were five main themes emanating from the data with respect to the infrastructure constructs. These include ICT infrastructure provisioning, Wi-Fi coverage across campus, ICT infrastructure (Wi-Fi) at residences, major stumbling blocks, and student charging stations in open spaces. Each of these categories, summarised descriptions, and frequencies are summarised below in Table 7.1. Frequencies refer to the number of times it was mentioned across the transcripts. Thereafter, the details of the responses to each of these themes where participants' comments are quoted verbatim are presented in the following sections.

Table 7. 1: Coding of the infrastructure construct

Theme	**Codes**	**Description**	**Frequency**
ICT infrastructure provisioning	IP	Refers to the hardware, software facilities, and network capabilities within the university. Poor Wi-Fi connectivity and inadequate computer labs.	4
WIFI coverage across campus	CAC	Coverage throughout the campus.	3

ICT infrastructure (WIFI) at residences	IR	Students expect wireless Internet access everywhere on residences.	4
Major stumbling blocks	MSB	An obstacle or hindrance to progress, belief, or understanding.	3
Student Charging stations in open spaces	SCS	Plug-in electric vehicle (PEV) charging to their faculty, staff, and students.	3

7.2.1 ICT infrastructure Provisioning (IP)

ICT infrastructure refers to the hardware and software needed to build and maintain systems and networks for communications services, as well as to support applications, and digital content. Hence, under this theme, comments about general ICT infrastructure provision such as those that refer to unstable Internet connectivity, poor Wi-Fi connectivity, and inadequate computer labs are coded. Despite infrastructure limitations and the diversity of organisational practices and cultures, e-Learning is an essential aspect of South African HEIs. Almost all faculty and students utilise ICTs in some form for learning and teaching activities, while usage is still limited to well-known technology.

The responses in this category related to the respondents' perceptions of ICT infrastructure provisioning to support teaching, learning and assessment. This theme actually elicited the highest number (4) of responses from participants. Some responses in this category noted that there was sufficient infrastructure in the university in terms of hardware, while others felt it was insufficient. They noted that with the onset of COVID, the university made moves to improve the infrastructure. Some noted that the server was limited. To support staff in working online from home, lecturers were given laptops. The following quotes are examples in this theme.

"We have got a proper infrastructure in place to support teaching and learning and assessment only when it comes to hardware. Due to Covid-19, the University has taken a decision to procure more servers to assist the existing infrastructure to be able to handle teaching and learning and assessment issues" (participant 1).

"Thanks to corona virus pandemic, lecturers who did not have laptops or had old laptops, were given the laptops and data so that they can also access Internet even at home in support of online teaching and learning. The capacity of servers we have is not enough for use by all stakeholders of the University" (participant 2).

"There is a need to purchase a new firewall to allow more students to connect internally when the need arise and access information internally. Due to Covid-19, the University has also given the students data although very few have laptops. They will use data to access information on the learning management system" (participant 3).

The above-mentioned quotes clearly indicate that the participating University of Technology has bandwidth problems, poor and insufficient Internet connectivity, inadequate ICT infrastructure with limited hardware and server. The preceding responses are thus in line with the literature overview on ICT infrastructure (Obiri-Yeboah et al., 2013; Sanga et al., 2013; Mtebe, 2014) who found that the identified factors may enable or impede the integration and use of the e-Learning system in learning, teaching, and assessment.

7.2.2 Wi-Fi Coverage Across Campus (CAC)

Wi-Fi network is a wireless networking technology that allows devices such as computers, mobile devices, and other equipment to interface with the Internet. It allows these devices to exchange information with one another, creating a network. Internet connectivity occurs through a wireless router. When you access Wi-F, you are connecting to a wireless router that allows Wi-Fi-compatible devices to interface with Internet. The region over which wireless signals are broadcast is referred to as wireless network coverage. Wireless signals are powerful within a given physical parameter, but they diminish dramatically beyond that parameter. This causes network connectivity to stutter or perhaps go down completely. Hence, under this theme, comments about Wi-Fi coverage across campus such as signal strength, and network coverage were coded. Of the five responses related to the Wi-Fi coverage across campus theme, there were three mutual agreements from participants. One common response presented by participants indicated that the Wi-Fi coverage signal strength across campus was largely poor, with access points not always working. One such comment was:

"The university's Wi-Fi network cannot handle all staff and students logging in at the same time, as well as no Internet access to most lecture rooms" (participant 4).

In addition to this comment, another participant said:

"Currently, Information and Technology Network (ITN) Department, is working on improving Wi-Fi coverage in all the teaching venues as a plan to reach an increased Wi-Fi coverage that will support a sustainable e-Learning" (participant 5).

Ssekakubo et al., (2011) found that the ineffectiveness of Wi-Fi coverage and poor signal strength across campus hampers the positive effects of e-Learning at the institution. A poor Wi-Fi signal might limit the amount of bandwidth available and possibly cause connection issues. Therefore, locating and resolving issues that may be affecting wireless signal will improve the speed and dependability of the network.

7.2.3 ICT infrastructure Wi-Fi at Student Residences (IR)

In this theme, participants' comments about the ICT infrastructure in the form of Wi-Fi at student residences such as its restrictions that students may have experienced were coded. The focus was on Wi-Fi access in student residences outside the University buildings. This theme is intended to better understand the effects of missing or inadequate Internet access at residences that could impact negatively on students' performance. The common comments presented by four participants indicated a need to improve Wi-Fi coverage at student residences. One such comment was:

"The Wi-Fi network at the University-owned residences is inadequate because it can only accommodate a limited number of students, and the situation is even worse with the external residences" (participant 4).

Furthermore, concerns of ICT infrastructure (Wi-Fi) at the residences were clearly articulated as posing a significant impediment to students' learning. For example, another participant said:

"Due to Covid-19, the university had to put Wi-Fi in the residents so that students can have access to the learning material even if they are off campus. Again, the corona virus pandemic

situation has forced the university to consider a project plan that we are finalising on Wi-Fi in all the teaching venues, although it has been taken some time" (participant 5).

The above responses echoed by respondents, were in line with related themes from the literature by Hussin et al., (2012) where it was indicated that poor Internet facilities and access are amongst the enabling or impeding factors to the integration of technology through an e-Learning system.

7.2.4 Major Stumbling Blocks (MSB)

Under this theme, responses based on participants' perceptions of the major stumbling blocks to ICT infrastructure acquisition at the participating university of Technology were considered. The most common result amongst the participants was the process of procuring ICT infrastructure related equipment. Three of the participants on this point said:

"The procedure and process of buying equipment at the university is frustrating (participant 1). It takes forever to get your order processed and the acquisition process has got a lot of red tape (participant 2). The high-level knowledge personnel at the procurement office should be employed so that they can give better guidance to follow when you want to buy some equipment" (participant 3).

In addition, another participant lamented:

"There is no process identified to follow and no standard operating procedures that will indicate how they will go along and what complicates it, from the acquisition point of view, is that the game changes as they go along in the requisition process" (participant 2).

The preceding responses reveal that one of the hindrances to move to an online system is the procurement process. For example, a further comment made was:

"There are financial restrictions in terms of buying and equipping ICT-related facilities, broadband Internet operating costs, and students' financial circumstances while acquiring e-Learning tools" (participant 1).

7.2.5 Student Charging Stations in Open Spaces (SCS)

Charging stations where cell phones and laptops can be plugged in are a visible sign of environmental responsibility and may benefit faculty, staff, and students in the institution of higher learning. Engineering students are tasked by several universities to design the placement of charging stations. Furthermore, some institutions choose to position charging stations in secure parking areas, while others prefer to place them in prominent locations on campus to encourage maximum visibility and accessibility to all. When deciding where to install charging stations, institutions should always keep future campus growth in mind. If a surface lot is likely to be impacted by future construction, for example, it may be smarter to put charging stations in a permanent parking structure.

When asked about charging stations for students' laptops and cell phones on campus, and if there were plans to expand this feature in the future, the three participants gave similar statements indicating that there is no charging station available in open spaces for students who are constantly faced with power challenges for their gadgets/devices. The following are responses echoed by two respondents:

"The university does not have charging stations for students' laptops and cell phones (participant 1). It is because of Covid-19 that we are planning of having some charging stations where students can charge their laptops" (participant 2).

Based on Chukwunonso and Oguike (2013), charging stations are part of the technical infrastructure that should always be provided for the success of e-Learning in a higher education institution. This therefore suggests a need for the participating university to benchmark with other institutions at various levels, to learn how to go about introducing this important feature.

7.3 Perceptions of ITN and TLDC Staff about Technological Systems

When we talk about a technological system, we're referring to the entire set of components that make up a single computer setup. Hardware, software, peripherals, power supply, and communication links, are among these components. In every institution of higher learning, technology systems have become essential to the current working environment. In the context of the present study, six themes emerged from the analysis of comments of the ITN and TLDC participants' relating to the systems construct. Table 7.2 presents the themes, descriptions, and frequencies which emanated from the views in assessing the availability of technological systems at the university to enhance the access and use of technology in learning and teaching.

Frequencies refer to the number of times the theme was mentioned across the transcript. Further details of the findings are discussed in subsequent subsections. The details of the responses to each of these themes in the section that follows where participants' comments are quoted verbatim were coded.

Table 7. 2: Coding of the Systems construct

Theme	**Codes**	**Description**	**Frequency**
Uptake of Blackboard and Moodle as official e-Learning platforms.	BM	Evaluation of Backboard and Moodle learning management systems.	2
Sufficient resources to develop a sustainable e-learning platform.	RDSE	The sustainability of open educational resources in higher education.	3
Available ICT tools in the classrooms for teaching and learning purposes.	ICTT	Changing the institutional teaching and learning in the context of ICT tools.	4
Lecture recording equipment in lecture venues.	LRE	Learning devices and software tools.	5
Demands different from the usual teaching and learning platform.	DD	Demand and supply are intertwined. The greater the requirement for ICT services that are critical to the university's performance and productivity, the higher the demand from students in the education and learning context and staff.	3
The computer specifications compatibility with the current academic staff requirements.	CS	System requirements: Minimum and recommended computer specifications	3

7.3.1 University Official Learning Management Systems (BM)

A learning management system (LMS), is a software program or web-based technology used to plan, carry out, and assess a learning process. It is used in e-Learning and, in its simplest form, consists of two components: a server that manages the essential functions, and a user interface that administrators, teachers, and students may manage. A teacher may often create and deliver material, monitor student engagement, and assess student performance using the LMS.

The participants reflected on the uptake of both Blackboard and Moodle as official e-Learning platforms in the participating University. From the five participants only two supplied a common result indicating that:

"Uptake of the learning management system at the university is very low because lack of support from the technical staff in respect of training on how to effectively use Blackboard and Moodle for learning and teaching" (participant 3).

"The students and lecturers' uptake of Blackboard increased because of Covid-19 and as for Moodle, students had challenges of data to access it as a result, and they also opted for Blackboard. In Pre-Covid-19, most employees lacked motivation to utilise e-Learning to help them with their everyday teaching routines, rendering e-Learning system in the university unproductive" (participant 4).

In coherence with the literature overview, proper training of students and lecturers is required to improve the use of LMS at university level (Leka et al., 2016;Alshammari & Qtaish, 2019). Opportunities for professional development for both students and lecturers should be provided to properly use the two LMSs. When students and lecturers are unable to use the LMS, the e-Learning platform becomes ineffective. Using a LMS to support classroom instruction may result in little or no progress toward e-Learning implementation unless students and lecturers have the necessary skills.

7.3.2 Resources to Develop a Sustainable e-Learning Platform (RDSE)

Even though participants had diverse viewpoints on the resources to develop a sustainable e-Learning platform, they all agreed that more resources are required to design a long-term strategy for the creation of a sustainable e-Learning platform. The absence of instructional designers was indicated as the most contributing factor to lecturers' inability to design students' learning and content development. An example of a response emphasising this point was:

"In my view we do not have sufficient resources to ensure the development of a sustainable e-Learning platform. Last year I did the Post Graduate Diploma educational technology because it has been difficult for the institution to get the learning designers in South Africa" (participant 5).

Instructional designers are learning designers that have been professionally, thoroughly, and ethically trained. They have the knowledge and abilities to support meaningful and engaging learning experiences in several settings and circumstances (Lachheb & Boling, 2018). Although instructional designers may be specialists in their technical field, it is critical that they grasp the high expectations of students and lecturers to make the entire process as pleasant as possible for all parties involved. The primary goal of instructional designers should be to lessen the likelihood of students and lecturers leaving, and to provide a great e-Learning experience. The ability of instructional designers to easily convey material from topic experts to learners is for them, the most crucial component.

7.3.3. Available ICT tools in the classrooms for teaching and learning purposes (ICTT)

The availability of ICT tools in classrooms for learning and teaching are critical aspects of promoting e-Learning. Hence, under this theme, comments about general perceptions of participants related to the suitability of currently available ICT tools (smart boards, OHPs, data projectors, audio systems, WIFI) in classrooms for learning and teaching were coded. Almost all the responses regarding the suitability of currently available ICT tools in classrooms for learning and teaching were negative. Approximately four out of five participants stated:

"There is a lack of ICT tools in classrooms for learning and teaching, and that a minimum standard of technology enhanced classrooms should be implemented (participant 1 & 3). The university has installed smart boards in nine lecture halls that are currently catching dust due to the classrooms not being technology friendly" (participant 4,& 5).

Research studies suggest that to make e-Learning more effective, it is required to equip lecture venues with sufficient equipment to promote the use of technology in classrooms such as Internet connectivity, and reliable power supply just to mention a few (Aydin & Tasci, 2005).

7.3.4 Lecture Recording Equipment (LRE)

As online education becomes more widespread, it's critical that lecturers have high-quality technology for recording their lectures. Because images accompanying teachings are delivered utilising platforms such as Google Classroom, Flipsnack, Animoto, Scratch, and others, it's critical for students to be heard at the first presentation and recording. As a result, remarks concerning typical lecture recording equipment, such as using an external microphone when capturing video on a smart phone or tablet, under this theme were categorised. When filming big crowds or rooms, this is quite beneficial.

The responses in this theme related to the respondents' perceptions of lecture recording equipment. This theme elicited the highest number (5) of responses from participants. All responses in this theme indicated that there was no lecture recording technology available in classrooms. The following quotes are examples of responses in this theme:

"*There is currently no lecture recording technology available in the classrooms. In the classrooms, technology-enhanced infrastructure is essentially non-existent. Except for nine venues across the University, none of the lecture halls include lecture recording equipment or data projectors" (participant 1).*

"The nine classrooms that have smart boards installed on them; they had the video recording equipment. Since the lecturers could not use the smart boards due to lack of training, they could not realise that these classrooms could record their lectures. We ended up removing these video cameras from the lecture halls" (participant 2).

"Due to Covid-19, it seems that, there's no need to expand the number of smart board classrooms, instead the university should divert funds from the construction of complex smart classrooms to the purchase of better software for lecturers and students to utilise on their laptops" (participant 3).

The abovementioned quotes clearly indicate that lecture venues of the participating University of Technology require attention with regards to equipment that must be fitted for the effective use of technology in learning and teaching in the classroom. The lack of necessary equipment impedes the integration of technology. The conditions in which technology may be effectively utilised in classrooms to promote student learning is a key topic surrounding the relationship between technology and education.

7.3.5 Different Demands due to e-Learning System (DD)

On the different demands due to e-Learning system, the respondents were requested to provide feedback on the demands the online system has brought on that differs from the face-to-face platform. The responses in this category related to the respondents' views of demands due to the introduction of the e-Learning system in learning and teaching. This theme draws three responses out of five from participants. Some responses in this theme noted that there was a demand on online learning and teaching, while others felt it was not stressful. The following quotes are examples of the respondents in this theme:

"The university only realised during Covid-19 that we needed to focus more on improving the educational technology skills of our students and lecturers" (participant 4).

"I am on the opinion that not only learning designers with competence in educational technology are missing at the university to assist in the demand students and lecturers are facing, but also academic personnel and students who can comprehend and rethink the new teaching and learning methods are an issue" (participant 5).

"Covid-19 has also made the university realise that we need to put in place infrastructural mechanisms that will allow students and lecturers to work from home more easily. So, when Covid-19 arrived, we realised we required more resources such as laptops, and data, thus the decision was taken to shift everything to the cloud so that we could have better spaces and our online systems could work more efficiently" (participant 2).

The above quotes suggest that providing different types of 'support' for students and lecturers who are less comfortable with technology, might be the only way to promote increased involvement with the online environment.

7.3.6 Students and Academic Staff Computer Specs Requirements (CS)

To function in the present learning environment, all institutions of higher learning need students and lecturers to have access to, and ongoing usage of a laptop/mobile computer for faculty courses. Some higher education courses require students to complete coursework using mobile laptops. As a result, students must use electronic means to obtain material, submit assignments, and connect with other students and professors. Departments with ITN support should be able to acquire pre-configured PCs and peripherals that are relevant to both students and staff when it comes time to buy new computers. Hence, under this theme, comments about general computer specs requirements such as those which refer to processor, memory, hard disk, mouse/keyboard, camera, network hardware, operating system, backup hardware, and battery were coded.

This theme elicited three responses from the participants. Some responses revealed that there is a need to change students' desktops in the computer labs and academic staff laptops on a regular basis, based on their life span. In addition, participants complained about the processor, network hardware, battery life and backup hardware, saying it did not meet the level required by the demand of work they do. In support of this statement, one participant indicated:

"The Covid-19 has compelled the university to consider upgrading students' desktops in the computer labs and academic staff laptops, which are due for replacement on time. Some of the computers used by the students and academic staff are of poor quality. Some employees are using computers that are six years old, while university regulation mandates that computers be replaced every three years" (participant 1).

The most essential step towards successful technology integration is undoubtedly universal availability to the hardware needed to operate educational computer programs. If computer lab time, and computer availability are limited, it is impossible to consistently use instructional technology (Warschauer et al., 2014). Due to irregular computer availability, lecturers find it exceedingly challenging to integrate technology into present lesson plans.

7.4 Perceptions of ITN and TLDC Staff regarding Support Services

There were five themes emanating from the data with respect to the support services construct. These included helpdesk support services to students and staff, training and support demand from students and staff, barriers that prevent the implementation of a more pro-active fault detection and resolution system, availability of training on the use of e-Learning system, and challenges on support services for improving the adoption of e-Learning. In Table 7.3, a summary of each of these categories, as well as their frequencies is presented. The number of times the theme is mentioned in the transcripts is referred to as the frequency. In the section that follow, where participants are cited directly, the details of their responses to each of these themes are given.

Table 7. 3: Coding for the Support services construct

Theme	Codes	Description	Frequency
Helpdesk support services to students and staff.	HPS	With the expanding intervention of remote technology in the near term and beyond, the function of constant, high-quality IT help desk service in the Higher Education market has become crucial.	4
Training and support demand from students and staff.	TSD	The goal of ICT training is to provide relevant, practical computer training courses to assist students and postgraduate students in learning how to operate the most widely used ICTs enabled applications.	3
Barriers that prevent the implementation of a more pro-active fault detection and resolution system as a support service for staff and students.	BIP	The scale of students and staff ICT responsibility, the degree of control they have over their ICT direction, the skills and competencies of ICT staff, the levels of demand on the ICT service, and the resources dedicated to the ICT service determine the university's ability to adapt to the constantly changing ICT environment.	4
Training on the use of the e-Learning system is available for lecturers and students.	TES	Students and lecturers should be subjected to a continuous and rigorous training program targeted at strengthening digital literacy abilities, which can then be deployed across the vast spectrum of hardware, software, and Internet applications that will be part of the user's digital collection.	5
Challenges on support services for improving the adoption of e-	CSS	Users are kept informed about the university's ICT systems and operations through a variety of methods. Policies, processes, and service standards in the field	4

Learning at the participating University.		of information technology are constantly up to date and available. Timelines for implementing new technologies and systems are communicated clearly and consistently, and special emphasis is paid to the knowledge transfer that is necessary to enable the technology's use.	

