

**Factors influencing Radiography students' experiences
of e-learning: a study conducted at a University of
Technology in KwaZulu-Natal**

by

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Declaration

This is to certify that the work is entirely my own and not that of any other person, unless explicitly acknowledged (including citations of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

29th May 2026

Signature of student

Date

Approved for final submission

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Date

Abstract

Background

E-learning and the use of technology is rapidly increasing in the Health Sciences field. E-learning, also known as electronic learning, can be defined as a technology-mediated approach of great potential from an educational perspective. E-learning refers to online learning that provides students with a virtual learning environment that is different from traditional methods of learning. E-learning is flexible and accessible and is used globally because it offers opportunities to meet significant educational outcomes, including long-term learning and increased participation. Notably, e-learning allows educational content to be adjusted to fit individual learning styles.

Varying results have been attained regarding the correlation between students and their ease with using technology. Whilst various authors have discovered that some students experience poor commitment and motivation in the e-learning experience, other students were found to value the interactive and visual elements of e-learning. Younger students have easily adapted to the use of technology for e-learning. The most common challenge that students experience in a developing country are accessibility issues, whereas the main issue in developed countries is high dropout rates. Several scholars have reported on the high levels of e-learning implementation at Universities of Technology in South Africa. The university of interest has also vastly increased their reliance on technology for e-learning since the onset of COVID-19.

The theoretical framework adopted in this study was the Technology Acceptance Model (TAM) developed by Fred Davis in 1986. The TAM is an information technology framework for analysing users' acceptance and use of new and updated technologies, particularly in a working environment, which in this case was the university of interest. This model has three main constructs: perceived

usefulness, perceived ease of use and actual use of e-learning. Attitude to use is a fourth factor which is influenced by the other three factors.

Aim of the study

The aim of this quantitative, cross-sectional study was to identify the factors influencing Radiography students' experiences of e-learning at a university of technology in KwaZulu-Natal to improve e-learning methods such that e-learning is both beneficial and straightforward for students.

Methodology

This study used a quantitative approach, which is the technique of using numerical values derived from observations to explain phenomena through observations, and conclude thereupon. The collected data is then analysed using mathematical methods. The positivism paradigm was selected to conduct this study because it was appropriate for a quantitative research approach. The positivism paradigm revolves around the researcher working with observable reality within the society, which in this research will be the factors influencing Radiography students' acceptance of technology for e-learning. This study was a descriptive cross-sectional study as the researcher was able to determine and outline the factors affecting Radiography students' acceptance of the technology used for e-learning at a specific point in time. There was no repetition of measurements amongst the research participants.

The setting for this study was the Radiography department at a University of Technology in KwaZulu-Natal. The researcher chose this particular setting because this is where research participants could be found, as information is required on the students' use of e-learning at this institute. The target population for the study was Radiography students studying at this university. This included first-, second-, third- and fourth-year students. The Radiography students targeted were from the Diagnostic, Sonography, Radiotherapy and Nuclear Medicine

disciplines. The sample size for the main study was 206 students. A non-probability convenience sampling technique was used.

The ethical approval number IREC 119/24 (Appendix 1) was provided when full approval was granted for the research to be conducted. Approval was obtained from the Director of Research and Postgraduate Support (Appendix 2a) at the university of interest to conduct this research study on first-, second-, third- and fourth-year Radiography students. Data analysis was performed using the following tests: descriptive statistics, ANOVA, Pearson's correlation coefficient, one sample t-test, independent samples t-test, factor analysis and linear regression.

Findings

A total of 206 participants were selected to provide their inputs regarding the research topic. There was no significant difference in the demographic constructs across gender, age, year of study or discipline. Results from ANOVA to determine whether there are any significant differences in these constructs across race shows that PEOU (perceived ease of use) differs significantly across race ($F(3, 202) = 5.367, p = .001$). Tukey's post hoc analysis shows that Indians (mean = 3.42) perceive e-learning to be easier to use than Blacks (mean = 3.04), $p < .001$.

The results depicted significant agreement that participants thought of e-learning as useful; that it was easy to use; and that they intended to use it more in the future. On the other hand, there was significant disagreement on whether participants had a good attitude towards e-learning. The independent variables PEOU, PU and ATT account for 48.9% of the variance in ITU (intention to use), $F(3, 202) = 64.437, p < .001$. PU ($\beta = .578, p < .001$) and ATT ($\beta = .190, p < .001$) are both significant predictors of ITU.

Conclusion

In conclusion, it can be stated that the purpose of the research, which was to identify the factors influencing Radiography students' experiences of e-learning at a university of technology in KwaZulu-Natal, has been achieved. Radiography students from the university generally have a positive experience when using technology for e-learning. Participants perceived e-learning to be useful. However, poor connectivity was an issue for most students. Participants also found e-learning platforms easy to use and their skills with technology sufficient. There were also contradicting attitudes towards e-learning. However, most participants eventually adjusted to e-learning. Future recommendations are that the results obtained in this study encourage further research into this topic and that another similar study may be conducted in more detail with a larger sample size, as research is essential for the progression of existing literature. More advanced technological programs can be developed to better suit Radiography students in order to achieve online educational goals with greater efficiency.

Key words: Perceived usefulness, perceived ease of use, behavioural use, e-learning, radiography students, Technology Acceptance Model

Dedication

*This dissertation is dedicated to God Almighty
for giving me strength when I had none, to my
family for your constant sacrifices and to
myself for every quiet comeback no one noticed.*

Acknowledgement

First and foremost, I dedicate this dissertation to the One who parts seas and moves mountains - God Almighty who nourished and inspired my quest and pursuit through an arduous journey. Thank you for making room for me in places I never imagined I'd reach.

To my family, '*disce amare et amari*' (learn to love and be loved), as they tolerated my demands and never failed to give me moral support. Thank you for never questioning why I chase degrees like they're stars. Your quiet sacrifices, constant encouragement and unshakeable belief in me have been the backbone of this journey.

To DUT - my second home, for granting me a space to grow.

To Dr S Naidoo and Dr N Gam, for their unflinching patience and commitment in guiding me through this research in a discipline which was challenging to me as a novice. Thank you for being both my compass and my anchor. Your guidance helped me find clarity in the noise, and direction in the doubt.

Lastly, to every student still in the thick of it – who sits with late nights, heavy hearts and constant fear of failure: I see you. I **was** you. Remember that progress is sometimes the silent decision to keep going. The finish line is closer than you think, and soon you will cross it - sleep deprived and overcaffeinated, but wildly proud.

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وَأَنْ لَّيْسَ لِلْإِنْسَانِ إِلَّا مَا سَعَىٰ

“And that each person will have only what they strive for”

-Surah An-Najm (53:39)

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Glossary of Terms

Actual Use – how often students use e-learning based on their perception of it (Amir *et al.* 2020: 6).