7.4.1 Helpdesk Support Services to Staff and Students (HPS)

In the helpdesk support services to students and staff theme, contributions related to the current state of play with respect to providing e-Learning technical support services to students and lecturers were considered. This theme was among the second highest. From the five participants that responded to this theme, four revealed that the existing state of play in terms of delivering e-Learning support services to students and lecturers is insufficient, and that the helpdesk is unable to satisfy clients. One respondent remarked as follows:

"Prior to Covid-19, there was no help desk service for students at all. It was only given to lecturers, and it was also not satisfactory and efficient. The institution only realised the increase of helpdesk services on technology to everyone because of Covid-19 pandemic" (participant 5).

The recorded response was also in line with the literature overview that specifically indicated that technical support services for students and lecturers is necessary so that it can improve the use of an effective e-Learning system (Omoda-Onyait & Lubega, 2011). Also implicated in the above results is that easy access to course resources and technology enhancements to teaching and learning are examples of support services needed for the effectiveness of e-Learning to stakeholders (Casey, 2013).

7.4.2 Training and Support Demand from Staff and Students (TSD)

Lack of training could result in students and lecturers missing benefits such as a fresh viewpoint on the knowledge-sharing process, and a better comprehension of the future of e-Learning support systems that utilise new technical possibilities. Training for students and lecturers must be prepared in accordance with a specific university plan, and that knowledge exchange must be equally vigorous for both students and lecturers. In the training and support demand from staff and students' theme, comments about general training and support aspects such as those which refer to lack of training and support on the use of technology in learning and teaching were considered. This theme elicited three similar responses from participants. Some responses in this theme noted that there was a lack of training and support in the university in terms of getting access to the Internet and learning materials, recording videos, and uploading videos from YouTube, however, others were comfortable with the use of technology. The following quotes are examples in this theme:

Concerning staff and students' experiences in training and support demand, respondents held different views. The following responses were echoed:

"*The demand was high, and we struggled to absorb the pressure from both students and lecturers as a unit*" *(participant 1).*

"Students and lecturers need to be trained on using new technologies, including how lecturers can adapt their existing materials to an online platform" (participant 2).

"Students needed to know how to get access to learning materials and how to make better use of their data for learning. During the initial stages of Covid-19 in the year 2020, this university had begun with the introduction of technology training to lecturers and students, with the goal of increasing the number of participants in the training sessions" (participant 3).

These results suggest that the participating University of Technology needs to devise a new strategy to encourage students and lecturers to attend training sessions. The only assumption that could be made was that the low attendance was due to poor marketing and advertising of the training opportunities. The Covid-19 pandemic effect contributed to an immense increase in the number of attendees, which caught the university off guard as the demand could not be met immediately.

7.4.3 Barriers that Prevent the Implementation of a More Pro-Active Fault (BIP)

The purpose of the barriers that prevent the implementation of a more pro-active fault theme, was to investigate the main barriers that exist in the various departments in the institution that hinder participants from implementing a more pro-active fault detection and resolution system, as a support service for students and lecturers. Hence, under this construct, comments about general main barriers such as those, which refer to the shortage of skills and staff capacity, are coded. The responses in this category related to the respondents' perceptions of barriers that prevent the implementation of a more pro-active fault. This theme elicited four responses from the participants. Some response noted that support departments work in silos and hence fail to understand the barriers faced by students and lecturers in the use of technology. The comments in this theme also revealed that the helpdesk system that was meant to address students' and lecturers' issues has not been efficient. Two respondents expressed their utter disbelief and disgust regarding the barriers by saying:

"There is lack of technical staff capability and skills. The helpdesk system, which is supposed to mediate and assist technical staff with job tickets and logging online, has not been helping thus rendering poor services to clients" (participant 5).

"For the unit to be pro-active, departments in the institutions should stop working in silos, constant communication on what units are doing is important so that we do not duplicate efforts to improve the implementation of e-Learning systems" (participant 4).

These results suggest that a clear plan must be in place for how the university wants to implement the e-Learning project for the benefit of students and lecturers. If this University wishes to transform the current scenario regarding online teaching and learning, it will need to build a strong working partnership of all contributing departments to the implementation of e-Learning.

7.4.4 Training on the Use of e-Learning System Available (TES)

In the training on the use of an e-Learning system available theme, contributions related to the current practice with respect to student and lecturer training on the use of learning and teaching using technology are considered. This theme of professional development addresses the question of training workshop attendance to improve students' and lecturers' skills to work in an ICT environment. This theme was the highest in terms of participants' responses, meaning all five participants felt the same way about it. In response to the kind of training available for students and lecturers on the use of the e-Learning system, the participants revealed that there are once-off seminars and workshops with no ongoing training sessions. The comments in this theme also revealed that, due to the different nature of academic departments' disciplines, it is also critical to ensure that the trainer is adequately trained to provide training on the use of technology. The following responses on the kind of training available were given:

"As the unit, we really need to offer extensive training to both students and lecturers since the university has request all staff and students to go online due to Covid-19 pandemic. The seminars and workshops we have had with students and lecturers have given us an opportunity to develop a survey to all students and lecturers so that we can really establish their experience of computer literacy and technology use" (participant 1).

"Our training sessions were one-size-fits-all training. There is a need to also offer digital literacy as some of the lecturers in the training indicated that they do not know how to make a PowerPoint presentation which we found it strange" (participant 5).

"The university need to migrate to 4IR completely and develop technology infrastructure, which includes laptops and Wi-Fi. The University also need to invest more money on student and lecturer data and iPads" (participant 3).

All the above responses pointed to frustration with role players in the e-Learning environment. It is therefore necessary to develop customised solutions utilising proper technologies since different subjects require different technology skills. Based on the responses, the university has to develop a training project for both students and lecturers and to suspend ad hoc training. Ongoing seminars, presentations, and staff development workshops can assist staff to show alternative techniques for engaging students in online education, but these activities must be relevant to the target audience and given at times and places that are suitable for the staff.

7.4.5 Challenges on Support Services for Improving the Adoption of e-Learning (CSS)

The fifth and final theme assigned to the support service construct relates to challenges on support services for improving the adoption of e-Learning. Under this theme, comments about general challenges students and lecturers face with regards to acceptance and adoption of an e-Learning system are coded. This theme elicited four out of five responses from the respondents, indicating that lengthy procurement processes to procure equipment are challenges they face with on support services for improving the adoption of e-Learning. In emphasising this point, participants said:

"It takes an eternity to buy equipment that may be utilised to increase e-Learning adoption and acceptance. The university will be stuck with F2F teaching and learning if the legacy prevails" (participant 2).

"There is a clear need to improve procurement services at this university. The policies on procurement should be clearly explained to all university community members before they are implemented so that everyone is clear about the processes to follow when procurement of equipment must be done" (participant 4).

From the above responses, the effective implementation of an e-Learning system requires that students and lecturers be given the necessary technical support services that could make them active participants on the system. Students and lecturers should also be given chances for engagement in ways that encourage change and progress in their understanding of knowledge and technology usage.

7.4.6 Overall Themes and Descriptions Considered to be Enablers to e-Learning

Two themes and descriptions emanated from the data with respect to the enablers to e-Learning systems as shown in Table 7.4. These include available resources, Covid-19, individual passions and initiatives, and management support. The descriptions in Table 7.4 are presented such that they do not need further details.

Table 7. 4: Coding for overall enablers for ITN and TLDC senior staff members

Themes	**Codes**	**Description**	**Frequency**
Available resources	AT	The institution has several resources to support eLearning.	5
COVID-19	C	COVID-19 has fast-tracked the adoption of eLearning.	5

7.5 Overall Themes and Descriptions Considered to be Barriers to e-Learning

Eight main themes emanated from the data with respect to the barriers to e-Learning systems as shown in Table 7.5. These included inexperience staff, lack of interest and resistance, infrastructure/resources, poor leadership/management, poor management of infrastructure, poor policy implementation, difficult procurement processes, shortage of devices/resources, and shortage of skilled personnel. Each of these categories is summarised in descriptions and frequency. The number of times a theme stated in the transcripts was referred to as the frequency. The details of the responses to each of these themes in the sections that follow where participants quoted verbatim are presented.

Table 7. 5: Coding for overall barriers to e-Learning for ITN and TLDC senior staff members

Themes	Codes	Description	Frequency
Inexperienced staff	IS	Staff members are not sufficiently experienced in design and delivery of eLearning.	5
Lack of interest and resistance	IR	There is lack of interest and resistance towards e-Learning.	1
Infrastructure / resources	IRs	Existing infrastructure is not sufficient to support e-Learning.	5
Poor management of infrastructure	PMI	e-Learning infrastructure is poorly managed.	5
Poor policy implementation	PPI	Policies and strategies concerning e-Learning are not properly implemented.	3
Difficult procurement processes	DPR	Inefficiencies in procurement processes affects e-Learning.	4
Shortage of devices /resources	SDR	Staff, students, and lab venues do not have sufficient e-Learning devices.	2
Shortage of skilled personnel	SSP	Insufficient personnel to support e-Learning processes and infrastructure.	1

7.6 Overall Perceptions of ITN and TLDC Staff about the Implementation of e-Learning

Eight themes and descriptions associated with the recommendations of the implementation strategies of an e-Learning system is shown in Table 7.6. The themes include online lessons, marketing of learning management system, coordination, and communication, creating incentives, learning from other institutions, monitoring and evaluation, provision of resources, recruitment and retention of skilled personnel, skills and resource audits, timeous response to requests, training, and capacity building, clear e-Learning strategy, improved management support and student-focused support. The number of respondents (frequency) in each description is given. The descriptions in Table 7.6 are presented such that they do not need further details.

Table 7. 6: Coding for the overall recommendations for ITN and TLDC senior staff members

Themes	Codes	Description	Frequency
Marketing of LMS	M	Continuous marketing of e-Learning to enhance uptake.	1
Coordination and communication	CC	Coordination and communication among stakeholders.	2
Provide resources	PR	Institution should provide the needed e-Learning resources & infrastructure.	2
Recruit& retain skilled personnel	RS	Recruit sufficient number and skilled personnel to support e-Learning.	3
Training and capacity building	TA	Ongoing training and capacity building of staff and students.	4
Clear eLearning Strategy	ES	Develop & implement clear e-Learning strategy.	1
Improved management support	IMS	Improved support of e-Learning by management.	2
Student-focused support	SS	Provide student-focused support.	3

7.7 Perceptions of Heads of Departments and Deans of Faculties about the Strategy

There were seven main themes emanating from the data with respect to the strategy construct. These included Adopting ICT in TLA, Strategies for ICT integration to improve student results, Teaching staff pedagogical knowledge innovations, Students have sufficient knowledge to work within an ICT environment, Senior management influence and support affect the uptake of eLearning, Strategies in your departments to integrate existing and emerging ICTs in T&L, and University strategy support students in an ICT environment. Each of these categories, summarised descriptions, and frequencies are summarised below in Table 7.7. Frequencies refer to the number of times that the theme was mentioned across the transcripts. The details of the responses to each of these themes in the sections that follow where participants' comments are quoted verbatim are presented.

Table 7. 7 : Coding for the strategy construct

Themes	Codes	Description	Frequency
Adopting ICT in TLA	AI	The ICT environment includes both internal and external technology factors that affect students' adoption of e-Learning resources in HEIs.	5
Strategies for ICT integration to improve student results	SIIS	Students may go to the next level in their usage of ICT in learning and teaching with the right technological infrastructure and LMS.	3
Teaching staff pedagogical knowledge innovations	PI	The term "pedagogical knowledge" refers to the specific information that teachers possess for creating effective learning and teaching environments for all students. The advantages of using digital tools and modern technology vary depending on the type.	7
Students have sufficient knowledge to work within an ICT environment	KICT E	ICT, which is based on a constructive learning approach, enables students to focus on more significant tasks rather than lower-level ones. Through collaborative learning using ICT, students have more opportunities to add new knowledge to their existing knowledge, and the courage to take risks and learn from their mistakes.	7
Senior management influence and support affect the uptake of eLearning	MIS	Covid-19 has forced management to realize that to achieve remote teaching and learning, provisioning of quality computers and data should be prioritized.	6
Strategies in your departments to integrate existing and emerging ICTs in T&L	DS	There are no current plans to combine T&L with both new and old ICTs. Using ICT can help students be more creative. They might pick up new multimedia skills and discover how to create material in the readily	7

		available styles through games. Through collaborative learning using ICT, students have more opportunities to add new knowledge to their existing knowledge, and the courage to take risks and learn from their mistakes.	
University strategy support students in an ICT environment	SSS	Technology should be used, not only to support traditional teaching methods. Not only should academics research how to utilize technology to supplement conventional teaching or increase productivity, but also how to incorporate ICT into classroom activities to encourage student learning from a student-centered perspective. This should be captured in the university strategy	7

7.7.1 Adopting ICT in TLA (AI)

The use of ICT in learning, teaching, and assessment has had a significant impact on how we learn, how we live, and how we approach every activity as a species, including education. However, as the world rapidly transitions to digital media and information, the importance of ICT in education is growing. Hence, under this theme, comments about general issues that could promote or inhibit the adoption of ICT are coded. This theme elicited five responses from the participants. Some responses in this category revealed a need to ensure that the University has an infrastructure that is conducive for students and lecturers to have progressed in integrating ICTs into teaching, learning, and assessment. The comments in this theme also revealed that for successful technology adoption, an institutional e-Learning policy that focuses on encouraging academics to participate in pedagogical reform and bring about a fundamental shift in an institution's learning and teaching culture should be in place.
The following quotes are examples in this theme:

"The lack of resources to support a multimodal approach to learning and teaching has a significant influence on lecture delivery and student learning. The lack of technology

infrastructure and students' and lecturers under preparedness to use technology for teaching and learning are reasons for the slow adoption of ICTs in this institution" (participant 1).

"Both students and lecturers were not ready to integrate technology through e-Learning system prior Covid-19 pandemic. It is important to understand that we should not only look at how many people have access to a computer, however, it is important to look at how many people can use the computer effectively for the purpose of learning and teaching" (participant 3).

"The university needs an infrastructure that allows everyone to have access to and use technology without difficulty on a regular basis" (participant 4).

To improve students' and lecturers' enthusiasm to utilize technology, any academic institution should priorities resources that may be used to upgrade the e-Learning system and provide Wi-Fi in classrooms, ensuring that there are no issues with using technology in lecture halls. Poor Internet connectivity and Wi-Fi band can result in the lack of progress of both students and lecturers in adopting e-Learning. It is critical to understand how implicit values, skills, cultural attitudes, and regulations might affect how an institution transitions and sustains new educational systems like e-Learning.

7.7.2 Strategies for ICT Integration to Improve Student Results (SIIS)

The term "ICT integration" in education refers to a technology-based learning and teaching process that is closely related to the usage of teaching aids in educational institutions. Since students are familiar with technology, and perform better in a technologically driven environment, the incorporation of ICT in the classroom is essential. With the help and support of ICT elements and components, the usage of ICT will result in successful learning. The use of technology in education has a significant impact on pedagogical aspects. The responses in this category related to the respondents' view of strategies for ICT integration to improve students' results. This theme focused on ICT integration strategies that the University uses to increase student success rates, as envisioned in the institution's strategic plan. This theme elicited the lowest number (3) of responses from participants. Some participants in this category noted that the support in terms of technology infrastructure or equipment, training of students, as well as the upgrading of procurement processes is lacking. Hence all the seven participants deemed the acquisition of high-quality technology equipment critical. The following comments emphasising this view are given below:

"The necessary procurement policies and guidelines should be articulated to all relevant departments so that staff could understand the processes that should be followed when procuring an equipment. Technology enhanced infrastructure, e-Learning strategy and policy should be in place before implementing e-Learning system since these factors will give direction" (participant 5).

"Many of the lecturers lack in-depth knowledge of how to conduct assessments using e-Learning system. This requires a strategy that could be implemented for training purposes" (participant 6).

"Providing access to computers is essential, however we need to explore the use of cell phones which is cheaper gadget. The university should consider providing students with smart phones instead of computers. In this case almost all the students can get this and use it for teaching learning purposes" (participant 7).

The above quotes clearly indicate that technology adoption can be disruptive, causing significant shifts in organisational culture and lecturers' long-term teaching practices. However, senior management should comprehend the nature and influence of innovation on them in order to develop suitable policies and strategies. A thorough understanding of the new online and mixed teaching environment, as well as the administrative and technological assistance that may be expected, is required for a successful transition to online teaching.

A common objective of many universities e-Learning strategies is to increase access to education. The university's e-Learning plan should not intentionally have unclear goals. Staff and student development must be considered as a critical aspect of implementing the university e-Learning strategy. HEIs that want to use e-Learning should plan their implementation approach thoroughly. Without a solid plan, e-Learning implementation risks the danger of cost overruns and the creation of unattractive e-Learning materials, which might lead to long-term failure for institutions.

7.7.3 Teaching Staff Knowledge about Pedagogical Innovations (PI)

Higher education must ensure the continuity of educational techniques that are focused on the student's growth of knowledge and practical skills. This will guarantee that their growth is not centred on the instructor, and that the result of knowledge is prioritised above the process of production. The more we learn about creative pedagogical techniques and how we can improve the teaching and learning process, the better we are able to prepare students for the job market. The responses in this category relate to the respondents' view of teaching staff knowledge about pedagogical innovations. This theme elicited the highest number (7) of respondents from the participants. There were convergent opinions in knowledge about, and access to, pedagogical innovations to make a positive impact on student learning outcomes.

The comments in this theme also revealed that, to grow the participation of students and lecturers on increasing knowledge on pedagogical innovations, the participating university should introduce an awards system not in monetary value, but rather a set of awards that encourage people to demonstrate their knowledge of technology and their ability to use it. This could be done by introducing a conversation each week, for example, on how to best upload video material to a learning management system. The discussion forum that could be created, should allow everyone to contribute by declaring their level of understanding of how technology can be used in the classroom.

For example, 3 respondents said:

"We do not have sufficient knowledge about pedagogical innovations (participant 2). Intensive workshops are required to provide students and lecturers with knowledge on numerous educational advances (participant 3). Lecturers require training that demonstrate various approaches to teaching that will have a beneficial influence on our students" (participant 7).

Based on the above quotes, identifying lecturer pedagogical beliefs and traditions with technology that is directly linked to perceived contextual factors, is essential in the integration of technology into learning and teaching. The quotes also suggest that insufficient technological integration can be attributed to a lack of experience, and unfavourable attitudes and beliefs.

7.7.4 Students Have Sufficient Knowledge to Work within an ICT Environment (KICTE)

The ability to use a computer is not the sole ICT skill needed to make effective use of information available on the Internet. Students' literacy in ICT or information is required to make effective use of these online resources. Remarks on broad ICT competence as the capacity to fully grasp and develop a wide range of capabilities such as identifying, assessing, and effectively using information, under this subject are categorised. This might indicate that, in addition to these core skills, the ability to question, communicate, and gather data is critical. Every student's education today includes learning how to use computers successfully. The respondents' views on the use of ICT in every sphere of life as extremely important since it enables growth, develops knowledge, and boosts productivity and human resources. However, it is critical to recognise that in order to properly harness the benefits of ICT for learning, students must acquire certain abilities. If students do not develop these abilities, they will never be able to attain high-quality learning with ICT. Students' knowledge to work within an ICT environment theme was amongst the highest number (4) responses from the participants. This implies that many respondents gave similar views on this theme. The common response was:

"The students do not have sufficient knowledge to work within an ICT environment. The learning management systems are not being used effectively due to a lack of knowledge and abilities to navigate the system. Furthermore, use of learning management system through e-Learning system is hampered by a lack of technical resources, as well as a lack of training, skills, and support in the development of learning materials" (participant 4).

The results of this study support the idea that universities should increase students' and lecturers' enthusiasm for e-Learning and improve their skills to support online systems, given the difficulties associated with e-Learning in this university, which has a significant impact on the quality of learning. Additionally, some students may find it challenging to access the e-Learning platform used for learning and teaching if they lack the necessary information to use it.

7.7.5 Senior Management's Influence and Support Affect the Uptake of eLearning (MIS)

To influence and encourage the adoption of e-Learning in any institution, top management must supply the required gear, software, and Internet connection. If the essential technological resources are regularly updated, students and lecturers may be better equipped to accept online learning. It is critical for senior management to create new rules and regulations to encourage students and lecturers to use the e-Learning system. They will also need to make certain modifications to the educational policy to guarantee that the transition from conventional to e-Learning is as smooth as possible. Hence, under this theme, comments about general issues that can affect the uptake of e-Learning due to the lack of senior management influence and support to students and lecturers are coded. This theme elicited the most responses from the participants. Participants believe that senior management can influence the acceptance of e-Learning among students and lecturers if it provides the appropriate resources and infrastructure. For an example, one respondent said:

"The university's senior management is doing very little and seem to lack vision and knowledge of the e-Learning system, as there was not much influence and support for the adoption of e-Learning system prior to Covid-19. Individual lecturers were infusing technology in teaching on their own accord. It is critical to elicit enthusiasm from senior management for academics to recognise the value of the using technology in teaching and learning" (participant 1).

Another participant indicated:

"The presence of Covid-19 has once again made senior management realise the need to provide students and lecturers with computers and data which are critical in achieving remote teaching and learning" (participant 5).

To some extent, the foregoing comments imply that participating universities should be aware of the features of their online teaching populations and employ communication tactics that include all faculty members. The findings also suggest that the university should inform all employees and students about the function and goals of online learning initiatives in connection with the institution's academic mission and standards of excellence. To increase the quality and perceived quality of online learning outcomes, senior management and faculty members must collaborate. Senior management of educational institutions may increase faculty participation in online instruction by better understanding what motivates them to teach online. Overall, this subject provides fresh insights and recommendations for senior management to ensure that e-Learning systems are used and adopted.

7.7.6 Strategies in Departments to Integrate Existing and Emerging ICTs in T&L

Within the strategies of various academic departments to integrate existing and emerging ICTs in teaching and learning, contributions related to the current state of play with respect to individual academic department's e-Learning strategies are considered. From the seven participants that responded to this theme, all indicated a similar view that there are no strategies available in academic departments to integrate ICT in learning and teaching. The common response, quoted in verbatim was:

"No strategies to integrate existing and emerging ICTs in teaching and learning exist in many departments (participant 4). Faculties should be the ones to take the lead in developing the strategies that can address online system challenges that could be experienced by students and lecturers" (participant 6).

Based on the above, the proposal that each faculty and department establish, publish, and maintain its own e-Learning strategy should be a fundamental principle adopted at institutional level. This will eventually inspire departments to discuss and investigate how they might utilise technology to fulfil their own, and the university's goals, as well as enabling faculty to articulate and communicate their teaching views. As a result, the department's e-Learning plan should aim to use both top-down and bottom-up approaches to implementation. It should also state the university's fundamental goals and propose efforts to attract departmental buy-in to e-Learning and stimulate bottom-up engagement.

7.7.7 University Strategy Supports Students in an ICT Environment

When asked about the extent to which the university strategy document supports students in working in an ICT environment, the participants claimed there was nothing in the strategy that assisted students in working effectively in an ICT environment. This theme elicited similar views from all seven participants. An example of such a comment was:

"The university approach lacks clarity on how to attain high-quality education while incorporating technology. The most significant feature that is missing is an e-Learning policy and strategy, which is necessary for directing how the use of technology should be implemented" (participant 5).

The e-Learning implementation program should concentrate on increasing departmental ownership and commitment to the university plan in light of this context provided by the participants. It should engage department heads and other senior managers, starting by educating them on the groundswell of energy and excellent practice that is occurring. It should harness the energy of innovators to drive change ahead. It should help employees choose educationally sound technologies. When developing faculty or departmental plans to deploy e-Learning systems, the promotion that calls for the selection of an e-Learning champion within each academic department should be considered.

7.8 Perceptions of Heads of Departments and Deans of Faculties about Leadership

With respect to the leadership construct as shown in Table 7.8, five main themes originate from the data. These include Senior management decision-making on e-Learning implementation, Provision of funding by senior management and Council, Role played by Senate and the faculties in the provision of leadership and support, Provision of leadership by Operational units for advancing e-Learning, and Senior management promotion of e-Learning. Each of these categories' summarised descriptions and frequencies are summarised below in Table 7.8. Frequencies refer to the number of times the theme was mentioned across the transcripts. Subsequently, the details of the responses to each of these themes in the sections that follow, where participants' observations are quoted verbatim are presented.

Table 7. 8: Coding for the Leadership construct

Themes	**Codes**	**Description**	**Frequency**
Senior management decision-making on e-Learning implementation	MDC	Keeping up with the rapid ICT revolutions is a struggle for many colleges. The university's ability to adapt to the rapidly changing ICT environment is determined by the decision-making process and the level of integration in the university's governance structure.	5
Provision of funding by senior management and Council	FSMC	Institutions must spend time on their ICT infrastructure, as well as in student and staff development, in order to create an e-Learning environment. The investment expenses, as well as the development and delivery costs, must all be calculated.	4

		With rising demand for access and delivery flexibility, increased globalization, and increased competitiveness in higher education, the long-term consequences of not investing may be larger.	
Role played by Senate and the faculties in the provision of leadership and support	SF	Evaluation and monitoring exercise is lacking at Senate on the approved submissions.	4
Provision of leadership by Operational units for advancing e-Learning	PLO	The problems of change connected with technological concerns can be addressed by developing and implementing a thorough professional development programme that is based on well-established core leadership concepts.	5
Senior management promotion of e-Learning	SMP	The value of education collaborations with companies and communities must be prioritized by university administration. Senior management should not dismiss the importance of lecturers in e-Learning education programs; rather, they should recognize that without their support and leadership, lecturers would be unable or less able to assist their students' learning.	4

7.8.1 Decision-making Inclusive/extensive with Respect to Consultations with Staff and Students (DMIE)

In the theme, decision-making inclusive or extensive with respect to consultation with staff and students, comments about general views such as those, which refers to involvement of students and lecturers in the availability of technological resources and innovations are coded. This theme elicited the highest number (5) of responses from the participants. Some responses in this category noted that the decision-making process regarding e-Learning at the institution was not inclusive and extensive. The comments in this theme also revealed that students and lecturers should be involved in the decision-making process when purchasing any platform to be used for teaching and learning. The following quote is an example:

"University decision-making on e-Learning system is not inclusive and extensive in terms of consultations with students and lecturers". For example, the University currently uses the Blackboard learning management system, which was chosen primarily on the interest of a few individuals rather than extensive consultation and agreement" (participant 1).

The above response points to the fact that the necessity of user consultation is crucial since it may lead to user acceptance or opposition. The most crucial feature of e-Learning debates that is missing is a benchmarking exercise against the most successful users of a certain technology based on these respondents' view. In any university intending to introduce an e-Learning system, a new decision-making culture should be established because it will have a significant impact on the adoption of online teaching and learning. It is essential not to implement any teaching and learning methodology without proper consultation.

7.8.2 Senior Management and Council Funding Provision (MCF)

In this theme, participants were requested to comment on senior management and the University Council's commitment to providing funding for the adoption and acceptance of an e-Learning system. Participants responded that there is some leadership commitment; however, it requires improvement so that technology infrastructure challenges facing the institution can be addressed. This theme drew four similar comments from participants. For example, they indicated that:

"Prior to Covid-19, there was nothing worth mentioning in terms of support (participant 3). Funding for ICT integration should be prioritised at the senior management and Council levels, particularly now that we are facing the new normal (participant 5 & 6). This will help this institution to improve and become one of the institutions that are recognised for teaching and learning utilising technology" (participant 7).

This comment suggests that it is critical for the team in charge of promoting the e-Learning system to use appropriate costing methods, and to conduct a thorough cost/benefit analysis to determine the total costs, both direct and indirect, and submit a report to senior management and the Council for consideration each new financial year. As a result, it is critical that universities build an effective and transparent economic strategy that allows them to earn enough revenue to become self-sustaining and fund future expansion.

7.8.3 Role Played by Senate and the Faculties in the Provision of Leadership and Support (SFP)

The theme, role played by Senate and faculties in the provision of leadership and support, considers the role of the Senate and Faculties in providing leadership and support for the e-Learning system. Four out of seven common replies were presented by participants, indicating that the Senate, as the decision-making body on teaching and learning issues, should have a robust discussion on the adoption and acceptance of e-Learning and be able to hold Faculties accountable for poor implementation of this platform. The comments in this theme also revealed that Senate and faculty should be debating concerns of significant change in the university's usage of LMS to remedy likely underutilization. The following quotes are examples in this theme:

"The implementation of a well-defined technological integration decisions at Senate are lacking. Decisions on evaluation and monitoring of the e-Learning system implementation in board meetings are lacking" (participant 1).

In addition, another comment made was:

"The Senate is lacking major debates on the benefits and drawbacks of issues that could lead to long-term e-Learning. The Senate should give faculties a mandate to deal with the promotion and acceptance of e-Learning and ask them to report on their success in overcoming the challenges they face" (participant 4).

To some degree, these quotes suggest that as a quality control measure, e-Learning implementation and practice be benchmarked against world-renowned best practices to guarantee the quality of e-Learning instruction is not jeopardised. Any institution would benefit from knowing what practices work, what practices don't, and what practices they need to improve. A favourable assessment of e-Learning practice and engagement may also contribute to e-Learning implementation success, improved underutilisation, greater return on investment, and the promotion of online education.

7.8.4 Operational units Charged with the Responsibility of Providing Leadership for Advancing e-Learning (OCR)

The responses in this category relate to the respondents' views of operational units charged with the responsibility of providing leadership for advancing e-Learning. This theme elicited the highest number of common results. According to participants, the operational units entrusted with providing leadership for expanding e-Learning are insufficiently capacitated to undertake this crucial duty. An example of such a comment was:

"There is lack the skilled human resources to advance the e-Learning initiatives. Most of the personnel in the operational units are former students at the university under study who never had the opportunity to work in industry or at other institutions after completing their studies" (participant 2).

The above response indicates that having the correct skill set is crucial, and you can only gain that skill set by working in various industries and understanding the best practices available. The distinction between success and failure in implementing e-Learning may be determined by leadership style and change methods. Collaborating with the community to achieve corporate goals is an example of transformational leadership practices required in the advancement of an e-Learning system for learning and teaching.

7.8.5 Senior Management Promotion of e-Learning (MP)

One of the strategies public universities use to deal with the rising demand for higher education and to attract more students is to switch from the traditional face-to-face (F2F) method of content delivery to e-Learning that entails the use of computer and network-enabled knowledge transmission. In this theme, which is focused on e-Learning promotion by senior management, the responses focused on the respondents' view of senior management promotion of e-Learning. This theme elicited four responses from a total of seven participants. The comments on this topic stated university administration and technical support must provide the required technology resources in order to continually maintain the e-Learning system. This is due to the significant correlation between improving the successful adoption of an e-Learning system and having adequate access to e-Learning materials without any technical concerns. The following quotes are an example:

"A project of this size and scale, such as e-Learning implementation, is huge and capital-intensive. The most obvious place to begin adopting e-Learning is to examine the organisation's preparedness to embrace technology. A solid decision in terms of who should lead the e-Learning project has to be taken based on competence of the individual" (participant 1).

In addition to this comment, another participant said:

"The strategic goals for developing an e-Learning system would be impossible to achieve if senior management cannot reduce the degree of illiteracy" (participant 3).

ICT initiatives can fail for a variety of reasons, including poor planning, funding, human error, and other problems. Based on the respondents' views, it is suggested that senior management adopts proactive measures, which should include a preliminary assessment of e-Learning sustainability preparedness.

7.9 Perceptions of Heads of Department and Deans of Faculties about the Culture

Six main themes emanated from the data with respect to culture constructs. These included individual training, proficiency in technology usage in TLA, culture towards engaging in productive and beneficial online teaching and learning, students' technology skills promotion for higher education, students' training opportunities to use online, and access to e-Learning resources. Each of these categories' summarised descriptions and frequency are summarised below in Table 7.9. Frequency refers to the number of times it was mentioned across the transcripts. The details of the responses to each of these themes in the sections that follow where participants' comments are quoted verbatim are presented.

Table 7. 9: Coding for Culture construct

Themes	**Codes**	**Description**	**Frequency**
Individual training	IT	Offering comprehensive training to individuals who will be using the LMS, including both students and lecturers, helps to ensure that the online course platforms are positively welcomed by users. It also ensures that the entire university is on the same page when it comes to getting the	7

		most out of the LMS, which aids in the rollout's success.	
Proficiency in technology usage in TLA	PTU	Technological competence is the ability to use technology to communicate professionally and effectively, organize information, provide high-quality learning and teaching, and develop thinking skills. The ability of a teacher to utilize technology to instruct and support students as well improve learning, efficiency, and performance, is referred to as technological competency in the classroom.	4
Culture towards engaging in productive and beneficial online teaching and learning	CPO	Managing technical competency necessitates information systems that are standardized and aggregated, and then perfectly applied by technically competent personnel.	4
Students' technology skills promotion for higher education	STS	Even though students' access to digital devices is growing more diversified, a small but persistent percentage of first-year students start at university with inadequate access to ICTs and computer literacy abilities. Inadequate access to ICTs is a widespread problem stemming from the reality that only a small percentage of households have computers and Internet connectivity.	5
Students' training opportunities to use online	STO	A rigorous approach to online student training and a sizable investment in staff training and development are both necessary for developing institutional competency for online education. While it is true that face-to-face teaching skills such as curriculum knowledge and pedagogy translate to online settings, it is equally critical	7

		to understand the specific skills necessary for effective online learning and teaching.	
Access to e-Learning resources	AER	Any engagement activity should have a strong academic growth element of familiarity with free access to e-Learning resources. When it comes to adopting OERs, there is a lack of understanding about open educational resources (OER).	5

7.9.1 Individual Training (IT)

The individual training theme scored the highest with seven participants indicating that training is not given to individual students and lecturers as each have different levels of understanding teaching and learning using technology. The respondents generally acknowledged that the TLDC unit does not understand individual training needs for students and lecturers in the use of learning management systems and other technologies used in e-Learning, given the various character of students and lecturers. The comments in this theme also revealed that training should be well-planned, not overlap with academic programmes, and that it be ongoing throughout the e-Learning life cycle. Four respondents echoed the following common response:

"Instead of customising training based on the needs of various students and lecturers, they always provide very basic training sessions on the usage of technology (participant 1 & 2). Change of culture in training sessions for students and lecturers needs to be considered" (participant 3 & 5).

In addition to this comment, another participant said:

"Our institution should provide some training programs for us to improve their ICT abilities and therefore become more inclined to adopt e-Learning system since they can play a vital role in guaranteeing high self-efficacy for both students and lecturers" (participant 4).

The participants responses to this theme, suggest that students' and lecturers' training programmes should be executed through a structured form because it is critical for developing computer skills and instilling a good attitude toward the use of technology in the classroom. Lack of sufficient training for students and lecturers might be one of the causes for the sluggish uptake of the e-Learning system. Training builds the capacity, skills, and information needed to make e-Learning a viable instructional option.

7.9.2 Proficiency in Technology Usage in TLA (PTU)

The proficiency in technology usage in TLA theme focuses on protocols that are followed to assist academic staff becoming proficient in the use of technology for learning and teaching. This theme elicited four similar responses from participants. Some responses in this category noted that there is no proficiency in technology usage in teaching, learning, and assessment in the participating university. One such comment was:

“There are no standard procedures that are followed to assist academic staff in becoming proficient in the use of technology” (participant 7).

Another comment on the same point was:

“The department entrusted with the implementation of e-Learning at the university should develop an e-Learning strategy. This strategy should address approaches to be followed on training students and lecturers to use technology effectively in teaching and learning amongst other issues. The strategy should further assist in developing a program to help academics enhance their capacity to use technology” (participant 3).

In a developing country like South Africa, one of the primary issues in the higher education sector is to improve quality and standards in teaching and learning. ICT is useful not just for teaching and learning, but also for assessment and evaluation, as well as encouraging inclusive education. The above quotes indicate that ICT may enhance access to educational materials, improve learning quality, increase teacher efficiency, and function as a useful tool for bridging the digital divide across socioeconomic groups.

7.9.3 Productive and Beneficial Online Teaching and Learning (PBO)

In the productive and beneficial online teaching and learning theme, all seven participants agreed that a bad culture existed among students and lecturers involved in productive and effective online teaching and learning. The comments in this theme revealed that training on creating videos for learning materials and educating lecturers on how to upload them, as well as teaching students how to access learning materials through the learning management system, is a challenge that needs to be addressed.

"Prior to COVID-19, there was no culture among staff and students to engage in constructive and useful online learning and teaching. In addition, the culture is hampered by a lack of capacity among students and lecturers to use an e-Learning platform" (participant 5).

In addition to the above comment, participants are further quoted verbatim indicating that:

"It is crucial to make sure that students at our institution have strong self-efficacy in order to fulfil the intended functions; otherwise, it is difficult to complete the learning activities using an e-Learning system if students have low self-efficacy" (participant 1 & 2).

The results of this theme clearly indicate a need for instilling a positive culture for technology training, accompanied by proper infrastructure. It is critical for the units entrusted with the responsibility of training students and lecturers on online teaching and learning, in particular, to develop a culture of regularly holding training sessions and seminars to help with the use of e-Learning. The above quotes also show that e-Learning system adoption cannot proceed without frequent awareness workshops to provide students with a sense of security and motivation when utilising the system.

7.9.4 Students Technology Skills Promotion for Higher Education (STS)

In this theme, comments related to the level of technology skills students at this university have been considered. It is essential to first establish students' ability to work on the e-Learning system before they are thrown in the deep end. The responses in this category related to the respondents' views of students' technology skills promotion for higher education. Some responses in this category noted that lecturers have not had time to prepare their students for online learning prior to the Covid-19 pandemic due to inexperience and workload challenges. The development of students' technology skills for higher education is important. In this theme, five out of seven participants shared similar views. The following quotes are examples in this theme:

"The new normal has made it necessary for the university to improve students' orientation and induction programmes so that it factors promotion of students' technology skills. Our workload made it impossible to get time and take students through what they should do to access their learning materials and engage with us using technology" (participant 5).

In addition, participants indicated the following:

"During the implementation phase, technological considerations should be made. There are some possible accessibility, availability, and usability issues with the present e-Learning systems, especially for individuals who are less familiar with the Internet usage" (participant 4).

This finding suggests that non-technical students, or those more accustomed to traditional face-to-face learning environments, may find it challenging to assimilate course material in e-Learning platforms. Students' ICT abilities may represent a challenge while utilising an e-Learning system for learning purposes, and if the need for training is not met, students will not be able to reap the full benefits of the e-Learning environment. Even students who are more forceful and driven should receive specialised instruction on how to make the most of e-Learning settings.

7.9.5 Students' Training Opportunities (STO)

Under this theme, broad comments about students' training opportunities on how to effectively use the e-Learning system in their learning are considered. All seven participants indicated that students' training opportunities in the participating university are limited. The common statement made by respondents in this regard was:

"It is assumed that students would be able to learn on their own utilising technology without having received any structured training (participant 1). The university should investigate all options to make the e-Learning system user-friendly because there is a problem with some students finding it difficult to use due to varying educational levels among students (participant 3 & 5). This factor is crucial to improving performance and making the students feel the system's utility" (participant 6).

In addition, the respondents further indicated:

"If the university wishes to improve in its usage of the e-Learning platform, it should invest on capacitating lecturers and students on how to access and use technology. There should be compulsory training of students from their first entry in the university system together with increasing the use of e-tutors and peer helpers that can be available 24/7 in and out of the campus" (participant 7).

Based on the findings in this theme, there is a need to implement a long-term program aimed at improving students' abilities to integrate technology into their learning. The number of drop-in laboratories at the university should be increased. The universities should consider investing in building competence that will allow both students and lecturers to operate better and feel confident using the e-Learning system.