E-learning - Electronic learning can be defined as a technology-mediated approach of great potential from an educational point of view (Hadullo, Oboko and Omwenga 2018: 152).

Perceived Ease of Use – the degree to which students believe that their use of the e-learning system would be mentally and physically uncomplicated (Wilson, Alvita and Wibisono 2021: 149).

Perceived Usefulness – the degree to which students believe that using an e-learning system will positively impact their academic performance (Vululleh 2018: 142).

Acronyms

Acronym	Full word/sentence
ATT	Attitude To Use
BHSc	Bachelor of Health Sciences
DOH	Department of Health
DUT	Durban University of Technology
HOD	Head of Department
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
TAM	Technology Acceptance Model
COVID-19	Corona Virus Disease of 2019

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

Dalmolin *et al.* (2018: 180) state that e-learning and the use of technology is rapidly increasing in the Health Sciences field. E-learning, also known as electronic learning, can be defined as a technology-mediated approach of great potential from an educational point of view (Hadullo, Oboko and Omwenga 2018: 152). E-learning is online learning that provides students with a virtual learning environment that is different from traditional methods of learning (Hadullo, Oboko and Omwenga 2018: 152). According to Moule, Ward and Lockyer (2010: 2786), e-learning is flexible and accessible and is used globally because it offers opportunities to meet significant education outcomes, including long-term learning and increased participation. E-learning allows educational content to be adjusted to fit individual learning styles (Dalmolin *et al.* 2018: 180). The researcher aims to analyse the experiences of Radiography students towards e-learning.

Varying results have been attained regarding the correlation between students and their ease in using technology. According to Ranadewa *et al.* (2021: 582), many students were still apprehensive towards using e-learning but the authors believe that this issue can be minimised by the improved preparation of e-learning courses. Dalmolin *et al.* (2018: 178), on the other hand, found that students, especially younger students, have easily adapted to the use of technology for e-learning.

According to Reddy (2015: 260), the most common challenge that students experience in a developing country are accessibility issues, whereas the main issue in developed countries are high dropout rates. Ranadewa *et al.* (2021: 583) affirmed that technology use for e-learning has vastly increased over the years. Concurring with the above, Louw (2016:1) and Aboagye, Yawson and Appiah (2020: 6) agree that several scholars had reported on the high levels of e-learning implementation at Universities of Technology in South Africa. The institution of interest has also vastly increased their reliance on

technology for e-learning since the onset of Corona Virus of 2019 (COVID-19), which was an infectious disease. However, there is no current information regarding the factors influencing Radiography students' experiences of e-learning at this university. This fact motivated the researcher to explore this topic.

Radiography education has distinctive teaching and learning requirements, as students are expected to develop both theoretical knowledge and practical clinical competencies. Consequently, e-learning within Radiography extends beyond the delivery of lecture content and incorporates learning management systems, digital image interpretation, simulation-based learning, virtual reality, online assessments and multimedia resources that complement clinical training (Konstantinidis, Apostolakis and Karaiskos 2022: 566; Pang *et al.* 2024: 74). These digital approaches provide students with opportunities to repeatedly practise image interpretation and clinical decision-making in a safe learning environment, while enhancing flexibility and accessibility to educational resources (Ogura *et al.* 2018: 622; Lim *et al.* 2025: 22). Furthermore, recent South African research has shown that Radiography students generally recognise the value of e-learning in supporting their academic learning, although challenges relating to engagement, the integration of practical skills and the balance between online and face-to-face teaching remain (Burger *et al.* 2022: 6; Gumede, Hazell and Lewis 2025: 5). Understanding the factors that influence Radiography students' experiences of e-learning is therefore essential for developing teaching strategies that effectively integrate technology while maintaining the practical and clinical standards required within the profession.

The theoretical framework that this study was based on was the Technology Acceptance Model (TAM) developed by Fred Davis in 1986 (Portz *et al.* 2020: 2), which is an information technology framework for analysing users' acceptance and use of new and updated technologies, particularly in a working environment, which in this case was the university (Portz *et al.* 2020: 2). Radiography students enrolled at the university in question depended greatly on e-learning for the completion of their modules. However, no information was available regarding their attitudes, perceptions and extent of

acceptance of technology, hence the need for this research. This section will be elaborated in Chapter Two.

1.2 PROBLEM STATEMENT

The acquisition of competencies is required to adequately operate medical imaging equipment to perform the necessary imaging requirements. Previously, these competencies and skills were achieved through traditional classroom learning and clinical work at designated hospitals or clinics. However, due to restrictions on clinical placements and classroom learning as a result of COVID-19, as well as changes in the dynamics of university education, there has been a need for alternatives to the traditional approaches of teaching, which is why e-learning has increased in universities (Ekpo, Giannotti and Akwo 2023: 22). Medical imaging technology continues to change, which requires continuous education development by universities in order to operate advancing medical equipment (Lim *et al.* 2025: 1). This further indicates that students have to be proficient in e-learning to be able to efficiently and rapidly grasp the daunting educational programs in order to succeed, according to Lim *et al.* (2025: 1).

The researcher observed that Radiography students at the university of interest were not proficient in using technology for e-learning when the university made a transition to online studies in 2020. Furthermore, some students were not completely satisfied with the e-learning outcomes. Aboagye, Yawson and Appiah (2020: 6) stated that a developed country's greatest challenge is creating strategies to sustain the global competitive market, whereas South Africa mainly struggles with poor accessibility to proper wireless connection and the lack of sufficient skills to use e-learning. The researcher also noticed a paucity of studies regarding e-learning that have addressed the actual use of e-learning, perceived usefulness and ease of use of e-learning of Radiography students in the province of KwaZulu-Natal, hence this research study. This issue was worth addressing because technology is becoming increasingly used around the world. Addressing this

problem was imperative because the lack of e-learning in a country could be considered a disadvantage (Sweileh 2021: 766).

1.3 AIM OF THE STUDY

The aim of this quantitative, cross-sectional study was to identify the factors influencing Radiography students' experiences of e-learning at a university of technology in KwaZulu Natal to improve e-learning methods in a way that is both beneficial and unchallenging for a student.

1.4 OBJECTIVES OF THE STUDY

The study sought to achieve the following objectives:

- i. To determine Radiography students' perceptions regarding the usefulness of e-learning technology.
- ii. To explore Radiography students' perceptions regarding the ease of use of e-learning platforms.
- iii. To investigate the extent to which Radiography students use e-learning.
- iv. To determine the attitudes of Radiography students towards the use of e-learning.

1.5 RESEARCH QUESTIONS

Primary Research Question:

What factors influence Radiography students' experiences of e-learning at a University of Technology in KwaZulu-Natal?