7.9.6 Access to e-Learning Resources (AER)

To use e-Learning, you need physical equipment like computers, servers, and communication networks. Furthermore, the accessibility of software programs and operating systems is critical to the success of e-Learning. The access to e-Learning materials by students and lecturers is the subject of this issue. The respondents indicated that a guarantee that students are adequately prepared and have access to relevant resources is needed. This will effectively make students use e-Learning systems for online learning. Some responses in this category noted that the current system is not easy to use by individuals who do not have personal computer skills, and therefore has the potential to lead to the system's failure. The comments on this subject also show that students with access to networked computers may be more likely to value a more adaptable learning environment, whereas students with no access to, or means to purchase a computer, may be excluded from this opportunity. The following quote is an example in this theme:

"Lack of computers and data for students, should be addressed at the university level so that students can understand and appreciate the importance of the e-Learning system. This will ensure that students are adequately prepared and have access to appropriate resources to allow them to effectively use the university systems for online learning" (participant 1).

One of the most important features of e-Learning methodology and delivery is that they give students more access to education when compared to the more conventional, less adaptable educational techniques. Due to technological advancements, students who previously did not have access to HE can now pursue their studies in the field that most closely fits their needs. Given that computers are a necessary component of effective e-Learning courses, it is crucial to look at both educational access and technological access when determining whether e-Learning gives students greater access to HE.

7.10 Overall Perceptions of Heads of Department and Deans of Faculties about Enablers to e-Learning Implementation

Four main themes emanated from the data with respect to the overall perceptions of heads of department and deans of faculties about technology enablers to e-Learning implementation as shown in Table 7.10. These include available resources, Covid-19, individual passions and initiatives, and management support. Each of these categories, summarised descriptions, and frequency are summarised below in Table 7.10, Frequency refers to the number of times that it was mentioned across the transcripts. Thereafter the details of the responses to each of these themes in the sections that follow where participants' comments are quoted verbatim are presented.

Table 7. 10: Coding for overall enablers from the participants

Themes	Codes	Description	Frequency
Available resources	AT	The institution has several resources to support eLearning.	6
COVID-19	C	COVID-19 has fast-tracked the adoption of eLearning.	4
Individual passions & initiatives	IPI	Some e-Learning initiatives are led by individual passions and initiatives.	2
Management support	MS	Ongoing management support has been instrumental in encouraging e-Learning uptake.	5

7.11 Barriers to e-Learning Perceived by Heads of Departments and Deans of Faculties

There were nine main themes emanating from the data with respect to the barriers to e-Learning implementation perceived by heads of departments and deans of faculties as shown in Table

7.11. These include inexperienced staff, lack of interest and resistance, infrastructure or resources, poor leadership or management, poor management of infrastructure, poor policy implementation, difficult procurement processes, shortage of devices or resources, and shortage of skilled personnel. Each of these categories, summarised descriptions, and frequency are summarised below in Table 7.11. Frequency refers to the number of times it was mentioned across the transcripts. Thereafter, the details of the responses to each of these themes in the sections that follow where participants' comments are quoted verbatim are presented.

Table 7. 11: Coding on barriers to e-Learning from Deans and HoDs

Themes	**Codes**	**Description**	**Frequency**
Inexperienced staff	IS	Staff members are not sufficiently experienced in the design and delivery of eLearning.	4
Lack of interest and resistance	IR	There is a lack of interest and resistance towards e-Learning.	3
Infrastructure / resources	IRs	Existing infrastructure is not sufficient to support eLearning.	2
Poor leadership / management	PL	Management is not doing enough to support and mainstream e-Learning.	3
Poor management of infrastructure	PMI	E-Learning infrastructure is poorly managed.	2
Poor policy implementation	PPI	Policies and strategies concerning e-Learning are lacking, hence there is poor implementation.	2
Difficult procurement processes	DPR	Inefficiencies in procurement processes affects e-Learning.	2
Shortage of devices /resources	SDR	Staff, students, and lecture venues do not have sufficient e-Learning devices.	2
Shortage of skilled personnel	SSP	Insufficient personnel to support e-Learning processes and infrastructure.	4

7.12 Recommendations

Fourteen main themes emanated from the data with respect to recommendations on the culture construct as indicated in Table 7.11. A description of each theme is articulated below.

Table 7. 12: Coding on recommendations from Deans and HoDs

Themes	Codes	Description	Frequency
Online lessons	OL	Introduce formal programmes on computer usage for learning	3
Marketing of LMS	M	Continuous marketing of e-Learning to enhance uptake	2
Coordination and communication	CC	Coordination and communication among stakeholders	6
Create incentives	CI	Introduction of awards to recognise lecturers that embrace eLearning	2
Learn from other institutions	LO	Benchmarking other institutions so that a similar approach can be adopted	2
Monitoring and evaluation	ME	Continuously monitor and evaluate the implementation of e-Learning across the institution	3
Provide resources	PR	Institution should be provided with the needed e-Learning resources & infrastructure	7
Recruit& retain skilled personnel	RS	Recruit enough, and skilled personnel to support e-Learning	2
Skills and resource audits	SA	Perform regular skills & resource audits to identify institutional needs.	2
Timeous response to requests	TR	Helpdesk should be structured to timeously respond to requests/tickets	1
Training and capacity building	TA	Ongoing training and capacity building of staff and students	5

Clear eLearning Strategy	ES	Develop & implement a clear e-Learning strategy	3
Improved management support	IMS	Improved support of e-Learning by management	4
Student-focused support	SS	Provide student-focused support	4

7.13 Chapter Summary

This chapter contains a presentation and analysis of data acquired through semi-structured interviews. Data from interview transcripts was used in the analysis. Several suggestions have emerged from the investigation. A more detailed description of these findings will be offered in Chapter 8.

CHAPTER 8: Discussion of Results, Conclusion, and Recommendations

8.1 Introduction

In chapter 5, 6 and 7 findings from students, lecturer questionnaires and semi-structured interviews respectively were presented. The main purpose of this chapter then, is to offer responses to the research questions and explore the similarities and contrasts between the results of the current study and earlier discoveries. The analysis of the results was guided by theoretical and conceptual viewpoints described in Chapter 3, Figure 3.6, which was used to guide the design, implementation, and analysis of the research. Three major phases were considered during data analysis that were presented in the preceding 3 chapters. The major findings as summarised under each phase are repeated in this chapter as the researcher interprets the results to pave way for discussion.

8.2 Phase 1: Students Results Interpretation

8.2.1 Students Demographics Profile

The students' demographic profile shown in Figure 5.1 and 5.2 in chapter 5 and participants in the current study were from a University of Technology in SA. The students that participated in the present study were from the Faculties of Engineering, Management Sciences, and Natural Sciences. There were 21.9% of students from the Faculty of Natural Sciences; 20.0% from the Faculty of Management Sciences; and 58.1% from the Faculty of Engineering who responded to the questionnaire survey. This could be attributed to the fact that students in the Faculty of Management in this university are a majority. The findings of this study show that male students made up the majority of those who replied (54.0%). This finding is comparable to the study on e-Learning system, where 60.5% of male students and 39.5% female students responded to the survey (Almaiah & Alyoussef, 2019). Figure 5.1 indicated that the bulk of the respondents (87.8%), were between the ages of 18 and 24, which is a promising sign for developing countries in terms of HE (Abdullah & Ward, 2016). This could be explained by the fact that currently students enrolling in universities are between the same ages observed in the present study.

8.2.2 Response Rate

Of the 1000 questionnaires distributed to students 835 were completed and returned, resulting in an 84 % response rate. According to PutraP, Widodo and Kamati (2017), the research study benchmark for return rates is 70 to 80%. Regarding representation of the whole population of interest, the response rates of 80.5 % for the questionnaire and 90.9 % for the interview are regarded as satisfactory (Johnson & Wislar, 2012).

8.2.3: Factors Influencing Students' Actual Use of Technology

The present study's first research question intended to determine which variables students believed to be enablers and impediments to the creation of a sustainable e-Learning environment. The factors were organised in terms of the constructs making up the framework proposed in Chapter 3. The constructs were: use of technology, access to technology, provisioning of technology training, and provision of technology infrastructure. Students' views pertaining to the factors associated with these constructs are summarised below.

8.2.3.1 Use of Technology

The results of the current research in terms of the WhatsApp platform used for learning, indicated that the majority (73%) of students have successfully utilised the WhatsApp platform for learning (see Figure 5.3). This finding is located within the construct (online socialisation) of the Salmon's Five Step Model. This finding might be attributed to the fact that most students enrolling at the universities have cell phones. These results are consistent with Ruxwana and Msibi (2018) who indicated that students develop abilities and capabilities through mobile phone social networking. Further findings revealed that the majority (66%) of students have used technology for learning (see Figure 5.3). Results of the current study further revealed that most students regularly made use of computers in the university's open labs for learning purposes (see Figure 5.3). Again, this finding is located within the construct (knowledge construction) from the Salmon's Five Step Model. However, the results also indicate that they encounter technological difficulties, such as inaccessibility of audio or video resources, technical support, immediate response, and the absence of adaptive technology. The It is quite challenging for lecturers to incorporate technology into current lesson plans when computer access is inconsistent (Kohn et al., 2010; Johnson, Jacovina, & Soto et al., 2016). Every institution that wants to integrate technology into learning and teaching must have regular access to hardware, software, and an Internet connection (Harrell & Bynum, 2018). This will enhance the efficacy of learning and teaching within the educational setting (Lye, 2013).

The results of the present study, also shows that only 43% of respondents successfully logged into Wi-Fi on campus (see Figure 5.3). This finding is in line with Mohammed (2020) who indicated that students have difficulty accessing the Internet at most universities in developing countries. The Internet is the most important resource for students who want to learn using ICTs. According to Ssekakubo et al., (2011), most e-Learning projects launched in some developing countries fail owing to several challenges to Internet connectivity in developing countries. According to (Al-Ghaith et al., 2010), Internet connectivity quality is a crucial element impacting the acceptance and use of e-Learning.

Finally, the respondents indicated that they have not used social networking technologies (Facebook, Twitter) for learning purposes (see Figure 5.3). This can be attributed to the fact that students have used these platforms largely for socialising amongst their friends and not for learning purposes. As a result, for learning with technologies to be feasible, social networking technology technical literacy is necessary. This implies a two-step process in which students first learn about the technologies before using them to study. The findings of the present study are congruent with those of Islam (2013) and Gwamba et al., (2018) and suggest that students should be exposed to many available learning technologies. The circumstances indicated in this section have the potential to negatively affect a student's ability to integrate technology through e-Learning environment. The overall results in this construct are located within the Salmon's Five Step Model.

8.2.3.2 Access to Technology

In terms of the researched university availing adequate computers and Internet connectivity for students, the results of the current study revealed that only 40% of students felt they had adequate computer and Internet connectivity (see Figure 5.5). This might be attributed to the fact that the participating university does not have a system of loaning students' computers and data. What must also be considered is that many students in this university come from low-income backgrounds. Therefore, for e-Learning to assist students by increasing their access to higher education, it is important to consider both access to education and access to technology, with computers being a crucial component of successful e-Learning courses (Hassanzadeh et al., 2012; Hani et al., 2013; Schindler et al., 2017). Certainly, the availability of computers and Internet facilities would increase students' access to technology in their learning as well as assist them in becoming self-directed independent students (Mikre, 2011; Schindler et al., 2017). Based on Gupta et al., (2020) students at the university participating in the study will find it difficult to work in an online environment.

The findings of this study's analysis of the availability of lecture halls or specialised computer labs with Internet connection for students showed that only 43% of respondents strongly agreed (see Figure 5.5). These results are like those carried by Sintema (2020) and Gupta et al., (2020) in which they found that a shortage of computers and Internet connection is prevalent in developing countries. These results also concur with those of Khan et al., (2012) and Tarus et al., (2015) who in their study of implementing e-Learning in higher education, indicated that in most institutions, there is always a shortage of computers in the computer labs, thus making integration of technology difficult. Access to ICTs is just a part of the efforts being made to address equality concerns. Equal care must be taken to ensure that the target students are really using the technology and that it is being used in ways that meet their requirements (Baelden & Van Audenhove, 2015). Chau (2010) raises concerns that the drive for technology-based initiatives like online education that utilise it as their foundation, hides the fact that not everyone has access to, or the knowledge to use it, and therefore would not profit from it.

In terms of students having sufficient access to ICT resources including hardware and software, the results showed that most students strongly disagree with this statement (see Figure 5.5). This finding is located within access and motivation construct on the Salmon's Five Step Model. The results of the current study with regards to students' experiences of the access to technology indicated that the participating university in the present study was not ready to exclusively implement e-Learning systems in learning and teaching. This finding is consistent with those of the studies carried out by Gulati (2008) and Sun, Tang, and Zuo (2020) in which insufficient hardware and software ICT resources were indicated as impediment factors on the uptake of e-Learning. To prevent e-Learning programs from being negatively impacted in the classroom, HEIs must offer wired and wireless networks with high connectivity bandwidth. HEIs should also make the necessary ICT infrastructure investments to enable students to readily access ICT gear, use user-friendly software, and receive consistent technical assistance. Students are, after all, the end users of the information systems that lecturers use to enhance students' learning experiences.

On the other hand, in terms of sufficient access to the Internet in lecture rooms, the study also revealed that students did not consider that access to the Internet in lecture rooms was sufficient (see Figure 5.5). The results are similar to a study done by Ndung'u et al., (2018) in which they found in their study that Internet was not always available on campus for students and academics to successfully integrate technology through e-Learning. In the study by Bediang et al., (2013) and Lakbala (2015) Internet access and bad Internet connection was indicated as a major impediment for integrating e-Learning for learning and teaching.

Finally, in terms of the university making sufficient provision for uninterruptible power supply for use during power cuts, the respondents indicated that there was interruptible power supply during power cuts. This finding is in line with Ossai (2020)) who noted that a lack of access to technology, combined with unstable power supplies made infrastructure availability the bane of online learning in Nigeria. These results are similar to those of a survey carried out by Makokha and Mutisya (2016) in public institutions in Kenya, where their results indicated that electric power disruptions are major impediments to e-Learning implementation. On the overall, the results of the current study in the access to technology construct are located to the Salmon's Five Step Model technology adoption framework.

8.2.3.3 Provisioning of Technology Training

The results of the present study regarding the lack of training in the use of technology for e-Learning environment, revealed that students believed they did not receive sufficient training in e-the Learning system (see Figure 5.7). These results depict other studies of a similar kind which indicated that structured technology training are challenges facing developing countries (Stödberg & Johan Orre, 2010). It is generally assumed that all students enrolling in higher education institutions have grown up with digital media and are computer literate. However, the current study found that students lack training on technology usage. The results of the current study are consistent with previous studies of Al-adwan and Smedley (2012) and show the importance of training and development to enhance the knowledge and skills necessary for learning. As indicated in other studies, training opportunities will afford them a platform to grow into active, self-directed students capable of interacting with the lecturer, collaborating with peers to develop personal understanding of course material, and taking increasing responsibility for their own learning (Khan et al., 2021).

Despite the increased use of social media by students and people in general, the results of the current study surprisingly revealed that students considered there was a lack of training in social media for learning purposes (see Figure 5.5). This points to an important issue, that students who are well versed in using social media do not consider themselves well prepared to use the same social media for learning and require specific training on how social media could be used optimally for learning purposes. Based on the study by Chawinga (2017), adequate students’ training on social media for class content learning purposes in higher education is lacking. As a result, to improve students' learning experiences, it's critical to train students on how to use, and benefit from, social media for learning purposes (El-Masri & Tarhini, 2017).

The findings of the present study further indicated that students thought there was insufficient training in Blackboard and Moodle learning management systems used in the participating institution (see Figure 5.5). These results depict other studies of a similar kind done in three Saudi Arabian universities which indicated that lack of training is the main barrier preventing students and lecturers from using learning management systems available in various universities (Alenezi, 2018). These results also concur with those of a study by Ertmer et al., (2012) that indicated that a lack of professional development on technology training results in the lack of e-Learning implementation. Therefore, it is necessary to give training and skills so that the faculty and students can utilise e-learning platforms efficiently. E-learning is more likely to be used effectively after ICT and related skills are learned through training.

In terms of lack of training in technological devices for learning, the results show that training in technological devices for learning was limited (see Figure 5.5). These findings imply that students and lecturers should be exposed and trained on many different types of technological devices so that they are able to use most available resources. Similar studies indicate that students and lecturers with inadequate training skills could became an impediment to the integration of technology through e-Learning system (Samir Abou El-Seoud et al., 2014).

Finally, in terms of the findings of the present study, it found that students believed there was insufficient training on teaching and learning through online platform for educational purposes (see Figure 5.5). This can be attributed to the fact that students do not get structured training on how they can effectively use the Internet for learning purposes instead of watching videos and connecting to one another through Facebook. Other studies on training for students and lecturers on the use of technology, indicated that if universities fail to come up with a structured programme to address this matter, they face the danger of falling behind in the use of technology through various techniques (Khan et al., 2021). Providing every student with computer learning application training, helps him or her gain sufficient understanding of how to utilise a computer for learning (Harrell & Bynum, 2018). Even if universities have the money to implement e-Learning, Aydin and Tasci (2005) concluded that using e-Learning systems may not be successful due to a lack of necessary abilities. In this section, all the results of the current study obtained are located within the technological pedagogical content knowledge (TPACK) framework. Thus, TPACK is a useful frame for thinking about what knowledge students must have to integrate technology into teaching and learning and how they must develop this knowledge.

8.2.3.4 Provisioning of Technology Infrastructure

The current study results regarding the provision of technology infrastructure for students in terms of classrooms configuration revealed that classroom configuration does not promote an e-Learning system due to insufficient infrastructure (see Figure 5.9). Based on the study by Akaslan et al., (2012), insufficient infrastructure is considered an impediment to e-Learning implementation. Therefore, it is essential that the necessary infrastructure is provided by universities for students and lecturers to realise the full benefits of e-Learning.

In terms of computer labs and classroom availability, the results show that computer labs are not enough, and cannot accommodate large numbers of students (see Figure 5.9). In a similar study to the present research, technology enhanced facilities are extensively scarce because of insufficient budget and over dependence on government funding (Philomina et al., 2020). Further studies suggest that significant infrastructural issues should be addressed if a university wants to achieve efficient utilisation of the e-Learning system (Mtebe & Raisamo, 2014). In addition to the lack of computer labs being an inadequate resource, researchers also discovered that in some universities, there were enough labs but a lack of Internet connectivity which could be an impediment to the use of e-Learning (Omoda-Onyait & Lubega, 2011).

In terms of computer labs and classrooms being constantly operational and in excellent functioning order, the findings indicated that computer laboratories and classrooms are not in good operating order (see Figure 5.9). This finding is in line with Tarus et al., (2015)'s study, which focused on the problems of adopting e-Learning in Kenya. According to their analysis, the infrastructure of most public institutions, including computers, networks, and Internet connectivity, is insufficient to support the enormous number of students who want to access e-

Learning (Ssekakubo et al., 2011b). Aydin and Tasci (2005) concluded that e-Learning systems may fail despite institutions occasionally having adequate resources for implementation, owing to a lack of requisite skills for utilising the resources. Finally, in terms of printing functionality available for students, the results also revealed that there is no printing functionality available for students (see Figure 5.9). In general, while their acquisition is dependent on financial resources, technological resources like computer and Internet connectivity facilities are essential facilitators for the long-term utilisation of e-Learning environment. The overall results in the provisioning of technology enhanced infrastructure construct in the current study are located to the facilitating conditions variable in the UTAUT technology adoption framework. From these results, it can be concluded that facilitating conditions in terms of the availability of hardware and software resources and technical support significantly will have an influence on the behavioural intention to use e-Learning environment.

8.2.3.5 Statistical Differences in Perceptions Based on Age, Gender, Grade 12 location, Qualification and Faculty

Students' perceptions of the use of technology, access to technology, provision of technology training, and provision of technology infrastructure that have the potential to enable or impede technology integration, have been examined based on age group, gender, Grade 12 location, qualification type, and faculty.

The age factor is considered in the analysis of results because some students in the researched university of technology start by getting employment opportunities before they enrol. This is beneficial to them because they receive bursaries from their employers to study at the university. The Ranksum test revealed a statistically significant difference by age only in the aspects of usage of technology and supply of technology infrastructure in the current study's results (Table 5.7). In other words, the findings demonstrated that students viewed the two dimensions as the greatest helpful or obstructing elements for technological integration. This might be because, as seen in Figures 5.9 and 5.10, students lack computers, data, and adequate Internet access.

In terms of gender, the data found that the change was statistically significant in access to technology between male and female students. This finding is similar with Hamad (2011) research on students' perceptions of e-Learning, which showed that participants chose accessibility as the most significant benefit of e-Learning, outranking others like flexibility, and cooperation.

The data showed that the total scores did not differ statistically significantly between individuals from urban and rural locations in Grade 12 (see Table 5.9). This conclusion suggests that students' adoption of technology is mostly determined by the availability and accessibility of technology equipment, rather than by their background. On the access to technology and supply of technological infrastructure aspects, the results revealed a statistically significant difference in total scores across certificate, diploma, and degree programmes in the students' current registration qualification (see Table 5.10). Finally, using the Kruskal test, the data indicated that across the three faculties of subjects, there was a sizable statistically significant variation in the overall scores for each of the characteristics (see Table 5.12).

8.3 Phase 2: Lecturers Results Interpretation

8.3.1 Lecturers Demographics Profile

The lecturers' demographics profile participated in the current study were represented by Figures 6.1; 6.2 and 6.3 in chapter 6. The lecturers participated in this study were also from a University of Technology in South Africa. Most of the respondents to the survey, 41.2% were lecturers from the Faculty of Natural Sciences; followed by Engineering (30.9%) and Management Sciences with (25,8%) responses. This might be attributed to the fact that lecturers in Engineering and Sciences are more aware of the potential benefits of technology in teaching and learning. According to the authors, academics in the sciences believe that technology is acceptable for their courses (Rolfe et al., 2006). The findings of the current study contrast those of Kisla et al., (2009), who found that Engineering had a larger percentage of academics' responders than other disciplines.

The lecturers surveyed are those who were expected to use e-Learning technology to improve the efficacy of educational institutions. Male academics made up the majority of those who replied (68.0 %) to the current survey. Other research concentrating on universities in Ghana, Lesotho, and Nigeria indicated that males were more likely to react than females (Owusu-Ansah, 2013; Ntemana & Olatokun, 2012; Oshinaike & Adekunmisi, 2012). This is a predicted trait in most developing nations, according to Abdullah and Ward (2016) in their study of analysis of the determinants for e-Learning services adoption. The demographics of the respondents in this survey, on the other hand, conflict with a study by Tayyib et al., (2020). These authors gathered data from 139 faculty members from 10 Saudi Arabian academic higher education institutions, where the bulk of the participants were female lecturers with a doctorate, more than 15 years of teaching experience, and 100% computer exposure.

8.3.2 Response Rate

A total of 97 of the 115 questionnaires sent to academics were completed and returned, yielding an 84.3 % response rate. The present study results in respect of response rate are similar to a study by Ntemana and Olatokun (2012) who engaged 250 copies of the questionnaire to academics in a comparable study, of which 213 were returned and all were judged relevant for analysis, yielding an 85.2 % response rate.

8.3.3: Factors Influencing Lecturers' Actual Use of Technology

The second research question (Chapter 1, section 1.6) in the current study aimed to determine lecturers' perceptions of barriers and enablers in creating a sustainable environment for the integration of technology and e-Learning system implementation at a UoT in SA. Institutional practices and e-Learning models from the literature that identify elements likely to impact the implementation of e-Learning can be used as a guide to gauge the likelihood of success. Additionally, some research findings on factors hindering or facilitating the integration of technology are discussed in relation to other studies. The following four constructs: Use of technology, Access to technology, Provision of technology training, and Provision of technology infrastructure for lecturers, were factors considered having the potential to hinder or enable the development of a successful sustainable e-Learning implementation.

8.3.3.1 Use of Technology

Even though most lecturers had previously used the e-Learning system prior to the survey, their options for using technology for learning and teaching are divided. The results of the current study revealed that most lecturers believe they always foster students' abilities to use technology for learning through facilitating teaching using technology (see Figure 6.4). This finding is located to social influence variable in the UTAUT model where lecturers have played an important role to socialise the students to the acceptance of use of technology.

The study also revealed that lecturers are of the opinion that they have some expertise to utilise technology to respond to students' topic queries outside of the classroom (see Figure 6.4). This staff member's perception may have been caused by the fact that they had uploaded learning materials for student learning which does not encompass the holistic use of technology.

Furthermore, in this construct, it was discovered that most responders responded that they could supply students with course materials (see Figure 6.4). The fact that just a fraction of the teaching staff in the entire university has been sufficiently taught on e-Learning abilities may be the cause of lecturer perspective in this respect. This finding can again be associated with effort expectancy variable from the UTAUT. The participants have indicated their level of effort that they give to promote integration of technology to their students.

Contrarily, the research also showed that lecturers are not satisfied with the experience they must use technology for designing general learning activities (quizzes, tutorials, tests) examinations since only 44% strongly agreed (see Figure 6.4). The findings of this study may need stakeholders to comprehend lecturers' viewpoints on the use of technology in teaching, and pinpoint challenges to restrict it. For lecturers and students to see the use of e-Learning positively, and advance and achieve the learning and teaching objectives, it is necessary to accommodate lecturers' expectations towards it in the teaching and learning activity.

Finally, there was evidence of discontent with the design and administering of formal assessments using technology (see Figure 6.4). It is not simple to acquire technology skills, and many instructors become frustrated when faced with the task of designing and administering formal exams due to a lack of technical understanding. With the rising usage of instructional designers for eLearning activities in higher education institutions, it is critical that we learn as much as we can about planning and producing effective instructional design across disciplines. PCK from the TPACK framework is one aspect of instructional design that has been overlooked. It is critical that we learn more about how values and culture, embedded within disciplines, cement pedagogy and content, resulting in practical and powerful pedagogical content knowledge.

8.3.3.2 Access to Technology

There was general disagreement to all five statements assessing the lecturers' experiences. On access to technology, the most popular response was "Disagreed", amounting to 51% of the participants who were dissatisfied with access to e-Learning resources in the classroom when they are teaching (see Figure 6.6). Notwithstanding the fact that lecturers' access to technology and integration of technology is imperative, they encounter numerous challenges, which if not recognised and attended to, could act as inhibitors.

The survey also showed that most participants had adequate access to the Internet on university campuses. This could be attributed to the fact that the executive management, in response to the Covid-19 pandemic in the year 2020, provided them with new computers and data, while students were only given data (see Figure 6.6). This result however contradicts the findings by Mutisya and Makokha (2016) who found that insufficient Internet connectivity was an inhibitor in their study on barriers to e-Learning uptake at Kenya's public universities. The challenge of access to the Internet and reliability of technology was also elevated in the study (Al-Senaidi et al., 2009).

The current study also revealed that respondents had sufficient Internet access off campus (see Figure 6.6). While only a few lecturers in Figure 6.6, may have access to Internet at home, a considerable number have had negative encounters with Internet connectivity in their homes due to network issues. On the other hand, the present study showed evidence of dissatisfaction regarding the non-availability of technical support whenever needed by lecturers (see Figure 6.6). According to the present study's findings, lecturers do not have appropriate access to technological support.

The study further revealed that lecturers do not have access to an instructional designer that could assist and support them in developing their courses (see Figure 6.6). This result is in line with Mutisya and Makokha (2016), who found that teachers at Kenya's public universities had insufficient ICT skills. They stressed that a lecturer's comfort and expertise in using computers and other ICT tools to impart knowledge and skills to their students was essential for e-Learning. The degree to which the lecturer had mastered the skills and his or her prior knowledge with the technology, were used to determine this competency. When lecturers lack confidence in their technological skills, they will either utilise it ineffectively or not at all, endangering the success of e-Learning integration. The findings in this paragraph can be located within the facilitating conditions variable of the UTAUT model where lecturers have indicated the extent to which insufficient access to technology could influence behavioural intention to use ICT systems.

Designing and teaching online courses entails a variety of academic responsibilities. These responsibilities begin with the course development process and continue until the course is delivered. The structure and instructional design of the course are the main duties during the development phase. A sequence of tasks needed resources, and scheduling, should be meticulously identified and planned. Lecturers can think about the opportunities and challenges they may encounter when developing online courses and the transition from a traditional classroom to an online learning and teaching environment after major components like the course description, specific course objectives, course competencies, evaluation criteria, and teaching strategies have been addressed.

Finally, participants revealed that they have insufficient access to e-Learning resources whenever necessary in the classroom (see Figure 6.6). Inequality in access to technology is driven by a variety of factors including infrastructure availability and reliability, university economic standing, lecturer technological capabilities, and user motivation. Any institution seeking to integrate technology into teaching and learning must have access to gear (such as laptops or tablets), software (such as reading and writing programs, web browsers), and an Internet connection on a regular basis. Consequently, the effectiveness of instruction and learning in the learning environment will increase (Lye, 2013). There are substantial worries that employing ICTs in education would widen existing gaps along economic, social, cultural, geographic, and gender lines given the stark inequalities in access to technology between developed and developing nations as well as between various groups within countries (Budhedeo, 2016). Undoubtedly, having widespread access to the hardware required to run instructional computer applications is the first and most fundamental step toward effective technology integration.

8.3.3.3 Provisioning of Technology Training

The study revealed that lecturers received enough training and professional development (see Figure 6.8). This is, however, very rare in public universities. This result may mean that the sample chosen had some ICT training opportunities. e-Learning programs focusing on training and continuous professional development, as well as adequate training and support on learning management systems, should be developed and strategically focused on pedagogy and e-Learning systems, despite the positive results of the current study on lecturers' provision of technology training (Esterhuizen et al., 2013). As a result, academics require professional development to gain new skills that will allow them to understand and determine why, when, and how to employ e-Learning in the classroom.

The current study also revealed that participants strongly agreed to adequate training and support on a learning management system (see Figure 6.8). This finding suggests a need to improve this focus area. The results of the investigation show that lecturers at this university are not opposed to receiving training in the use of technological applications; they are just unsure how to incorporate such training into lectures or other more formal teaching techniques. In the integration of technology in learning and teaching, lecturers: must learn to recognise their new roles, evaluate new pedagogical possibilities, and provide appropriate learning opportunities for the medium. In the absence of face-to-face teaching, they should learn how to communicate effectively and engage with students, as well as how to motivate students to study, and assess higher-order student learning outcomes. In support of previous studies, the current study recommends that universities in a developing country like South Africa, should give lecturers enough pedagogical training to improve their capacity to find, evaluate, and use material on the Internet to develop effective, original, and critical teaching and learning processes; and should offer administrative assistance (Clarke, 2007; Wells & Wells, 2007).

Moreover, the results of the present study revealed that lecturers do not have sufficient time to attend e-Learning training, which is a contradiction to the previous paragraph where they indicated they have enough training on technology (see Figure 6.8). This may be because most teaching staff are preoccupied with their regular teaching and research duties, and so do not have enough time to attend training seminars. However, the research also showed that lecturers' training on remote lecture presentation is lacking (see Figure 6.8). Once skills in ICT and e-Learning are acquired through training, then e-Learning is likely to be used effectively.

Lastly, consistent with Coman et al., (2020), the study revealed that training on emerging technologies is lacking (see Figure 6.8). By utilising the different functions offered by an e-Learning platform to adapt their teaching style to the online environment, such as using the video conference function where students may actively participate, lecturers' technological proficiency can be determined. These technological abilities also include the capacity to use developing technology to deliver lessons remotely (Coman et al., 2020). It goes without saying that the effectiveness of delivery and adequate instructor training in technology integration are necessary for the success of e-Learning in higher education.

The current study's overall outcomes in the delivery of technology training construct are located within the TPACK framework. To develop an effective foundation for teaching with educational technology, TPACK draws from the three main underlying areas of content, pedagogy, and technology (Saienko et al., 2020). To make successful use of the TPACK framework, teachers must be open to some essential notions. Technology can be used to depict concepts from the topic being taught. Pedagogical strategies can use technology to transmit content in a variety of ways. Varying material concepts necessitate different levels of expertise from teachers. Some of these requirements can be met with the use of educational technology. Educational technology can be utilized in conjunction with lecturers' existing expertise to either strengthen or generate new epistemologies (Harris & Hofer, 2011).

8.3.3.4 Provisioning of Technology Enhanced Infrastructure

The current study revealed that generally, ICT facilities (computers, Wi-Fi, and Internet) in the researched university of technology are not well functioning (see Figure 6.10). The findings regarding the lack of computers, Wi-Fi, and Internet, corroborated those of previous similar research in the field. Tarus (2015) discovered that at most public institutions in Kenya, to accommodate the enormous number of students who want access to e-Learning, infrastructure including computers, networks, and Internet connectivity, as well as computer laboratories, were insufficient.

The study also revealed that the lecturers at the university under study believe the quality of equipment available for integration of technology in teaching is not good enough (see Figure 6.10). This is evidenced by (64%) of respondents who believed the university has no high-quality equipment available for integration of technology in teaching. Obtaining suitable infrastructure (Internet, extranet, intranet, and LAN networks) for ICT production is one of the biggest obstacles to the introduction of e-Learning environment in HEIs, especially in poor nations. HE institutions must offer wired and wireless networks with large access bandwidth to prevent adversely affecting e-Learning programs. Furthermore, institutions of higher learning should make the necessary investments in ICT infrastructure to facilitate easy access to ICT hardware and software for students and professors, while also offering constant technical assistance. Moreover, the present study revealed that lecture room design does not support ICT in teaching (see Figure 6.10). In essence, (75%) of respondents believed the existing design in lecture rooms does not support ICT in teaching.

The study further revealed that fast and reliable Internet connectivity is lacking (see Figure 6.10). There was evidence of dissatisfaction concerning fast and reliable Internet connectivity. For example, there was strong disagreement (79%) on the existence of fast and reliable Internet connectivity in classrooms. Instead of depending on expensive and unreliable Internet, developing nations must devise creative ways to provide electronic learning materials on the national backbone to reap the benefits of e-Learning.

Lastly, the study revealed that there was no necessary teaching ICT infrastructure (see Figure 6.10). The majority of lecturers (78%) strongly agree that an ICT infrastructure is required for instruction. Based on these findings, higher education institutions should make investments in ICT infrastructure that facilitate easy access to ICT hardware and software for students and lecturers, while also offering constant technical assistance. These limitations, as well as lecturers' and students' limited access to e-Learning infrastructure, have the potential to increase the failure likelihood of any e-Learning initiative (Al, 2013). There was general disagreement to all five statements assessing the lecturers' experiences in the provision of technology infrastructure; the most popular response was “Disagree” amounting to (53.6%) of the participants who were dissatisfied with fast and reliable Internet connectivity (see Figure 6.10). There was evidence of statistically significant association between the dissatisfaction with the teaching ICT infrastructure and the fast and reliable Internet connectivity; high quality equipment available for integration of technology, and lecture room design support for ICT infrastructure in teaching ($p = 0.009$). Alternatively, there was no statistical significance with functioning ICT facilities.

The total outcomes of the current study's provisioning of technology enhanced infrastructure construct are located within the facilitating conditions variable from the UTAUT model. Facilitating conditions are analogous to the concepts of 'perceived behavioural control' and 'compatibility' in Theory of Planned Behavior (TPB) and Innovation Diffusion Theory (IDT), respectively. The invention of the UTAUT model, on the other hand, merged all the measurements of these two constructs into one known as facilitating conditions. In the context of the current study, a facilitating condition is a state in which an individual has access to all the required facilities, tools, equipment, and help to enable the use of a system. It is possible to hypothesize that facilitating conditions are a predictor of behavioural intention to utilize a system. The current study produced results which corroborate the findings of a great deal of previous work in this field. For example, a study on the use of technology found that supportive conditions have a significant effect on behavioural intention to use a web-based training system

(Alrawashdeh, 2012). Other related research' findings suggest that supportive conditions influence students' intention to utilize interactive white boards and e-learning systems in the learning environment (Teo, 2010; Wong et al., 2012).

8.3.3.5 Statistical Differences in Perceptions Based on Gender, Qualification and Faculty

It has been discovered that lecturer demographic characteristics have a significant impact on the elements that limit or support technology integration in higher education. The current study looked at the differing viewpoints of lecturers in respect of the use of technology, access to technology, technology training, and technology infrastructure. Gender, qualification, and faculty were among the demographics of lecturers chosen for the current study.

Using Ranksum and t-test, the current study found no statistically significant difference in total scores on gender for the dimensions: usage of technology, access to technology, provision of technology training, and availability of technology infrastructure that affect the implementation of e-Learning (see Table 6.6). However, on the usage of technology dimension, both girls and males got the greatest median score (17.0) and median score (19.0), respectively. This is because both male and female instructors view all four dimensions to be equally significant in the integration of technology.

However, using Kruskal and ANOVA tests, the data showed that the total scores did not differ statistically significantly among the educational levels for the four aspects (see Table 6.7). According to these data, qualification has little bearing on the incorporation of technology in HE. Regardless of their academic qualifications, all lecturers have a single obligation to use technology to improve learning and teaching in HE.

Finally, using Kruskal and ANOVA tests, the lecturers found no statistically significant variation in total scores for the dimensions between participants from the Faculty of Engineering, Management Sciences, and Natural Sciences (see Table 6.8). In other words, the data demonstrated that lecturers from all faculties thought the four aspects may help or hinder the integration of e-Learning systems into learning and teaching.

8.4 Phase 3: Qualitative Results Interpretation

The third and last research question of the current study was to pinpoint the organisational design and technological domain elements that could impact on how well technology is incorporated into education. According to the interview schedule, the qualitative analysis of the interview replies was pertinent to the questions (Annexure, C, D and E). The qualitative analysis of the interviews yielded results that were consistent with relevant issues from the literature review, particularly the theoretical framework in chapter 3, and the study's goals concerning the qualitative section.

In the qualitative study, 11 respondents were interviewed out of 15 who were scheduled to participate in the semi-structured interview, yielding a response rate of 73 %. All participants were accessible, except for four, who were unable to participate in the interview owing to poor Internet access.

8.4.1 Technological Domain Factors

As the following phase in the research process, the data from the qualitative study is analysed in a methodical manner in this section. The findings of the study were initially presented as a qualitative analysis of the data collected during the individual semi-structured interviews. Furthermore, it is critical to remember that the qualitative and quantitative aspects of the data are linked, in that the qualitative data findings help the establishment of a sustainable e-Learning environment for the participating UoT in the current research.

The first aspect of research question three examines the technological domain in the current study as indicated in Chapter 1 section 1.6. This research question adopted a qualitative-interpretivist-pragmatic approach wherein a semi-structured interview with three senior staff members in the Information and Technology Network (ITN) Department and two senior staff members in the Teaching and Learning Development Centre (TLDC). Perceptions regarding technological systems in the university and determination of the extent they impede or promote the integration of technology through the e-Learning system were investigated through the semi-structured interview. The following three factors of technological domain are discussed: Infrastructure, Systems and Support services.

8.4.1.1 Infrastructure

In terms of ICT infrastructure provisioning (IP) as a technological domain factor that can impede or enhance integration of technology in the present study, the findings revealed that uneven access to electricity and poor Internet connectivity (bandwidth capacity) are some of challenges hindering the integration of the e-Learning system. Consistent with Wachira and Keengwe (2011); Unwin et al., (2010); Mtebe (2014) and Sanga et al., (2013) the respondents made it clear that there are significant infrastructure issues that need to be resolved for the institution to achieve e-Learning implementation (Section 7.2.1). Four of 5 members who participated in the interviews, indicated that poor ICT infrastructure, limited availability to ICT hardware and software, and a lack of skilled ICT teaching staff were barriers to technology integration (Section 7.2.1). The findings of the present study regarding infrastructure technical domain factor, are similar to the studies by on Osika et al., (2009) and Oroma et al., (2012). For instance, insufficient ICT infrastructure, expensive ICT facilities, and poor ICT facilities in lecture halls were identified as the most significant factors affecting the integration and use of e-Learning systems in learning and teaching (Obiri-Yeboah et al., 2013). E-Learning developments in some countries are not only impacted by poor infrastructure, but also by lecturers' inability to integrate technology into learning and teaching activities (Basar et al., 2013).