Secondary Research Questions:

1. What are Radiography students' perceptions regarding the usefulness of e-learning?

2. What are Radiography students' perceptions regarding the ease of use of e-learning platforms?
3. What factors influence Radiography students' attitudes towards e-learning?
4. How do Radiography students experience the use of e-learning in their academic program?
5. What improvements can be made to enhance the e-learning experience of Radiography students?

1.6 RATIONALE FOR THE STUDY

Radiography is a technologically driven profession that requires students to develop both theoretical knowledge and clinical competence. As higher education institutions increasingly integrate e-learning into teaching and learning, it is important to understand the factors that influence Radiography students' acceptance and use of e-learning technologies. Although e-learning has been widely implemented across higher education, limited research has specifically explored the experiences of Radiography students within the South African context, particularly at Universities of Technology. This identified knowledge gap provided the rationale for conducting the present study.

The study aimed to investigate the factors influencing Radiography students' experiences of e-learning using the Technology Acceptance Model (TAM). Understanding students' perceptions regarding the usefulness and ease of use of e-learning, together with their attitudes, behavioural intention and actual use of e-learning technologies, may provide valuable insights into the factors that promote or hinder the successful integration of digital learning within Radiography education.

The findings of this study were expected to assist higher education institutions and Radiography departments in developing strategies to enhance students' digital competencies and improve the design, accessibility and effectiveness of e-learning. The study was also expected to contribute to the implementation of teaching approaches that

support student engagement, academic success and the effective integration of technology into healthcare education.

Furthermore, the study sought to contribute to the limited body of knowledge relating to e-learning acceptance among Radiography students in South Africa and provide a foundation for future research in this field. By generating evidence within the context of Radiography education, the study aimed to support the ongoing development and continuous improvement of teaching and learning practices within higher education.

1.7 DEFINITION OF TERMS

E-learning - E-learning refers to the use of electronic technologies and digital platforms to facilitate teaching and learning. It is a technology-mediated approach that enables students to access educational content, participate in learning activities and communicate with lecturers through online or digital systems (Hadullo, Oboko and Omwenga 2018:152). In higher education, e-learning may include online lectures, recorded presentations, learning management systems, discussion forums, electronic assessments, digital study materials and simulation-based learning activities (Amir *et al.* 2020: 6). In the context of this study, e-learning refers specifically to the use of online learning platforms and digital educational technologies utilised by Radiography students at a University of Technology in KwaZulu-Natal for academic purposes. This included activities such as accessing lecture materials, attending online classes, submitting assignments, participating in virtual discussions and engaging with digitally supported learning resources. The study assessed students' perceptions, experiences, attitudes and use of these e-learning methods through the questionnaire.

Perceived Usefulness – the degree to which students believe that using an e-learning system will positively impact their academic performance (Vululleh 2018: 142).

Perceived Ease of Use – the degree to which students perceive that their use of an e-learning system would be mentally and physically uncomplicated (Wilson, Alvita and Wibisono 2021: 149).

Actual Use – how often students use e-learning based on their perception thereof (Amir *et al.* 2020: 6).

1.8 STRUCTURE OF THE DISSERTATION

The structure of the dissertation per chapters is outlined below:

Chapter One: Overview of the study

This chapter introduced the background to the study, including the research problem, the aim, objectives, rationale and significance of the study.

Chapter Two: Literature Review

The existing literature as well as the gap in the literature on e-learning was discussed. The theoretical framework was also mentioned and related to previous research.

Chapter Three: Research Methodology

This chapter outlined the process undertaken during data collection, including the philosophy that underpinned this process. It included aspects such as an explanation of the paradigm, research design, methodological approach, the study setting, target population, recruitment, sampling strategy, inclusion and exclusion criteria, data collection process, data collection instrument and analysis.

Chapter Four: Presentation of the results

The results obtained during data collection were presented in this chapter.

Chapter Five: Discussion of the results

Chapter Five discussed the findings and integrated it with current literature and the theory used in the research.

Chapter Six: Limitations, conclusions and recommendations of the study

This chapter provided a summary of the study, including its limitations, conclusions and recommendations for future research.

1.9 SUMMARY OF THE CHAPTER

The use of e-learning in the Health Sciences has vastly increased over the years due to e-learning being flexible, accessible and efficient in meeting significant education outcomes. However, some research reflected that multiple establishments have failed in properly implementing e-learning due to insufficient knowledge on how to use technology for e-learning. The theoretical framework of this study was based on the TAM, which is an information technology framework for analysing users' acceptance of technology. Some research indicates that students experience poor commitment and motivation to the learning experience with e-learning. Students were found to value the interactive and visual elements of e-learning. On the other hand, contrary research stated that students, especially young students, are generally comfortable with utilizing technology and have a positive attitude towards e-learning. The perceptions of Radiography students towards e-learning are not known. The following chapter presents the literature used as a framework to direct this study.

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

This chapter builds on of Chapter One, in which the study's objectives were drawn up. These objectives will guide the literature search for this review, which introduces the reader to the body of literature on online learning in Radiography. Comparisons are drawn between amongst different authors so that the current standing on the topic may be appreciated. This chapter includes the problem statement viewed from a global context as well as a local context, which is at the university under study. The study focus is on e-learning in higher education and the theoretical framework used for the study is Davis's Technology Acceptance Model (TAM). The variables comprising this framework are: the actual use, perceived enjoyment, perceived usefulness and students' attitudes towards technology for e-learning.

An electronic search was used to review and collect literature and to determine appropriate resources for the review. Several databases were used, namely Google Scholar, Google Books, ScienceDirect, PubMed, NCBI, ResearchGate, as well as Webster's Dictionary. Exchangeable keywords and phrases, namely "e-learning; students' acceptance of e-learning; actual use of e-learning; usefulness of technology for e-learning and ease of use of technology", were searched. The keywords on e-learning were used in conjunction with keywords relating to Health Sciences education. The keywords on e-learning were collectively used with the names of journals specializing in health education, tertiary education and Radiography. Only documents published in peer-reviewed scientific journals were considered to avoid false information. Keywords related to education, namely "education" or "tertiary institutions", were added to the search inquiry to curtail articles unrelated to education. The researcher also used the reference list of relevant articles and suggested articles that were found online to access other articles.

2.2. GLOBAL AND LOCAL CONTEXT OF THE STUDY

Perspectives on the use of e-learning can be considered at local and global levels. These include access to a wireless connection and the skilling of academic staff. These factors are further outlined below.