In terms of Wi-Fi coverage across campus (CAC), the findings revealed that Wi-Fi coverage signal strength across campus is largely poor, with shortcomings at access points experienced most of the time (Section 7.2.2). These results concur with those of a study done on e-Learning initiatives implemented in Sub-Saharan countries in which it was pointed out that e-Learning tends to fail, partially or totally, due to an inadequacy of infrastructure (Ssekakubo et al., 2011a). With regards to Wi-Fi at residences (IR), the results revealed that the Wi-Fi network at university-owned residences is inadequate as it can only accommodate a limited number of students, while the situation is even worse at external residences (Section 7.2.3). This might indicate that Wi-Fi in residences is lacking due to limited computer servers and firewalls to allow more students to connect internally when needed. It could also point to an increased number of students being serviced by an inadequate computer server system and needs to be improved. These results depict other studies of a similar kind which indicated that the lack of WiFi-coverage is amongst the huge infrastructural problems that need to be addressed if an institution is to achieve satisfactory integration of technology in using e-Learning (Onasanya et al., 2010;Mtebe & Raisamo, 2014)

In terms of major stumbling blocks (MSB), interviewees showed that procurement processes and training of staff is a challenge that could lead to an e-Learning system not being accepted. In addition, interviewees also revealed that the lack of funding is a hindrance in the promotion of integration of technology in the participating University of Technology (Section 7.2.4). The unavailability of funds to improve technology infrastructure was cited by both groups of staff who participated in the technological domain factor. These results are similar to those of (Oroma et al., 2012) and (Omoda-Onyait & Lubega, 2011) in which the lack of funding was raised as an issue faced by most developing countries to secure appropriate technology enhanced infrastructure. An institution's ability to effectively sustain the use of e-Learning is influenced in part by its ability to fund all e-Learning activities. Both ITN and TLDC staff members indicated that the lack of funding technology infrastructure has resulted in most of classrooms not having video recording and data projectors. To expand the quantity and scope of these services, they suggested the organisation consider raising the investment budget for ICT infrastructure services. The current study has proved the importance of ICT infrastructure services in fostering the success of e-Learning systems, and this construct may be viewed as a foundation for effective e-Learning systems (Alsabawy et al., 2013). Findings from the current study further indicated that funding is a major factor in ensuring that universities have access to technologically advanced infrastructure (Section 7.2.4). The current study supports the ideas of some previous research that requires institutions of higher learning to increase funding for technology, particularly computers, Internet access and facilities, which would help teachers with their issue. (Kabilan & Rajab, 2010; Hussin et al., 2012).

Finally, in terms of student charging stations in open spaces (SCS), the participants recorded that there is no charging station in an open space and as a result, students experience power challenges for their devices. Participants further revealed that Wi-Fi spots that were installed have no electricity supply and are not maintained (Section 7.2.5). The outcomes of the current study can help e-Learning applications and enhance the services supplied by the system. The important advice for educational institutions that have already implemented an e-Learning system is to pay close attention to ICT infrastructure services by creating and maintaining these infrastructures, which is based on the findings of the current study (Section 7.2.5).

8.4.1.2 Systems

In terms of the uptake of Blackboard and Moodle e-Learning platforms, the current study revealed that the uptake is very low owing to the lack of support from senior management (Section 7.3.1). These results also confirm findings of other studies which indicate that students and lecturers should be given proper training on learning management systems so that they benefit from the e-Learning system (Deng & Tavares, 2013; Samir Abou El-Seoud et al., 2014). As a result, lack of training may be attributed to the academic staff's disregard for the LMS, including technical knowledge, psychological considerations, and social aspects. This finding suggests that the university emphasise the importance of using learning management systems throughout the year. Academic staff should be trained on new innovations in ICT usage and how to utilise both Blackboard and Moodle on a regular basis. In Session 7.3.1 of the current study, it is further indicated that Internet connectivity is one of the significant issues that both students and lecturers face while using LMS.

The findings on the resources to develop e-Learning platforms (RDSE) revealed that the absence of instructional designers has a negative impact on lecturers' content development (Section 7.3.2). Interviewees indicated that nine smart boards installed at the university are gathering dust because lecturers lack the knowledge and skills to utilise them. The interviewees in Session 7.3.3 further indicated that there is insufficient effective learning content as both Blackboard and Moodle are not widely utilised by lecturers to connect with students. If both platforms offered sufficient learning content, lecturers could always utilise them as the initial point of contact for their students, pointing them to both LMSs for learning resources.

Implementing ICT infrastructure for e-Learning and training academic personnel on e-Learning are both extremely expensive. According to participants in the semi-structured interview performed for the current study in Session 7.3.5, the expense of upgrading network speed for the LMS to be accessed faster outside the university provides a significant financial hurdle to MUT senior management. This was also emphasised in a report on Sub-Saharan African (SSA) universities research, which found that administration in the SSA area is problematic due to a lack of funds to mainstream the university's operations (Sylla et al., 2020). To a certain extent, these results suggest that faculty members should be encouraged to establish teams to help one another and exchange learning tools. Collaboration among academic staff can aid in the sharing of e-Learning materials within and between faculties. To guarantee that the LMS has enough learning resources, faculties should ensure that academic staffs collaborate, generate, and exchange learning content.

The present study in terms of available ICT tools in the classrooms for teaching and learning purposes (ICTT) reported that ICT tools and minimum standards are lacking (Section 7.3.3). This might be due to a lack of planning for the implementation of an e-Learning system across faculties and departments. Furthermore, this result shows the necessity for a strategic approach, which might include identifying target courses or programs that can operate effectively online as a mechanism for driving advancement and sufficiently planning for resources that students and lecturers would require. Commercial e-Learning systems, such as Blackboard, tailored programs built to meet the particular requirements of organisations, and open source LMSs are all options. The primary disadvantages of the former are high maintenance costs and inability to adjust to the individual demands of an institute. The most serious problem with bespoke programs is their unreliability.

With regards to lecture recording equipment (LRE), the result revealed that there is no lecture recording technology available in classrooms (Section 7.3.4). In terms of different demands due to e-Learning systems (DD), the results also showed that instructional learning designers as well as academic personnel and students able to comprehend and rethink teaching and learning methods, are lacking in the university under study (Section 7.3.5). Lastly, in terms of academic staff computer specs requirements (CS), the interviewees indicated that staff laptops had not been changed in line with the recommended interval basis. These findings all challenge the implementation of e-Learning systems (Section 7.3.6).

8.4.1.3 Support Services

All methods used to assist learning perseverance and success, as well as to increase the quality of the learning experience through engagement and technological integration, are referred to as student support services in the context of the present study. The aim is to give all students, particularly those from underserved communities, the help they require and deserve in a user-friendly manner, allowing them to be fostered, encouraged, and supported throughout their academic careers by integrating with the e-Learning platform. The summary of various findings on the support services construct will be highlighted in this section.

The current study on helpdesk support services to staff and students (HPS) revealed that helpdesk services do not satisfy clients (Section 7.4.1). This finding implies that students and lecturers are unable to effectively integrate e-Learning system due to a lack of support services. Based on the research by (Olelewe et al., 2020), (Issa et al., 2011), and (Yang et al., 2013), students and lecturers at this university will not effectively integrate technology through the e-Learning system since they lack technology support services. Many aspects of student aid should be incorporated in all e-Learning programs, even though student support services differ at the various institutions. To summarise, e-Learning student support services should intend to address the pedagogic, technological, and administrative issues that impact online students. Students should be able to access an advising service and staffed helpdesk at convenient times.

The present study on training and support demand from students and academic staff (TSD), indicated that lecturers' attendance at training is poor hence, there was no training demand and support (Section 7.4.2). Training support has a major influence on technology utilisation. Technical issues have grown into a major source of annoyance for both students and lecturers, causing disruptions in the teaching and learning process. Technical issues become a key hurdle, (Türel & Johnson, 2012). These problems include things like poor connectivity, cyber-attacks, and broken printers. When lecturers are unable to use technology because of a lack of technical help, they are typically unhappy and might eventually lose interest in the integration of technology (Cheok & Wong, 2015). The respondents claim that not enough emphasis is placed on student-centred learning, but if e-Learning platforms are used successfully, they may help students enhance their interpersonal and teamwork abilities. Additionally, there is not enough support within the university to encourage and promote e-Learning. The university leadership and administration in charge of the procurement and maintenance of e-Learning systems are, above all, occasionally financially strapped and less eager to encourage institutional use of these technologies.

In terms of barriers that prevent the implementation of a more pro-active fault (BIP), the interviewees revealed there is a shortage of human resources, internal staff capacity, and skills (Section 7.4.3). Students who use an e-Learning system need more than just course content and competent instruction to have the best chance of succeeding in their studies. They require a variety of support services to assist them in engaging with their tutors, teaching assistants, and lecturers, succeeding in their studies, connecting with one another, and successfully transitioning to the workplace. For example, they require access to all on-campus services, including e-Learning system orientation, advising and counselling, learning resource centres and libraries, computer laboratories, and technical help desks. With regards to training on the use of the e-Learning system (TES), the results revealed that there is a once-off seminar and workshop with no continuous training sessions (Section 7.4.4). In addition, participants revealed that there is one-size-fits-all professional development training.

Finally, in terms of challenges on support services for improving the integration of e-Learning (CSS), interviewees showed that procurement processes take forever to procure equipment

(Section 7.4.5). In addition, they further indicated that there is a need to establish strong relationships with all units that can successfully contribute to the improvement of technology infrastructure. Findings from the interviewees further indicated that the budgets for technical and technological resources were typically inadequate. Interviewees also felt that at this university, proper budgeting is essential, which may reduce the need for ad hoc resource and maintenance equipment purchases (Section 7.4.3). Finding sufficient funds to create and maintain appropriate technology, offering static technical assistance, paying for training courses, and recruiting support workers are just a few of the university's financial concerns (Section 7.4.4). Addressing these challenges first, could assist in persuading lecturers to engage with, and accept, the use of technology in their teaching (Keogh & Fox, 2008). The capacity for support services, suitable infrastructure, and incentives required to encourage the integration of e-Learning must be effectively supported (Section 7.4.5).

The findings of this study support the idea that universities should increase staff and student knowledge on the advantages of e-Learning as well as enhance their preparedness to support e-Learning, which has a significant impact on the quality of course design and the quality of e-Learning systems. In relevant research, the absence of appropriate measures to promote e-Learning was also cited as a barrier (Khan et al., 2012; Tarus et al., 2015).

8.4.2: Organisational Design Factor

The second aspect of the third research question sought to investigate organisational design towards the development of a sustainable e-Learning environment. This aspect in the research question adopted a qualitative- interpretivist-pragmatic approach wherein a semi-structured interview with faculty Deans and Heads of Department was conducted using the Ms Teams platform. Additionally, insights regarding the decision process for implementing sustainable e-Learning systems were uncovered. The three constructs: Strategy, Leadership, and Culture had various relevant interview questions that were part of the instruments that addressed the organisational design factor in the present study.

8.4.2.1 Strategy

The findings of the current study in terms of integrating ICT in teaching, learning and assessment (AI), revealed that there is a lack of resources to support a multimodal approach to teaching and learning (Section 7.5.1). In addition, the lack of technology infrastructure, students', and lecturers' under-preparedness in using technology was another reason for the slow integration of ICT. According to the interviewees, the successful transition to an e-Learning system for teaching and learning demands a complete understanding of the new platform and blended teaching environment, as well as administrative and technological assistance.

In terms of strategies for ICT integration to improve students' results (CIIS), the results revealed a need to improve individual skills, training of students to fully utilise the e-Learning system, and procurement processes (Section 7.5.2). ICT and e-Learning illiteracy, according to the interviewees, is impeding the proper integration of an e-Learning platform. The findings in this section are similar to that of a study carried out by Ssekakubo et al., (2011) and Tarus et al., (2015) which indicated that improvement of technology infrastructure is necessary for the success of e-Learning.

With regards to teaching staff knowledge about pedagogical innovation (PI), the result revealed that academics do not have sufficient knowledge and access to pedagogical innovations (Section 7.5.3). This competency is determined by the lecturers' experience with technology and the degree of knowledge they have gained. When lecturers lack confidence in their ability to use technology, they are more likely to either not use it at all or use it ineffectively. In both circumstances, the prospects of a successful e-Learning integration are slim.

In terms of students having sufficient knowledge to work within an ICT environment (KICTE), the interviewees revealed that students do not have sufficient knowledge to work within an ICT environment (Section 7.5.4). This can be attributed to the fact that most students do not have computers and access to the Internet due to economic imbalances in developing countries. Provision of computers and Internet by the institution of higher learning should be organised as this will revolutionise the present traditional education paradigm by encouraging students to engage in active learning and allowing them to move away from information memorisation toward knowledge application (Ahluwalia, Gupta, & Aggarwal, 2011).

In terms of senior management influence and support affecting the uptake of e-Learning (MIS), the interviewees showed that the university's senior management is doing very little and seems to lack vision and knowledge of the e-Learning system (Section 7.5.5). Despite the university strategy plan (2020-2025) emphasising the development of solid infrastructure and competences, no e-Learning plan has been created, despite the need to encourage innovation in emerging fields, support innovation in current and cutting-edge technologies, and improve the delivery of value to students. The lack of a strategic plan also signifies a lack of direction in achieving technology integration. The study findings indicate that management and faculties should create extensive institutional and faculty-level e-Learning strategic plans to serve as a roadmap for changes in how the institution conducts business and oversees teaching and learning to meet its goals. The difficulty in e-Learning implementation may be seen in the absence of both a policy and a strategic strategy. The relative strategic importance of e-Learning in HE institutions, as well as its actual integration, is heavily influenced by the context, history, individual campus culture, and unique personalities that contribute to the institution's ethos. If an institutional vision and an e-Learning strategy for technology integration are not in place, both these may become possible obstacles to technology integration.

Moreover, in terms of strategies in various departments to integrate existing and emerging ICTs in learning and teaching (SD), the interviewees revealed that there no strategies exist in many departments to include existing and emerging ICTs in teaching and learning space (Section 7.5.6). According to this conclusion, top university administration and academic stakeholders must be passionate about integrating and using technology in teaching and learning by creating a practical ICT policy on technology use inside their institution.

Finally, in terms of university strategy supporting students in an ICT environment (SSS), the results of the study showed that there is nothing in the strategy document that assists students in working effectively in an ICT environment (Section 7.5.7). According to deans and heads of departments there is no e-Learning strategy or implementation plan in place to advise students and lecturers on how to incorporate e-Learning practices. Porter et al., (2016) and Zuvic-Butorac et al., (2017) found comparable results. Furthermore, the university's e-Learning policy should stress the significance of collaboration across faculties and university departments in providing e-Learning infrastructure, IT technical assistance, and lecturers' and students' support. These goals are consistent with the implementation plan and implementation principles outlined in Section 7.5.7.

When management goals are correctly aligned with user expectations to suit their requirements, users are encouraged to use e-Learning resources. Even though some management staff members blamed the faculties and departments for lacking initiative, the cultural setting and power structure may explain this, which made initiatives from the bottom-up challenging to accept. To impact adoption and integration of e-Learning methods across the university, a strong managerial emphasis, an enforcement strategy, and a deadline are essential.

Overall, this study's results demonstrate that e-Learning policies have a big influence on how ready an institution is to support e-Learning. Institutions must include e-Learning policies into institutional policies, according to the empirical results. According to the interviews, staff personnel must be included in the implementation of the e-Learning process by distinctly outlining their roles and responsibilities, as stated in section 7.5.7. According to Czerniewicz and Brown (2005), an institution's preparedness to embrace and sustain e-Learning is determined by how well-prepared its e-Learning policies are. E-Learning policy statements often outline senior leadership's expectations and degree of commitment to preserving and supporting e-Learning inside their organisations (Czerniewicz & Brown, 2005). According to studies, policy is crucial to the successful adoption of e-Learning inside institutions (Czerniewicz & Brown, 2005).

8.4.2.2 Leadership

The findings of the present study, in terms of decision-making being inclusive and extensive with respect to consultations with staff and students (DMIE), revealed that there is no inclusive and extensive consultation with students and lecturers in decision-making around e-Learning implementation (Section 7.6.1). The results were that management was not able to clearly describe how technology may be incorporated into teaching and learning at the university in the medium- to long-term. As a result, the intended level of performance and achievement expectations from students and lecturers as the primary users of the e-Learning system were not met. Failures caused by a lack of vision and goals, demonstrate a lack of motivation and a weak explanation for the elements that contribute to successful technology integration in learning and teaching (Zuvic-Butorac et al., 2017).

In terms of senior management and council funding provision (MCF), the results showed some leadership commitment. However, the needs for e-Learning integration should be given greater consideration (Section 7.6.2). According to other research, one of the most significant barriers to e-Learning deployment is a lack of financial assistance (Khan et al., 2012; Tarus et al., 2015). Leadership and resource coordination are tools for successful e-Learning deployment, according to best practice examples (Hardaker & Singh, 2011a). Duplication of efforts occurs because of poor resource coordination, resulting in resource waste. Interviewees also indicated that dedication of management to extending residential facilities without a comparable increase in infrastructure support for effective student learning raises concerns about the importance and commitment to promoting an e-Learning system in tandem with improved teaching and learning quality. For example, similar studies found that senior management support had a significant influence on the availability of e-Learning systems in their study (Macharia & Pelser, 2012). Lecturers are motivated to employ genuine and constructively aligned e-Learning methods with teaching techniques that suit their environment by the strategic consequences of shared leadership and adherence to well-defined aims. While leadership will harmonise resource utilisation and coordination, the commitment will provide enough budget allocation to improve technological integration. Quality assurance leadership will guarantee that the right standards for the e-Learning platform are in place.

With regards to the role played by senate and faculties in the provision of leadership and support (SFP), the findings revealed that robust discussion on the integration and acceptance of an e-Learning system is lacking at both senate and faculties (Section 7.6.3). Based on the findings of the present study, the senate and faculty approach to assisting the implementation of an e-Learning system demonstrates insufficient leadership and commitment to the process (Section 7.6.2). Lack of coordination and collaboration between the e-Learning platform, which frequently resulted in conflict situations, a lack of quality validation measures in digital transformation, poorly coordinated services, and support, as well as the absence of a structured plan to integrate technology into the university curriculum, all confirm the lack of e-Learning system leadership.

In terms of operational units charged with the responsibility of providing leadership for advancing e-Learning (OCR), the interviews showed a lack of properly skilled human resources to advance the e-Learning initiatives (Section 7.6.4). University policy makers must understand how ICT may provide the most value to their institution's educational system and create a supportive policy environment and structure for its integration to effectively employ ICT in expanding the reach and quality of teaching and learning. The results are consistent with previous studies and show that, although significant progress has been achieved in this area, South African institutions of higher learning urgently need to overcome the debilitating access to technology barrier (Achimugu et al., 2010) (Section 7.6.4).

Lastly, in terms of senior management's promotion of e-Learning (MP), the interviewees recorded that senior management should lead the discussions on the implementation of an e-Learning system (Section 7.6.5). The results of the current study demonstrate that leadership commitment, a lack of clear policy initiatives for e-Learning, and a lack of strategic e-Learning methods were important variables impacting insufficient institutional actions and efforts to adapt e-Learning. Questions of e-Learning vision, goals, and management experience with the use of novel technologies for e-Learning were equally crucial. The onus is on institutional leadership to provide the resources and infrastructure required to implement their respective institutional e-Learning strategies, because the difficulties that HEIs encounter and the obstacles that prevent the use of e-Learning within institutions are common across the educational spectrum (Mapuva, 2009). Without strong leadership, especially with a background in technology and an understanding of its potential in enhancing teaching and learning, a transition to technology adoption in any institution would result in mixed results, both intended and unintended, with no clear guidance and support to move towards the desired goals.