2.2.1 Access to a wireless connection

The greatest challenge in terms of the successful conduction of e-learning experienced in some countries is the poor or absent accessibility of a proper wireless connection (Aboagye, Yawson and Appiah 2020: 6). The application of wireless networks contributes to the strategic direction of electronic learning by providing opportunities for observing the learning process of students and the control of their academic performance (Yang 2024: 2). Despite the role of wireless networks in the grand scheme of e-learning and the potential for e-learning being so immense, its implementation in lesser developed countries faces significant hinderances, namely limited internet connectivity; exorbitant costs of digital devices; and a deficiency of digital knowledge amongst both learners and educators (Abuali and Ahmed 2025: 2).

Within South Africa, particularly at Universities of Technology, the implementation of e-learning has accelerated in recent years, driven in part by broader global digital transformation trends and the increased reliance on online education (Louw 2016: 1; Aboagye, Yawson and Appiah 2020: 6). However, this rapid expansion has also exposed inequalities in access and engagement, reflecting challenges that are not unique to South Africa but are shared across many Global South nations. Countries such as India and Brazil, for example, have similarly experienced rapid growth in digital education alongside persistent disparities in connectivity, digital literacy, and equitable access (Costa 2021: 392). These shared challenges position e-learning within a broader South–South discourse on equitable digital transformation and highlight the importance of contextually grounded research to inform policy and practice (Costa 2021: 392).

The South African government has also recognised the importance of broadband connectivity and digital inclusion within higher education and broader society. The National Development Plan 2030 emphasises the creation of an inclusive information society through improved access to information and communication technologies and expanded broadband infrastructure across underserved areas in South Africa (National Planning Commission 2012: 190). In support of this vision, government initiatives aimed at improving wireless connectivity seek to reduce digital inequalities and enhance access to educational opportunities, particularly within rural and previously disadvantaged communities (National Planning Commission 2012: 191). Improved broadband access within higher education institutions may therefore contribute positively towards the effectiveness and accessibility of e-learning among university students, including those enrolled in technologically intensive programmes such as Radiography (National Planning Commission 2012: 192).

2.2.2 Skills of academic staff in the use of e-learning

Another challenge faced in lesser developed countries like South Africa is that even though there are a high number of reports displaying e-learning implementation at most universities of technology in South Africa, Aboagye, Yawson and Appiah (2020: 6) state that many academics and students lack sufficient skills to properly use the features of e-learning. Developed countries also experience difficulties with the successful implementation of e-learning, and their biggest challenge is developing and implementing the strategies that are framed in order to sustain the global competitive market (Abuali and Ahmed 2025: 2). The aim of this study is to explore the factors influencing Radiography students' experiences of technology for e-learning.

2.3. ADVANTAGES OF E-LEARNING

Globally, e-learning is seen as flexible, accessible and as offering opportunities to meet significant education outcomes, including long-term learning and increased participation

(Abuali and Ahmed 2025: 1). From a global perspective, e-learning facilitates connectivity across the world by eliminating the physical restrictions of academic institutions (Sweileh 2021: 766). Moreover, e-learning allows educational content to be adjusted to fit individual learning styles (Dalmolin *et al.* 2018: 180). Sweileh (2021: 766) concurred with the above by stating that e-learning made education more exciting, flexible and vast because it includes a lack of time constraints for attending lectures, and proffers the opportunity to access lecture material at any time. Due to the advantages, the use of e-learning and technology is increasing, particularly in the Health Sciences field (Dalmolin *et al.* 2018: 180). However, Aboagye, Yawson and Appiah (2020: 2) caution that many e-learning initiatives have failed because establishments and their constituents were not prepared for the transition. The impact of e-learning on the Radiography students at the current study site are unknown, hence the need for this research to implement strategies on a successful transition to one day completely rely on e-learning.

According to Sweileh (2021: 766), it is necessary to assess the ability of multiple countries and world regions to implement e-learning in Health Sciences education as an accessible and equitable learning method. The author further suggested that the lack of e-learning in a country would be considered a disadvantage and decreased the adaptability of the education system to natural disasters or infectious disease outbreaks like the COVID-19 pandemic. On the topic of COVID-19, Naciri *et al.* (2021: 2) contradicted the above by noting that the sudden transition to e-learning during COVID-19, along with the affiliated time constraints, prevented the appropriate and effective implementation of e-learning. Additionally, some educators had inadequate skills in e-learning based teaching methods. A lack of motivation and reduced or absent interactions between educators and learners were also considered disadvantages (Naciri *et al.* 2021: 2). This research intends to identify the factors influencing a Radiography student's experiences of e-learning.

The study by Dalmolin *et al.* (2018: 178) revealed that students are generally comfortable utilizing technology and have a positive attitude towards e-learning. Additionally, younger students are more likely to use online resources as a learning tool relative to older

students. On the contrary, the results of the study by Yang (2024: 2) suggest that students experience poor commitment and motivation to the learning experience with e-learning. Furthermore, group projects became more strenuous as many students exhibited a lack of attendance. In order to counteract these issues, new technologies such as interactive gamification were introduced (Yang 2024: 2). According to Aboagye, Yawson and Appiah (2020: 6) and Abuali and Ahmed (2025: 2), the most common challenge that students experience in a developing country is accessibility. This includes connectivity and using compatible electronic devices, whereas in developed countries, cost and access to the Internet are not major barriers to e-learning. South Africa, being a lesser developed country, is expected to produce results supporting the former claim.

On one hand, many studies have reported positive perceptions of e-learning among both students and academic staff (Layali and Al-Shlowiy 2020:11; Yang 2024:2). These positive perceptions were associated with the flexibility, convenience and accessibility offered by e-learning platforms, which enabled students to access learning materials remotely, engage with recorded lectures and participate in self-directed learning activities. E-learning has also been recognised for promoting independent learning, improving access to educational resources and supporting continuity of education through digitally enhanced teaching and learning methods (Layali and Al-Shlowiy 2020: 11). Within healthcare education, including Radiography, e-learning may further support technologically integrated learning environments that encourage the development of digital competencies required in modern clinical practice (Layali and Al-Shlowiy 2020:11).

On the other hand, studies by Xhelili *et al.* (2021:103) reported that Albanian university students demonstrated more positive perceptions towards traditional face-to-face learning when compared to e-learning. Some students perceived traditional learning environments as more interactive, engaging and supportive of direct communication with lecturers and peers. Additionally, Abuali and Ahmed (2025: 2) stated that while developed countries experience fewer infrastructural barriers due to greater technological advancement and digital literacy, challenges still exist regarding the continuous

development and implementation of sustainable e-learning strategies capable of maintaining competitiveness within the global education sector.

Participants in the study by Xhelili *et al.* (2021: 103) reported that complications of e-learning related predominantly to the unattainability of an internet connection and the lack of technological devices. Naciri *et al.* (2021: 8) concurred that the barriers to e-learning may be attributed to a limited internet connection; technical problems in the use of educational programs; and difficulties in perfecting clinical skills. Sweileh's (2021: 772) views accorded well with those of Naciri *et al.* (2021: 103) and Xhelili *et al.* (2021:8) when he stated that despite the popularity of e-learning, several barriers can be attached to the implementation and the development of e-learning with regard to Health Sciences, especially in developing countries, namely inadequate infrastructure; undeveloped technical skills; the absence of institutional strategies and support; or the negative attitudes of the involved parties. Sweileh (2021: 722) further explained that in Saudi Arabian universities, the infrastructure and technology dimension was the weightiest barrier as perceived by participants. According to the study by Al Zahrani *et al.* (2021: 5) on Saudi Arabian universities, the educators and students claimed that e-learning is a flexible and useful source of teaching and learning that assists in distance education with less use of resources and time, but the majority of their participants concluded that e-learning is unsuitable for Health Sciences studies because practical and clinical work was not properly taught or learnt. This study also depicted further disadvantages of e-learning, namely poor engagement, motivation and perception; high levels of anxiety and stress; and poor interactions between students and educators.

According to Hayat *et al.* (2021: 1), health institutions have gravitated towards e-learning as it alleviates the interruption in classroom education. A study by Yekefallah *et al.* (2021: 1) also depicted a higher number of Health Sciences students who preferred e-learning and gained desirable satisfaction, as compared to those with undesirable satisfaction. Based on the study results of Maatuk *et al.* (2021: 35), students believed that e-learning contributes to their learning, but it transferred the workload off the institution and placed

it onto the students. At the institutional level, e-learning permits the inclusion of a large number of students at a reduced cost with increased quality of teaching materials (Sweileh 2021: 722). This would definitely be profitable to these students as some students reside further away from the institution and the implementation of e-learning should alleviate that. There are also a large number of students at this institute and using e-learning would allow for larger classes to be formed, instead of turning students away. This would in turn contribute to the welfare of the economy and the educational standing of the country.

Yakobi *et al.* (2025: 3) mentioned that the technology used for e-learning in South Africa has vastly increased over the years. Moreover, this increase in popularity can be credited to the following factors: its ability to encourage peer-to-peer collaboration; the ability to improve low-cost social networking; and simultaneously engaging multiple audiences. Concurring with the above, Mpungose (2025: 17208) stated that several scholars have reported on the high levels of e-learning implementation at Universities of Technology in South Africa. Abuali and Ahmed (2025: 1) emphasized that educational technologies reveal a world of potential within learning and teaching, where qualified individuals and students may communicate on a level that will improve the quality of their learning experiences. Furthermore, the authors mention that e-learning technologies include various features for instructors to help students, including creating assignments, managing courses and online assessments, author content and fostering collaboration. However, many academics and students lack sufficient skills to properly use these features of e-learning (Mpungose 2025: 17207). Even though the institution of interest has become more reliant on e-learning since the onset of COVID-19, the effect on Radiography students as well as their perceptions on this aspect has not yet been discovered.

2.4. THE PROGRESSION OF E-LEARNING IN HIGHER EDUCATION

Historically, e-learning has been used since the late 1990s, with the gradual development of broadband networks and the formulation and implementation of distance learning programs by national and international educational institutions (Konstantinidis, Apostolakis and Karaiskos 2022: 565). However, 2020 truly marked a significant increase in the use of e-learning for distance education and human computer interaction due to the COVID-19 pandemic and the limitations on physical interaction, with the same progressive trend in 2021 (Konstantinidis, Apostolakis and Karaiskos 2022: 565). Ali, Khaled Hossain and Ahmed (2018: 353) and Valverde-Berrocso *et al.* (2020: 1) posit that e-learning is being used more often every day, particularly in higher education. Similarly, Amir *et al.* (2020: 2) describe e-learning as learning that uses information and communication technologies. The use of the world wide web (www) has extended to a large extent in the past two decades, causing universities to invest in information systems such as Moodle, Blackboard and Microsoft Teams, which allow face-to-face as well as isolated course delivery (Al Kurdi, Alshurideh and Salloum 2020: 6484). Moreover, e-learning has earned recognition in transporting educational resources, which has become possible with the use of the internet and web technologies. Encarnation (2020: 384) concurs with the above by mentioning that the introduction of e-learning has significantly improved the mode of learning, particularly in higher education, and it is an important factor in educational institutions (Alzaghoul 2012: 27). Likewise, Hadullo, Oboko and Omwenga (2018: 152) advocate e-learning as online learning that provides students with a virtual learning environment that is different from traditional methods of learning. Moreover, it promotes individual learning rather than group learning and students can manage their time according to their needs. However, it is important to note that the impact of e-learning on students depends on many factors, such as the quality and delivery of the course, implementation of appropriate assessments and the learning theory that students adopt (Encarnacion 2020: 392).

Ali, Khaled Hossain and Ahmed (2018: 358) found that e-learning is effective for university students irrespective of their background, but the effectiveness of e-learning varies amongst students. Additionally, factors that influence the effectiveness of e-learning

include students' knowledge of technology and self-efficiency. E-learning permits individuals to focus on a specific area, but this comes with the responsibility of self-discipline (Yang 2024: 2). Amir *et al.* (2022: 2) stated that the effectiveness of e-learning also depends heavily on the student's commitment to the course. The authors further maintain that e-learning has proven to have the same results as traditional learning in terms of the knowledge gain and performance of students. Moreover, despite challenges that students encounter with the transition to e-learning, they are still able to adapt to distance learning, with some finding it more efficient than classroom learning because it is less time-consuming, less costly and user friendly (Amir *et al.* 2020: 2).

2.5. E-LEARNING IN RADIOGRAPHY

The use of e-learning in teaching, learning and assessment across the four disciplines of the Radiography profession has increased over the years. The use of e-learning in Sonography, Diagnostic Radiography, Radiotherapy and Nuclear Medicine is further discussed below.

2.5.1 Sonography

Evelyn (2025: 1) declared that different societies defined the educational objectives for Radiography curricula, and consequently recognized and emphasized the need for structured educational programs that include faculty digital literacy, institutional support and a flexible curriculum structure. According to Situ-LaCasse *et al.* (2021: 4), ultrasound requires theoretical knowledge, sensorimotor and perceptual skills, as well as the ability to assimilate ultrasonographic findings into a clinical setting. Furthermore, fundamental motor skills as well as core psychomotor skills are developed and applied in each ultrasound examination. Situ-LaCasse *et al.* (2021: 4) mention that teaching ultrasound integrates multiple aspects of learning, including the skill of incorporation of the findings into the clinical environment, the sensor–motor component of moving the ultrasound probe, and the skill of pattern recognition. Situ-LaCasse *et al.* (2021: 4) explain that the

operator utilises these skills to manipulate and move the probe in response to sensory information such as the feel of a chest rib or the image on the screen. The pattern-recognition skill can be taught using e-learning and the integration into the clinical context can be partially trained using e-learning by adding simulation software and virtual classrooms (Evelyn 2025: 1). Situ-LaCasse *et al.* (2021: 6) agree that basic ultrasound hands-on skills in acquiring images can be developed by students using e-learning methods that teach ultrasound techniques. The factors influencing Sonography students' acceptance of technology at this institution for e-learning are not known.