The distinction between success and failure in establishing an e-Learning system could be determined by leadership style and change initiatives. Effective leadership is the glue that holds the implementation together and drives it along in a favourable manner. The management of the institution's leadership components that deal with maintaining, upgrading, and sustaining the learning environment is referred to as the leadership construct. To achieve whole-system restructuring, Fullan (2010) highlights the significance of communication and relationship-building. Communication during implementation, according to Fullan (2010), is considerably more crucial than communication before implementation. To establish and preserve the institution's capabilities, effective leadership necessitates constant relationship building and providing a culture of trust and open communication (Cosner, 2009).

8.4.2.3 Culture

With regards to productive and beneficial online learning and teaching (PBO), the findings revealed that the culture among students and academic staff to engage in constructive and useful online teaching and learning is lacking (Section 7.7.3). Cultural influences have a significant influence on how people learn, including the way they connect and communicate, which is at the heart of e-Learning. These elements significantly affect the system architecture and design as well as the usability and acceptance of online learning systems, two crucial components of these systems (Seufert, 2003). Cultural orientation must be taken into consideration while designing and facilitating a competitive framework in e-Learning environments (Downey et al., 2005). One of the characteristics of a good e-Learning system, according to (Edmundson, 2006), is the inclusion of users' cultural characteristics in its design. This is a powerful motivator for participants and helps to speed up the integration process.

In terms of students' technology skills promotion for higher education (STS), the study revealed that lecturers do not have time to prepare their students due to workload commitments they currently have (Section 7.7.4). On the other hand, in terms of student training opportunities (STO), the study revealed that student training opportunities are limited (Section 7.7.5). Lastly, in terms of access to e-Learning resources (AER), the interviewees reported that the students' culture on the use of emails should be improved so that they were made aware that emails could be used to communicate with their lecturers (Section 7.7.6).

Culture is often considered as a tool used by senior management to influence and regulate human attitudes, perceptions, and behaviours to assist organisations achieve specific objectives (Fard et al., 2009). In the educational sector, culture refers to the beliefs, attitudes, and societal conventions that govern learning, (Rosenberg, 2008). For example, e-Learning culture examines organisational attitudes and beliefs around the use of learning technologies (Rosenberg, 2008). The digital divide may be bridged by developing a shared culture in a secure online environment that encourages collaboration and gives students the chance to use various technologies.

8.5 Theoretical Contribution: Proposed Framework for Ensuring Sustainable e-Learning Implementation

One of main contributions of this study is the proposed framework that could be used to ensure a sustainable e-Learning implementation. The original conceptual framework as presented in Figure 3.6 was derived after a consideration of existing technology models. In Figure 8.1, the researcher presents a modification of Figure 3.6. and depicts a data-driven diagram depicting a proposed framework that could be used to ensure a sustainable e-Learning implementation with aspects influencing students and lecturers' perceptions of barriers and enablers in the development of a sustainable environment.

The framework has been modified by the addition of five subjects to the original four subjects appearing in Figure 3.6 (lecturer actual usage, student actual usage, organisational design domain and technological domain). The additional subjects are University e-Learning strategy document, attitude towards eLearning, lecturer behavioural intention to use and student behavioural intention to use which are explained below in Sections 8.5.1- 8.5.4. A second modification is the flow diagram depicting the framework. In the original conceptual framework of Figure 3.6, the four subjects were individually set out, with each one linking directly to the intended outcome of a sustainable e-Learning environment. With the modified framework the nine subjects are interlinked showing a directional flow which leads to the intended outcome.

Even though these parameters were derived from the case study university's experiences, they may be applicable to institutions with comparable qualities. These contributing elements will help in the construction of an e-Learning system by filling in the gaps in existing e-Learning systems in the researched university of technology and those with similar context. Its purpose is to promote self-reflection and, as a result, to improve e-Learning skills and knowledge. The knowledge contribution paradigm in the proposed framework in Figure 8.1 that considers aspects of the TAM model as well as of UTAUT could be used to ensure a sustainable e-Learning implementation.

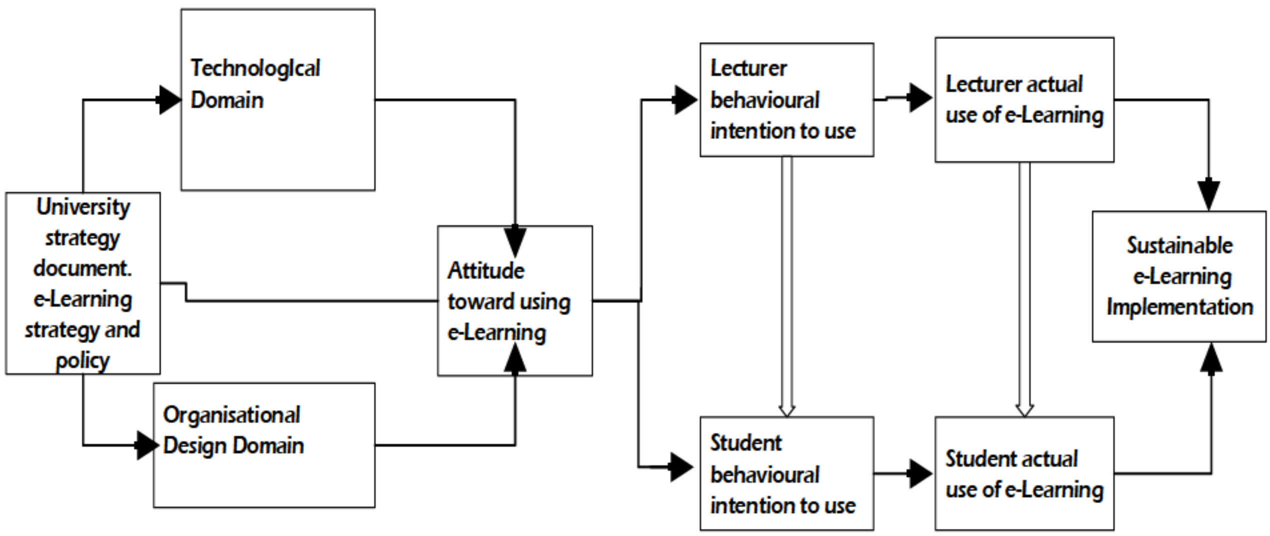

Figure 8. 1: Proposed Framework for ensuring a sustainable e-Learning implementation.

What follows now is a description of each of the subjects that have been included and why they are crucial parts of the e-Learning sustainable framework.

8.5.1 University strategy document, e-Learning strategy, and policy

The qualitative data revealed that there was a missing link in the process. There was no strategy document especially with respect to the eLearning strategy and policy which should have provided direction to the teaching and learning arena using technology. In the modified framework, the university strategy and policy on e-Learning environment is located within the external variable (external stimuli) construct from the TAM, expressed in Figure 8.1. The academic institution's policy on the usage of e-Learning environments, as well as its rules, take precedence over students' and lecturers' views and inclinations. Based on field observations, the researcher in the current study contends that both the decisions that influence the regulations that govern the use of information systems and the talents of students and lecturers combined determine the extent to which systems are used optimally. Although lecturers typically have personal and professional goals that must be aligned with the rules of the organization in which they work, their personal and professional goals inevitably have a significant influence on the extent to which their organization's e-Learning environment is utilized optimally. Before COVID, most lecturers took on technology only if they wanted to, because there was no policy and strategy on eLearning that would enforce the use of technology.

The lecturer is required to use the system since university rules and guidelines regarding how ICT is deployed and used must be followed, especially because the desire for development and promotion remains a motivating force. As a result, the degree to which a specific technology is accepted and used can be measured by the lecturer's outputs and performance appraisal, rather than the employee's perceived ease of use, as proposed by TAM. From the interview phase of the current study, university strategy, e-Learning strategy and policy was identified as a positive factor that could enable technology adoption.

8.5.2 Attitude towards using e-Learning

The qualitative data obtained from the TLDC, ITN, HODs, and Deans of the faculties, helped identify that a crucial element in the take up of an eLearning intervention is that of attitudes. They indicated that before COVID, staff used technology only if they wanted to and hence very few implemented e-Learning strategies. Their attitude that technology was an add- on and not a necessary tool in the teaching and learning, was changed by the Covid pandemic. In the modified framework, attitude towards using e-Learning environment is located within the TAM. The key point in Figure 8.1 on attitude towards using e-Learning environment is that lecturers' ICT proficiency and experiences encourage the ease of use of technology, whereas the university's rules, policies, and ICT guidelines regulate technological adoption and intention. The desire to be promoted, as well as personal or professional goals, moderate attitudes toward improved ICT use to perform better, which then increases the intention to utilize the system. This viewpoint was supported by Ding and Er (2018)'s study, which discovered that lecturers' effectiveness or self-efficacy has a favourable effect on the ease of use and perceived utility of a system (Ding & Er, 2018). The external component that may influence technological acceptance has already been examined, and it is not only perceived ease of use, as stated by the TAM (Joo, So, & Kim 2018; le Roux, 2015). As a result, in this scenario, the use of technology is founded on verifiable experiences and ICT abilities as moderating factors influencing the students and lecturers' attitude, intention, and usage of technology.

Many studies on e-Learning acceptability have found that attitude is a strong predictor of behavioural intention to use e-Learning (Cheung & Slavin, 2013; Tosuntaş et al., 2015). The link between attitude and behavioural intention in the current study suggests that students and lecturers are more likely to engage in specific behaviours if they have a positive attitude toward them (Keong, Albadry, & Raad, 2014). In addition, attitudes about technology fully mediate impacts on behavioural intention. The current study results from the analysis of qualitative and quantitative data indicated that students and lecturers have good attitudes and perceptions regarding technology use, as well as high self-confidence, and are more willing to use technology for instruction.

Furthermore, lecturers' perceptions toward the use of such technologies play an important role in deciding their intents to employ them (Ma, Anderson, & Streith, 2005). The attitudes of lecturers toward technology use are critical in facilitating successful classroom technology integration (Ranasinghe & Leisher, 2009). Lecturers' attitudes regarding computers and instructional software have been found to have a substantial influence on their students' attitudes toward technology if enough assistance and time for teachers to master the technology is provided. Based on Figure 8.1, if lecturers have a positive attitude toward e-Learning, it is likely that they will embrace the integration of the e-Learning strategy into university teaching and learning.

The most essential aspect in influencing students' intention to adopt e-Learning is their attitude toward it. Students' subjective norms, or the influence of others around them, have a role in their decision to adopt e-Learning. In the context of this study, there are two probable reasons why the technological domain and the domain of organizational design are important in students' and lecturers' attitudes on using e-Learning in learning and teaching. To begin, the participants were students and lecturers with limited experience with e-Learning for online professional development. Secondly, technological domain is the predicted overall positive influence of system use on task outcome whereas organisational design domain is the amount to which a user thinks that utilizing a system would be free of effort. In general, one's attitude toward technology reflects the likelihood of adopting practices to some extent. When it comes to an e-Learning system, lecturers with a favourable and positive attitude toward it are more likely to embrace its integration into the teaching and learning process in higher education.

8.5.3 Lecturer behavioural intention to use

A further addition to the framework is that of the lecturers’ intention to use the technology/ Drawing from TAM (Davis 1989) and UTAUT (Venkatesh er at., 2003) models, lecturers and students, behavioural intention to use is located within behavioural intention (BI) variable. In the context of the present study, attitude towards the use of technology significantly influence lecturers’ BIs towards acceptance and adoption of e-Learning environment. The positive BI of lecturers will directly influence students BIs. The Theory of Planned Behaviour states that when behaviour is deliberate, behavioural intention has a direct impact on performance (Ajzen, 1991). Hardgrave and Johnson (2003) argue that behavioural intention should still be evaluated in instances when behaviour is not choice, such as in academia and other educational environments. Attitude towards using e-Learning environment has a positive and significant influence on individual behaviour governing one's intention to use a technology. In addition, individual’s acceptance, and intention to use e-Learning environment will most likely, be increased when one perceived e-Learning environment as useful.

8.5.4 Student behavioural intention to use

Like the case of the BI of lecturers, the BI of students is also important in any TAM model. The qualitative result of the present study shows that lecturer behavioural intention to use e-

Learning environment has a significant influence on students BIs to use the system. Since the present study was conducted in the previously disadvantaged and ICT challenged environment in the developing country, students enrolling in the researched university are bound to have poor background of use of technology for learning purposes. Therefore, as lecturers help students perceive e-Learning system as easy and simple to use, then the acceptance and usage of online learning will be high from students. This is because when the students are made to perceive that a technology is easy to use, it is probable that they will assume that the system is simple and will be satisfied with it. Research shows that when students develop a positive BI, they would then eventually sign up to join and use the system and remain longer in the system simple because, students' favourable perceptions of utility and ease of use explain their integration of e-Learning environment (Davis, 1989; Venkatesh et al., 2003).

8.6 Proposed training session mitigating the results of the present study

The results from the study can be used to inform the development of a training session for lecturers, students, management as well as support staff in the university of technology. Other institutions of higher e-Learning which have a similar background could benefit from designing similar training workshops, depending on their own context.

The most important influence on learning through instructional technologies is not the technology itself, but what is presented with that technology. Students and lecturers training programs that are poorly designed and implemented will not stimulate or promote learning outcomes, regardless how dynamic or cutting-edge the technology used to provide the training is. The university management needs to develop an informed perspective about the importance of providing training opportunities for students, lecturers, and support staff. Funding for training must be ringfenced in the annual budget so that it is continuous feature. In addition, effective training requires accommodating infrastructure that can enable the successful implementation of e-Learning in a sustainable manner. This includes both on and off campus technology resources for students and lecturers. Building excellent students, lecturers training and development program for the twenty-first century necessitates the integration of instructor-led training, technology-based training, assessments, coaching, work centre simulations, and measurable training outcomes (Mhlanga & Moloi, 2020).

The funding for the training programme need not be excessive. When training expenditures provided are typically minimal, whereas training demands are always high, training programme will not be successful. To mitigate this, it is advisable to make your training available online. Online training eliminates the need for travel and venue expenditures, and it frequently reduces facilitation costs as well. The use of high-performance LMS when you are educating many personnel will make a significant difference in how far your budget can extend. It is also of paramount importance to simplify your content creation by focusing on the most cost-effective formats, for example, combined with feedback activities, might save development expenses. Another approach to save money and time is to use webinars instead of in-person lectures. Utilizing internet-enabled training capabilities can maximize educational training resources by designing the training so that can be asynchronously drawing upon cloud-based features.

In the context of the researched university of technology in the present study, first-year student orientation is considered a standard practice, however, the study identified that more is needed in e-Learning environment. Students need an intensive programme during their orientation that emphasises the fundamentals of working with technology such as in communication, searching for information, doing research, using university learning systems. Considering e-Learning environment as a part of a blended learning approach, where platforms like Blackboard, Moodle, Microsoft Team, and Zoom are prominent in e-Learning environment, the outset is to develop a model descriptor as part of the program curriculum. Noted by Bayanov et al., (2019), this will reformat the educational environment from a source of knowledge to a full-fledged participant, which changes the nature of the interaction between the teacher, student, and digital technologies.

Student engagement can be divided into three categories: cognitive, emotional, and behavioural. Without these three, poor knowledge retention, passive learning, and a lack of commitment all contribute to training and development issues. Furthermore, behavioural change is impossible to achieve without learning engagement. When instruction feels irrelevant or useless, most students mentally and emotionally "drop out" and refuse to participate. This underlies the importance of helping lecturers appreciate the important role that they play. The training for students cannot be seen as disconnected from that for lecturers. Some students may be intimidated by technology because of a lecturer's lack of confidence, competence, and technology skill. Alternatively, they may be competent in their use of ICT but unsure how to organise ICT activities to proceed over a series of applications. At least three generations are represented in the students, lecturers, and management of the researched university, each with a fundamentally different relationship with technology. Therefore, assuming that all students and lecturers are similarly tech-savvy or have the same knowledge levels and learning habits will make the training less effective.

The study revealed in Figure 5.7 that some lecturers need training to improve their technology literacy, while others have developed their necessary skills but need help in organising and planning their teaching to use technology optimally. Different lecturers have different needs, so training cannot be based on a one-size fits all model. A detailed needs analysis will need to be conducted before the training for lectures is designed. The training will need to be designed and conducted by the TLDC and ITN, so they need to ensure that different programmes are designed for lecturers to meet their diverse needs,

Some of the modules that must be developed for lecturers need to include the following activities.

- Methods to expand educational activity types which utilise the latest and diverse digital technologies.
- How lecturers can attend to the tasks of planning, designing, presentation and assessment in innovative ways
- Use of resources such as electronic textbook, online tests, tools for modelling educational concepts such as simulations and monitoring software
- The communication boundaries (information exchange, access to electronic libraries and encyclopaedias, data bases, dictionaries, and other information resources).

In terms of improving the technology literacy of Considering e-Learning environment as a part of a blended learning approach, where platforms like Blackboard, Moodle, Microsoft Team, and Zoom are prominent in e-Learning environment, the outset is to develop a model descriptor as part of the program curriculum. Noted by Bayanov et al., (2019), this will reformat the educational environment from a source of knowledge to a full-fledged participant, which changes the nature of the interaction between the teacher, student, and digital technologies.

8.7 Self Reflection

The present study's journey has had a major impact on the researcher’s development as a lecturer in mathematics education using technology. His research focused on the implementation of an e-Learning system and the development of a sustainable e-Learning environment, as he attempted to investigate the ongoing challenges students and lecturers in higher education institutions in ICT-challenged environments faced while learning and teaching. With the issues that universities have faced because of the Covid-19 epidemic, not only in South Africa but throughout the world, it became critical that he perform this research. The current study's dual goals of research and development fit into my wider perspective of research not only as helpful in and of itself, but also as a potent tool for fostering the creation of a long-term e-Learning environment. As a lecturer at the institution under investigation, he had the opportunity to participate in professional development activities including the use of technology in learning and teaching with students and lecturers. The researcher realised that students and lecturers suffer many of the same issues when it comes to adopting technology. These issues range from a lack of professional development in the use of an e-Learning system, to a common absence of constructive discourses during the integration of technology in the classroom, which might lead to more learning possibilities. This experience highlighted the significance of rigorous and unambiguous operationalisation when discussing and describing technology integration and e-Learning system deployment.

Finally, as he became more familiar with the present study data, he realised how difficult it is to implement an e-Learning system, particularly the development of a sustainable e-Learning environment. In this setting, how we assist students and lecturers in being successful and efficient in learning and teaching utilising technology has become critical. How senior management, technical support staff and policy development units in a university, support students and lecturers in order for them to support quality learning and teaching has been the key motivation for this study. The researcher believe that the process and the outcomes of this study have contributed to this endeavour.

8.8 Conclusion

The aim of the study was to investigate various factors impeding and enabling the integration of technology in learning and teaching in the HE sector, and how these factors could be addressed where they are barriers in the process. The three broad research questions of the current study were: (1) What factors do students at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment? (2) What factors do lecturers at a university of technology perceive as barriers and enablers in creating a sustainable e-Learning environment? (3) What are the organisational design and technological factors that impede the development of a sustainable e-Learning environment at a university of technology?

The nature of the issues and causes highlighted by the current study, have given the researcher and the participating university a comprehensive grasp of the policy and strategic practices necessary to ensure a successful e-Learning deployment. It has been determined that an effective combination of students' actual usage, lecturers' actual usage, organisational design domain, and technological domain, provide a clear picture of what the participating university senior management team needs to successfully implement e-Learning and develop a sustainable e-Learning environment. The supply of suitable technology infrastructure and training is necessary, but not sufficient, for e-Learning environment to thrive. Implementation requires management policy, defined objectives, strategy, leadership, commitment, money, and priorities that suit the needs of students and lecturers. Students' and lecturers' comprehension of the relative benefits of using e-Learning, as well as their ability to engage (training) and incentives, are viewed as critical. Relevant training, sufficient resources to serve users, and enthusiasm to offer novel services, are all requirements for technical workers. Students also require instruction, encouragement, and guidance from instructors in order to engage in optimal resource usage and shift away from an emphasis on utilising the Internet for amusement and social networking.