Lien *et al.* (2023: 1) conducted a study amongst two groups of Sonography students. The first group was exposed to e-learning, whilst the second group had no access to e-learning and instead used bedside one-on-one random learning. The point-of-care ultrasound (PoCUS) curriculum for the focused assessment of Sonography for trauma was conducted and assessed by an objective instructor who was not involved in the experiment and was unaware of the use of e-learning. It was discovered that e-learning had a positive effect on ultrasound education. The first group of students had a comparable performance with the second group and even better image acquisition, even though the second group had more PoCUS experience.

2.5.2 Diagnostic Radiography

Diagnostic Radiography is a hands-on profession where radiographers and radiologists form a multidisciplinary team, both during screening or diagnosis and intervention, enabling them to be aware of the clinical information as well as the medical history of the patient (Konstantinidis, Apostolakis and Karaiskos 2022: 565). Together with the radiologist, a radiographer is responsible for image quality assurance; the accessibility, availability and interpretation of radiographic images; and for the performance of additional imaging, biopsy techniques and pre-operative localization (Konstantinidis, Apostolakis and Karaiskos 2022: 565). Ogura *et al.* (2018: 626) suggested that e-learning for diagnostic radiographers should be considered for continuing their education because

it is effective in improving their skills. The study by Teo *et al.* (2020: 359) concluded that as Radiography students, they did not all have conducive learning environments compared to university facilities that were designed specifically for optimized studying and shortening clinical placements, which is a significant discrepancy in adequate learning. Furthermore, classroom learning enabled students to engage in group discussions and exchange ideas as everyone was studying at the same pace. Lastly, the lack of clinical practice to supplement and augment learning leads to sub-optimal Radiography education because it is difficult to put theories into practice (Teo *et al.* 2020: 359). Contrary to the above, the most recent study performed by Konstantinidis, Apostolakis and Karaiskos (2022: 570) states that e-learning can be as effective as traditional learning for developing, maintaining and upgrading the skills of professionals in the field of medical imaging, such as radiographers. Moreover, e-learning can assist healthcare professionals to develop and hone their skills according to their personal needs; minimize errors during clinical practice; and increase self-confidence.

2.5.3. Radiotherapy

Although modern Radiotherapy began at the discovery of the X-rays in the late 1800s, the field of Radiation Oncology has had multiple renaissances since its formal inception six decades ago. This means that as imaging and treatment delivery methods have improved, the applications of radiation oncology have expanded (Chandra *et al.* 2021: 171). International literature and experience have portrayed many approaches to the e-learning subject in the field of Radiotherapy in that multiple international institutions have implemented e-learning tools for the lifelong education and development of the health professionals they represent, even prior to the COVID-19 pandemic (Konstantinidis, Apostolakis and Karaiskos 2022: 569). According to Burger *et al.* (2022: 2), Radiotherapy plays a critical role in cancer care, with approximately half of all cancer patients requiring radiotherapy during their treatment. According to more recent literature, the combination of imaging data from a medical image repository with virtual reality and simulation technology is the key in distance learning for undergraduate radiotherapy students, and

even healthcare professionals (Burger *et al.* 2022: 2). Due to the situation created by the COVID-19 pandemic, or even other situations that may arise in the future, students and healthcare professionals can develop their clinical skills in a safe virtual environment. Moreover, considering that a simulation is most times impossible directly on real equipment in an educational environment due to restrictive costs and requirements in space and shielding, a simulation platform could provide the necessary knowledge to the trainee for theoretical and practical subjects (Konstantinidis, Apostolakis and Karaiskos 2022: 569).

Burger *et al.* (2022: 7,8) conducted a study in Cape Town, South Africa, whereby a radiotherapy program had to be structured virtually due to the COVID-19 pandemic, and in so doing, discovered that doing such provided many opportunities and insights into Radiotherapy practical training and on-line educational teaching models. An IT coordinator had to become an integral part of the process for the courses to run smoothly. Pre-recording lectures became an effective way of overcoming the gap caused by absent lecturers. Even though the virtual simulation system was limited due to limited technology upgrades, the issue was still overcome by the combination of livestreaming and pre-recorded videos. A major concern for online training raised by both teaching faculty and students was found to be an unstable internet connectivity. Connectivity issues during training were very disruptive. Overall, the Radiotherapy Treatment Planning Computer Access Strategy proved to be successful. The study concluded that despite the challenges, which could be overcome, there were considerable advantages such as geographical reach, financial and time savings. This study proves that e-learning for radiotherapy students in South Africa is a possibility, even though more research is required in terms of resources and money in attaining such at this point.

2.5.4. Nuclear medicine

Nuclear medicine is the process of administering small doses of radioactive material to a patient and then using a camera to detect the location of the material. Furthermore,

nuclear medicine differs from other imaging studies in that it shows the body's anatomic structures and the organs' function (Goldenhart and Senthilkumaran 2022: 1). According to a study on nuclear medicine students performed by Tulipan *et al.* (2024:300) in Norway, not all studies on the transition from traditional lectures to online learning displayed increased levels of student satisfaction and engagement. In fact, student resistance was more common due to factors such as reduced face-to-face interaction, decreased opportunities for practical and clinical engagement, technological challenges and difficulties adapting to fully online learning environments. Students also reported concerns regarding reduced motivation, limited peer interaction and the perceived effectiveness of online learning compared to traditional classroom-based teaching. In a survey amongst 60 students on an e-learning course in the United Kingdom, participants complained that e-learning courses did not prepare them for the detailed knowledge required in written examinations (Tulipan *et al.* 2024: 300). The outcome of Nuclear medicine students with regard to online education has yet to be determined.