The relative strategic importance and actual integration of an e-Learning system in higher education institutions, is influenced by the context, history, individual campus culture, and unique personalities that contribute to the institution's ethos. If an institutional vision and an e-Learning strategy for technology integration are not in place, both these may become possible obstacles to technology integration.

8.9 Recommendations

The researcher provides suggestions on the following aspects, lecturer and student real usage of technology, organisational design domain, and technical domain, based on the findings of the empirical study, theory, and literature studied.

Recommendations 1: The case study university might consider a needs assessment to determine whether instructors and students require further training. Such a requirement assessment would give baseline data that would tell university decision makers about the gaps between students' and lecturers' proficiency in utilising e-Learning systems and what they need to know to improve their utilisation. The institution is then able to offer programs that are relevant, creative, and aimed at improving the competency of students and lecturers in using the e-Learning system.

Recommendation 2: Each department at the participating institution should employ technological support personnel to collaborate with course material creators to make them more interactive and able to be monitored. To ensure continued use of the e-Learning environment, capacity building should be broadened to include technical support capabilities. Individual factors such as academics' teaching experience, students' degree of awareness of the use of technology in learning, technical ability, and students' level of study should be considered when creating such capacity building programs on technology acceptance and utilisation.

Recommendation 3: It is suggested that the participating university design an e-Learning policy on technology integration and usage to provide a suitable atmosphere for lecturers and students to utilise the e-Learning system in teaching and learning.

Recommendation 4: The university senate committee should play an essential role of creating and managing conducive atmosphere for students and lecturers to effectively use e-Learning environment. A more detailed description of possible training mitigation that could be promoted at Senate is given in Section 8.6

8.10 Recommendation for Future Research

The current study focused on the previously disadvantaged and ICT Challenged university of technology in South Africa where the researcher new there was some use technology taking place in learning and teaching. The use of one university out of 26 universities in SA does not give a completely true picture of the integration of technology through e-Learning environment in the higher education sector as it excludes other universities. The study findings are solely valid and reliable for this university used as a case study. It cannot be extrapolating any further. Hence a further study using a larger sample of students and lecturers' experiences on the integration of technology through e-Learning environment in the higher education sector, should be conducted. A further study would be to implement workshops for training of students and lecturers as identified in Section 8.6 and to study the extent to which it facilitates the use of e-Learning environment.

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Appendix 1. 1: Students Questionnaire

Thank you for agreeing to participate in this research project which is intended to better understand the pace of e-Learning adoption at MUT. The information you provide in this survey will assist in analyzing the underlying challenges that MUT lecturers and students face in accepting and adopting technology in teaching and learning.

Please note that all responses are confidential and that only aggregate reporting will be used. Your responses cannot be linked back to you, as your details are not stored on the system. Ethical clearance for this study has been obtained from the MUT Ethical Committee and may be viewed on this link. To proceed, please provide your consent to participate in the survey and click Next.

You may contact the researcher by emailing Alfred@mut.ac.za., should you require any assistance and/or clarification. The questionnaire should take about 5-10 minutes to complete. Please note that you may exit the survey at any time by merely closing the browser window. Thank you.

Prof A M Msomi.

Please provide your Consent to proceed*

I confirm that I understand the nature of the research project, and consent to participating in the research project for which I am about to provide data I believe is true to the best of my knowledge. I understand that I may withdraw from the survey at any time, without any adverse implication to myself.

YES	
NO	

SIGNATURE OF PARTICIPANT ……………………………..DATE………………

SECTION A: DEMOGRAPHIC BACKGROUND OF RESPONDENTS [for statistical purposes]

A1. Select your gender (**Please choose one option only**.)

A. Male

B. Female

A2. Select your age group. (**Please choose one option only**.)

A. Less than 18 years

B. 18 – 24 years

C. More than 24 years

A3. Select your qualification type (current registration) (**Please choose one option only**.)

A Certificate

B Diploma

C Advanced Diploma

D Degree

E PG Diploma / BTech

F Masters

G Doctorate

A4. Select your Faculty. (**Please choose one option only**.)

A. Faculty of Engineering

B. Faculty of Management Sciences

C. Faculty of Natural Sciences

A5. Select the type of area in which your school (where you completed Grade 12) is located. (**Please choose one option only**.)

A. Urban

B. Rural

A6. To what extent did you use technology for learning [pre-COVID-19] (**Please choose one option only**.)

A. High: almost daily
B. Medium: 3 to 5 times a week
C. Low: less than 5 times a month
D. Very Low: every now and then
E. I do not use technology for learning

A7: To what extent did your lecturers expect you to use technology for learning purposes? [pre-COVID-19] (**Please choose one option only**.)

A. Almost always
B. About half of the time
C. Less than half of the time
D. Never

SECTION B: USE OF TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements regarding your use of technology in higher education teaching, over the past year or so. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
B1	I have used technology for learning purposes.					
B2	I have used social networking technologies (Facebook, Twitter) for learning purposes.					
B3	I have used WhatsApp for learning purposes.					
B4	I have regularly made use of computers in the university's open labs.					
B5	I have regularly logged into Wi-Fi on campus.					

SECTION C: ACCESS TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
C1	My University has made available the resources (adequate computers and Internet connectivity for students).					
C2	There is sufficient access to the Internet in lecture rooms.					
C3	Our University has available space (lecture rooms or dedicated computer laboratories with Internet access for students).					
C4	There is sufficient access to ICT resources including hardware and software.					
C5	My university has made sufficient provision for uninterruptible power supply for use during power-cuts.					

SECTION D: PROVISIONING OF TRAINING TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
D1	Our University does not offer adequate training and / or support in using Internet search for learning materials.					
D2	Training courses in new devices, modern technologies using e-Learning are lacking at the university.					
D3	There is a lack of training in using university Learning Management Systems such as Blackboard, Moodle, Google classroom etc.					
D4	There is a lack of training on using social media for learning.					
D5	There is a lack of training on how to use technology devices for learning (Cell phone, IPads, Laptops, etc.)					

SECTION E: PROVISIONING OF INFRASTRUCTURE / ENVIRONMENT TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
E1	I am satisfied with the availability of computer labs / classrooms.					
E2	Classrooms are configured in a way that promotes learning using technology.					
E3	I am satisfied with the range of technologies available for learning.					
E4	Computers in the labs / classrooms always work and are in good condition.					
E5	I am satisfied with the printing functionality available for students.					

Thank you for your input

Appendix 1. 2: Lecturer Questionnaire

Thank you for agreeing to participate in this research project which is intended to better understand the pace of e-Learning adoption at MUT. The information you provide in this survey will assist in analysing the underlying challenges that MUT lecturers and students face in accepting and adopting technology in teaching and learning.

Please note that all responses are confidential and that only aggregate reporting will be used. Your responses cannot be linked back to you, as your details are not stored on the system. Ethical clearance for this study has been obtained from the MUT Ethical Committee and may be viewed on this link. To proceed, please provide your consent to participate in the survey and click Next.

You may contact the researcher by emailing Alfred@mut.ac.za., should you require any assistance and/or clarification. The questionnaire should take about 5-10 minutes to complete. Please note that you may exit the survey at any time by merely closing the browser window. Thank you.

Prof A M Msomi.

Please provide your Consent to proceed*

I confirm that I understand the nature of the research project and I consent to participating in the research project for which I am about to provide data I believe is true to the best of my knowledge. I understand that I may withdraw from the survey at any time, without any adverse implication to myself.

YES	
NO	

SIGNATURE OF PARTICIPANT ………………………………..DATE……………….

SECTION A: DEMOGRAPHIC BACKGROUND OF RESPONDENTS [for statistical purposes]

A1. Select your gender (**Please choose one option only**.)

A. Male
B. Female

A2. Select your highest academic (formal) qualification level. (**Please choose one option only**.)

A. First diploma / degree
B. Advanced Diploma
C. B-Tech / PG-Dip / Honours Degree
D. Master's degree
E. Doctoral degree

A3. Select your Faculty. (**Please choose one option only**.)

A. Faculty of Engineering
B. Faculty of Management Sciences
C. Faculty of Natural Sciences

A4. Select your higher education teaching experience. (**Please choose one option only**.)

A. 0 – 5 years
B. 5 – 10 years
C. 10 – 15 years
D. More than 15 years

A5. Select the level of courses you currently teach. (**You may select more than one option**.)

A. Diploma level
B. Advanced Diploma level
C. PG Dip / B-Tech level
D. Masters level

E. Doctoral level

A6: How long have you used technology in your teaching? (**Please choose one option only**.)

A. I do not use technology in my teaching
B. 0 – 5 years
C. 5 – 10 years
D. 10 – 15 years
E. More than 15 years

A7: How will you describe your use of technology for teaching over the past year or so? [Pre-COVID-19] (**Please choose one option only**.)

A. High: almost daily
B. Medium: at least 3 to 5 times a week
C. Low: less than 5 times a month
D. Very low: every now and then
E. Not applicable

A8: How would you describe your use of a LMS for teaching, over the last year or so? [Pre-COVID-19] (**Please choose one option only**.)

A. High: almost daily
B. Medium: at least 3 to 5 times a week
C. Low: less than 5 times a month
D. Very low: every now and then
E. Not applicable

SECTION B: USE OF TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements regarding your use of technology in higher education teaching, over the past year or so. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
B1	I have enough experience to use technology for making course materials available for students					
B2	I have enough experience to use technology for designing general learning activities (quizzes, tutorials, tests, examinations).					
B3	I have enough experience to use technology for designing and administering formal assessments.					
B4	I have enough experience to use technology in responding to students' content questions outside of the classroom.					
B5	I always foster students' ability to use technology for learning through facilitating teaching using technology.					
Please add any comment below about your current experience on the use of technology						

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SECTION C: ACCESS TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements regarding your access to technology for higher education teaching. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
C1	I have sufficient Internet access on campus.					
C2	I have sufficient access to Internet off campus.					
C3	I have sufficient access to an instructional designer who assists and supports me in developing my courses.					
C4	I have sufficient access to e-Learning resources in the classroom whenever necessary.					
C5	Technical support is readily available if lecturers are faced with difficulties.					
Please add any comment below about your current experience on the access of technology						

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Section D: PROVISIONING OF TRAINING TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements regarding your own training and development. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
D1	I have adequate training and support in using the Learning Management System.					
D2	There is enough training and professional development provided for lecturers on the use of e-Learning in teaching.					
D3	I have sufficient time for attending e-Learning training.					
D4	I have training on presenting lectures to students remotely (ie. When I am off-campus).					
D5	There is sufficient training to use emerging technologies for teaching.					
Please add any comment below about your current experience on the provisioning of training to technology						

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SECTION E: PROVISIONING OF INFRASTRUCTURE / ENVIRONMENT TO TECHNOLOGY

Please indicate the extent to which you agree or disagree with each of the following statements. **(Please choose one option only.)**

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
E1	The University has high quality equipment available for integration of technology in teaching.					
E2	The ICT facilities (computers, Wi-Fi and Internet) in the University are well functioning.					
E3	Lecture rooms have necessary ICT infrastructure for teaching.					
E4	The internet connectivity in the classrooms is fast and reliable.					
E5	The current design of lecture rooms supports ICT in teaching.					
Please add any comment below about your current experience on the provisioning of infrastructure to technology						

………

………

………

<u>**Thank you for your input**</u>

Appendix 1. 3: Interview questions on the infrastructure construct

Construct	Question	Interview questions	Probing questions
Infrastructure	1	How will you describe the current ICT infrastructure provisioning at MUT to support: Teaching, Learning, and Assessment, Academic Administration, and Support Services?	How do you think we can improve this over the next 3-5 years? [We want to know whether there are any plans to enhance our infrastructure (including, computing and storage devices, back-up devices, software and hardware, and auxiliary equipment such as Uninterrupted Power Supply and other specialised equipment that may be required by specialised academic programmes.]
	2	How will you describe our current WIFI coverage and signal strength across campus (Lecture rooms, specialised lecture rooms, open student spaces)? [Perhaps get a "score" on a scale from 1-to-10?]	What in your view, is required to get us to 10 on the scale (or 100% coverage)? Do you think we can achieve this? When? Are there any specific targets that have been set in your dept's strategic and/or operational plans at this stage? What plans do we have to reach an increased WIFI coverage that will support a sustainable e-Learning?
	3	Same as #2, but with specific reference to the ICT infrastructure (WIFI) at residences…this is important since more than 75%(?) of students live in residences	What in your view, is required to get us to 10 on the scale (or 100% coverage)? Do you think we can achieve this? When? Are there any specific targets that have been set in your dept's strategic

		either owned or leased by MUT.	and/or operational plans at this stage? What plans do we have, to reach an increased WIFI coverage that will support sustainable e-Learning?
	4	Explain what you believe to be the major stumbling blocks to ICT infrastructure acquisition at MUT.	Why is this so? How do you think this can be improved?
	5	Charging stations (students)/ open spaces (students). Currently there appears to be only a few…what plans are there for increasing this feature?	In your opinion, why after 40 years has the University not improved in respect of charging and open spaces?

Appendix 1. 4: Interview questions on the Systems construct

Construct	Question	Interview questions	Probing questions
Systems	1	The University uses both Blackboard and Moodle as official e-Learning platforms. In your view, how is the uptake of these two platforms by both lecturers and students?	Any possible reasons that you can think of that lends itself to this situation? Is there any possible measure we can take to increase the pace at which these are used at MUT?
	2	In your view do we have sufficient resources (both material and human) to ensure the development of a sustainable e-learning platform (whether this is BB or Moodle) in the medium to long-term (over the next 5 years)?	If no, what do you think may be required to secure such a sustainable system? (Answer could be broken down into immediate and medium-term).
	3	Lecture delivery systems: How would you describe the suitability of currently available ICT tools (smart boards, OHPs, data projectors, audio systems, WIFI) in the classrooms for teaching and learning purposes?	What plans exist to improve the current lecture delivery systems?
	4	Lecture recording systems: Do our lecture venues contain lecture recording equipment?	Are there any plans to increase our capacity to record, edit and produce videos of in-person lectures? Does your annual budgeting process make allowance for the costing of e-Learning resources? d Are there mechanisms to ensure that funds

			allocated to e-Learning are used efficiently for the advancement of the e-Learning project? If yes, do you believe this is sufficient? Please explain. If no, do you believe that it should be part of your unit’s budget?
	5	Staff Resources: When last were computer specs for staff reviewed and do you think this matches the current academic staff requirements? [writing tables, touch screens + memory]	Please explain
	6	What are some of the demands the online system has brought on that are different from the usual teaching and learning platform?	What are the demands for teaching, and what are the demands for students? What do we do to help students and staff to cope with the online environment?

Appendix 1. 5: Interview questions on Support Services construct

Construct	Question	Interview questions	Probing questions
Support Services	1	HELPDESK SUPPORT: What is the current state of play with respect to providing e-Learning support services to staff and students?	Why do you think we have not implemented a helpdesk for students?
	2	How will you describe the demand for training and support from staff and students?	How confident are you that we have sufficient support systems in place to enable students and staff to troubleshoot challenges and obtain the assistance they seek?
	3	What are the main barriers that exist in your unit/department that prevent you from implementing a more pro-active fault detection and resolution system as a support service for staff and students?	What causes these barriers in your view? How do you intend to address them? Is there any plan in place?
	4	What kind of training on the use of an e-Learning system is available for lecturers and students?	How frequent is this training? Is it effective in your view? If possible, can you explain the immediate and medium-term plans in providing appropriate and relevant training for staff at MUT?
	5	Is there anything else you would like to say about the challenges on support services faced your unit/department in	How can these, in your view, be mitigated against?

		improving the adoption of e-Learning at MUT?	

Appendix 1. 6: Interview questions on the Strategy construct

Construct	Question	Interview questions	Probing questions
Strategy	1	The MUT Strategy commits MUT to integrating ICTs in the core functions of the University. How do you rate our progress with respect to the adopting of ICTs into the TLA functions of the University? Please elaborate…..	What in your view, is required to get us to 10 on the scale (or 100% coverage)? Do you think we can achieve this? When? Are there any specific targets that have been set in your dept's strategic and/or operational plans at this stage? What plans do we have at Faculty level to reach an increased staff and students' motivation to adopt the use of technology?
	2	In your opinion, what strategies for ICT integration can be employed at MUT to ensure that student success rates are improved as envisioned by the strategy document? Please elaborate…..	Please explain.
	3	In your opinion, does university teaching staff in general, have sufficient knowledge about, and access to, pedagogical innovations to make a positive impact on student learning outcomes? Please elaborate…..	Explain how you think we can improve lecturers' capabilities to have a positive impact on student learning.
	4	Do you think students have sufficient knowledge to work	Please explain or expand on this point.

		within an ICT environment? Please elaborate…..	
	5	In your opinion, how does Executive Management's influence and support affect the uptake of e-Learning among staff and students at MUT? Please elaborate	What you think could be the cause of such circumstances? What is it that they are doing? What is it that they are not doing?
	6	From your own knowledge or understanding, are there any strategies in your departments to integrate existing and emerging ICTs in T&L? Please elaborate….	If so, can you please elaborate? If no, where do you think this responsibility should be located? Please elaborate.
	7	To what extent does the University strategy help students work effectively within an ICT environment? Please elaborate….	Does it provide access to e-Learning in the classroom? To what extent does it ensure quality teaching in the classroom? What possible improvements can we make to rectify or improve the situation?

Appendix 1. 7: Interview questions on the Leadership construct

Construct	Question	Interview questions	Probing questions
Leadership	1	Do you believe that decision-making regarding e-Learning is inclusive/extensive with respect to consultations with staff and students?	How do you make sure that your own decision-making is inclusive within your department? If no, how would you suggest that this can be improved? What kind of consultation can be done?
	2	Do you believe that MUTs Executive Management and Council provide the necessary support, funding, and leadership in the adoption and acceptance of e-Learning among faculty staff and students at MUT? If no, what else in your view, should they be doing?	What is their role as leaders? What kinds of funding could they provide? What kinds of support could they ensure that would assist the University in having a sustainable e-Learning system?
	3	What role do the senate and faculties play in the provision of leadership and support in advancing the eLearning project at MUT? Do you believe it is sufficient and if not, what else can be done?	What is their role as leaders - what kinds of support could they ensure?
	4	Do you believe that the operational units at MUT charged with the responsibility of providing leadership for advancing e-Learning [TLDC/ITN] are sufficiently	What more can be done? What is their understanding of the work done by these units?

		capacitated to perform this important function? Please elaborate….	
	5	Are there any other matters that you believe we should seriously consider, from a leadership point of view, in promoting e-Learning at MUT, considering that it will in all likelihood become the new normal? Please elaborate….	Please explain

Appendix 1. 8: Interview questions on the Culture construct

Construct	**Question**	**Interview questions**	**Probing questions**
Culture	1	Do you think that the TLDC has a good understanding about individual training for faculty and students in the use of the University LMS and other technologies used in eLearning, considering the diverse nature of our staff and students? Please elaborate...	How do you decide what staff and students need training on?
	2	Are there any protocols or guidelines to assist academic staff becoming proficient in the use of technology for TLA? Any compulsory interventions required from academic staff in performing their duties? Orientation and induction?	What could MUT do to assist them in becoming more proficient?

	3	What can you say about staff and students' culture towards engaging in productive and beneficial online teaching and learning? Please elaborate….	Please explain
	4	How does the staff help students develop skills in preparation for higher education academic literacy? Please elaborate…	Please explain
	5	What are the current training opportunities for students on the use of online in learning and what else do you think needs to be done? Please elaborate….	Please explain
	6	What can we do to ensure that students are sufficiently prepared and have access to appropriate resources to allow them to effectively use the University Systems for online learning? Please elaborate….	Please explain