Gnanasegaran *et al.* (2021: 428) explored a case wherein Nuclear Medicine students had to transition to online learning due to COVID-19 and the following aspects were determined: Firstly, it was found that innovative and effective teaching methodologies should be developed to provide optimal training for future Nuclear Medicine physicians while using available online educational resources because nuclear medicine students' teaching is now shifting from traditional structured face-to-face lectures to remote teaching to the more flexible blended-learning approach being adopted. Secondly, conventional nuclear medicine training is delivered through scan reporting sessions, didactic lectures as well as taught programs in several countries with ending exams. These authors believe that nuclear medicine training can be transferred from live face-to-face teaching to online platforms. This can be further improved by pre-recorded lectures or webinars, followed by live discussions and self-assessment questions. However, as with anything new, challenges may be found such as the threat of social and intellectual isolation. However, the authors still argue that despite the challenges, e-learning is beneficial because everybody gets access to structural material irrespective of distance

or background. Lastly, there are a few methods in overcoming constraints, such as good course content, quality and the “user friendliness” of delivery platforms. However, internet access, connectivity and hardware might be limiting factors in low-income countries.

Radiography students at the selected institution currently greatly rely on e-learning for the completion of their modules. This includes online lectures, assessments, and resources or course materials. Currently there is insufficient theory about the factors influencing Radiography students’ experiences of e-learning, which this study aims to identify.

2.6. THEORETICAL FRAMEWORK

The theoretical framework used for this study as illustrated in Figure 2.1 is the Technology Acceptance Model (TAM) (Portz *et al.* 2019: 2), which was used in this study to determine the perceived usefulness and perceived ease of use of learning, along with the variables that influence them which is attitude to use, intention to use and actual use of e-learning.

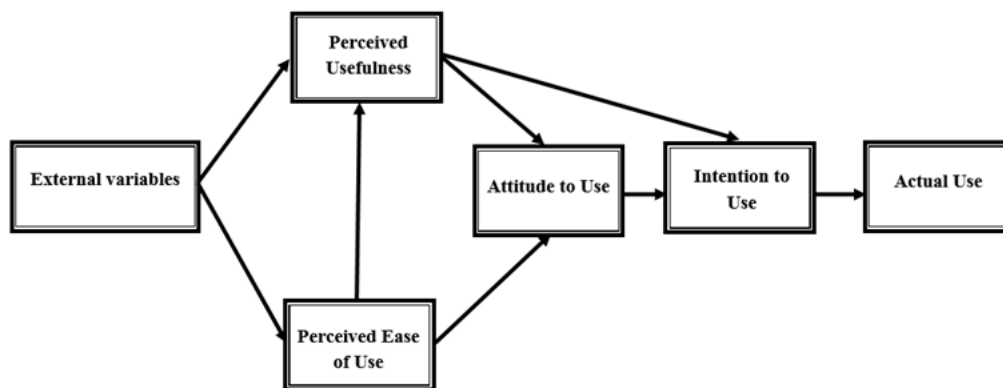


Figure 2.1: Original version of TAM (Al-Kurdi, Alshurideh and Salloum 2020: 6486)

The TAM was first introduced by Davis in 1989 (Portz *et al.* 2020: 2). The TAM model addresses the attitude of the user towards the use of technology and its actual usage. Essentially, the authors advocate that TAM is a users’ intention-based model developed to predict or determine users’ acceptance of technology. Sakarji *et al.* (2019: 17) elaborate that TAM is an information technology framework for analysing users’

acceptance and use of new and updated technologies. It can be implied that an individual's intent to use (acceptance of technology) and usage behaviour (actual use) of a technology is founded by the individual's perceptions of the specific technology's usefulness (benefit from using the technology) and ease of use (Portz *et al.* 2020: 2). This model has four main constructs, namely perceived usefulness, perceived ease of use, attitude to use and intention to use or actual use of e-learning (Vululleh 2018: 142). The objective relating to the use of e-learning incorporated aspects of both behavioural intention to use and actual use, as these constructs were explored collectively within the study.

2.6.1 Perceived Usefulness

The construct 'perceived usefulness' is demarcated as the degree to which students believe that using an e-learning system will positively impact on their academic performance (Vululleh 2018: 142). In TAM, perceived usefulness can be explained as the level to which an individual believes that using technology will improve their work performance, and ease of use indicates how effortless it is to use this technology (Sakarji *et al.* 2019: 19). Furthermore, both of these factors influence a user's attitude towards technology. Some disadvantages of e-learning methods can be attributed to the lack of interaction, and that feedback from lecturers and peers were not immediate (Yang 2024: 2). On the other hand, Abuali and Ahmed (2025:2) described the advantages of e-learning as the flexibility of the time, place and pace of the learning activity.

Evelyn (2025: 1) states that students who receive hands-on training experience exhibit longer lasting outcomes of skills retention. Scholars like Abuali and Ahmed (2025: 3) stated that students strongly believe that technology can be used to enrich their learning and see their futures as using technology for learning, as well as to prepare them for the competitive job market. However, the main frustration for students is the restrictions, such as poverty or inaccessible resources to technology use for learning (Mpungose 2025: 17208). Teo *et al.* (2020: 359) claimed that Radiography students did not receive

adequate information with e-learning alone and required clinical education to reinforce their education. Alternatively, Lien *et al.* (2023: 4) have conducted a study on the influence of case-based e-learning on students' performance in point-of-care ultrasound courses, and concluded that e-learning prepares Sonography students efficiently for hands-on training.

2.6.2. Perceived Ease of Use

Perceived ease of use can be described as “the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use” (Al Khurdi, Alshurideh and Salloum 2020: 6487). Hussein (2018: 854) determined that perceived enjoyment can clarify behavioural intention to use information systems. In learning, a student's personal feelings of pleasure, joy and positive holistic experience play a pivotal role in understanding user acceptance and the usage behaviour of e-learning (Hussein 2018: 854). Moghavvemi *et al.* (2017: 4) explained that students who enjoy using technology would begin to enjoy the activity they experienced and understand the resourcefulness of it, as well as find it easier to use. Moreover, when more technology is used in learning, it can prove to be a more enjoyable experience for students. Thus, a student will have the intention to use technology if they perceive e-learning as enjoyable.

Intrinsic motivation can be defined as the satisfaction gained from the execution of behaviour, according to Moller and Deci (2024: 3654). When an individual is intrinsically motivated, they are directed to act for the fun entailed instead of external pressures, prods or rewards (Moller and Deci 2024: 3654). The above was supported in a study by Hussein (2018: 854), which anticipated that intrinsic motivators such as perceived enjoyment could have an impact on a user to use information systems such as e-learning, and the results reflected that perceived enjoyment had a great impact on student intention to use e-learning. It is not known whether Radiography students perceive e-learning to be

enjoyable, hence the researcher wishes to investigate their perceived enjoyment of technology for e-learning.

2.6.3. Attitude to Use

The conclusion derived from the study by Hussein (2017: 163) contends that perceived usefulness and perceived ease of use do not significantly influence a student's intention to use e-learning. This could be attributed to the majority of students having prior knowledge about e-learning, and they feel satisfied with technology because it is convenient for them (Hussein 2017: 163). However, Sakarji *et al.* (2019: 19) believe that both perceived usefulness and perceived ease of use are considered distinct factors that influence a student's attitude towards using technology for e-learning.

Student characteristics, such as willingness, satisfaction as well as past experiences with e-learning, play a vital role in the acceptance and success of e-learning initiatives (Yang 2024: 3). Examples of these traits include self-efficiency, level of technological anxiety, technological efficiency and experience, as well as their attitudes towards e-learning. Yang (2024: 3) cautions that a student's motivation towards e-learning is subjective to the quality of the course, their computer skills and how easily they can access and use the e-learning platforms and courses. Adhering to the information above, Khalilia (2020: 54678) suggests that the attitudes of students towards e-learning is generally positive and that these positive attitudes include increased student motivation to learn, flexibility in place and time to study, as well as communication out of working hours. Yarobi *et al.* (2025: 10) suggest that a student's attitude plays a significant role in persuading their intention to use e-learning. The author elaborates that a positive attitude towards e-learning will lead to an increased intention to use it.

2.6.4. Behavioural Intention and Actual Use

According to Salloum *et al.* (2019: 128450), behavioural intention is thought to be the main indicator of actual use. Salloum *et al.* (2019: 128450) believe that behavioural intention is the intent of students to utilise e-learning and requires consistent use. Additionally, it also entails the willingness of students to use e-learning systems as an existing way of learning in the future. Samsudeen and Mohamed (2019: 225) suggest that behavioural intention is also an indication of students' willingness to conduct a certain behaviour. These authors also believe that the actual use of e-learning systems is directly positively affected by the intention to use.

Hadullo, Oboko and Omwenga (2018: 153) mention that behavioural intention and actual use are influenced by students' attitudes and the quality of e-learning, which include instructor factors, student factors and institutional factors. Additionally, the authors state that course design, course assessment and course support also affect the quality of e-learning delivered. Students' attitudes, year of study and personality traits may also influence how they perceive the quality of e-learning (Amir *et al.* 2020: 6). For example, students who are self-motivated and adaptable may engage more actively with online learning platforms and independent learning activities, while students who prefer structured face-to-face interaction may experience lower levels of engagement and satisfaction. In some cases, students may only engage with e-learning platforms when assessments, tests or assignment submissions are approaching, rather than participating consistently throughout the learning process. Additionally, senior students may perceive e-learning differently from junior students due to greater academic experience and familiarity with institutional learning platforms. The factors influencing the actual use of e-learning by Radiography students in KZN are not known. The researcher endeavours to understand how attitude to use and intention to use influence the actual use of technology for e-learning in order to identify the factors affecting a students experience with e-learning.

2.6.5 Alignment of the study to the selected theoretical framework

It is of great importance to align the selected theoretical framework to the study being conducted (Portz *et al.* 2020: 2). The alignment of the theoretical framework to the current study was ensured through the use of Table 2.1 below.

Table 2.1: Alignment of the theoretical framework to the theoretical framework

Concepts from the TAM framework	Alignment to this research
<i>Perceived usefulness</i> - demarcated as the degree to which students believe that using an e-learning system will positively impact on their academic performance.	How did e-learning impact on Radiography students' academic performance?
<i>Perceived ease of use</i> - "the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use."	To what extent do Radiography students find e-learning to be easy to use or enjoyable?
<i>Attitude to use</i> - Student characteristics, such as student willingness, satisfaction as well as past experiences towards e-learning.	What is the attitude of Radiography students towards e-learning? Do students perceive e-learning systems as a positive or negative method of learning?
<i>Intention to use</i> - Behavioural intention is an indication of students' willingness to conduct a certain behaviour.	How willing are Radiography students to use technology for e-learning?
<i>Actual use</i> - The actual use of e-learning systems by students, which is directly positively affected by the intention to use.	How often do Radiography students use e-learning systems? What devices do students use for e-learning?

	For how many hours do students use technology for e-learning?
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2.7 SUMMARY OF THE CHAPTER

This research topic stemmed from the fact that e-learning has occurred on a much more frequent basis as a result of the COVID-19 pandemic, when individuals could not meet face-to-face in a classroom situation. Many students at the institution under study were previously using technology for e-learning in conjunction with classroom learning. However, they were not solely dependent on technology for e-learning. Radiography students at the institution of interest currently greatly rely on e-learning for the completion of some of their modules. Even after the stringent COVID-19 restrictions have been reduced, e-learning remains a fundamental aspect in the Radiography department of the current institution. Considering studies conducted by previous researchers, the current researcher noticed that there are no known studies regarding e-learning in the province of KwaZulu-Natal (KZN) that have addressed the perceived usefulness and perceived ease of use of students, particularly Radiography students. The following chapter will outline the research methodology followed in the planning and execution of the study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1. INTRODUCTION

In the previous chapter, the breakdown of literature relevant to this research was discussed. This chapter provides a detailed description of the research methodology used in this study. This includes the research design, research paradigm, methodological approach, the study setting, data collection tool, the population, sampling, the pilot study, data collection and ethical consideration methods. The types of questionnaires, the administration of the questionnaires, data analysis techniques, and reliability and validity issues are also addressed. The theoretical framework used was the Technology Acceptance Model (TAM). The research was conducted using the positivism paradigm and a cross-sectional research design, with a quantitative methodological approach. The study was conducted at the Radiography Department of a University of Technology in KwaZulu-Natal (KZN) and was performed on Radiography students at all levels. A non-probability convenience sampling technique was used.

3.2 RESEARCH PARADIGM

Paradigms are general ideologies or a set of common beliefs agreed upon by scientists on how problems can be understood and addressed (Kumatongo and Muzata 2021: 17). Research paradigms can also be understood as methods by which scientists respond to the three essential ontological, epistemological and methodological questions (Kumatongo and Muzata 2021: 17). Reisch (2019: 342) stated that a paradigm is made up of the intellectual structure and the fundamental assumptions upon which research and development in a field of inquiry are founded. Research paradigms can be divided into positivism, interpretivism, post-positivism, critical theory (ideology), constructivism and/or pragmatism (Kumatongo and Muzata 2021: 17).

This study was conducted using the positivism paradigm as it is appropriate for a quantitative research approach. Positivism revolves around the researcher working with observable reality within the society, which in this research will be the factors influencing Radiography students' acceptance of technology for e-learning. Furthermore, it involves strict attention to pure data and facts, independent of the influences of the human mind by interpretation bias (Yong, Husin and Kamarudin 2021: 5859).

3.3 THE RESEARCH DESIGN

Kumatongo and Muzata (2021: 17) described a research design as the plan, outline or scheme that a researcher uses to produce answers to research questions. These authors further stated that a research design is a framework comprising the strategies and approaches that a researcher uses to answer a research problem. Furthermore, research designs can be broadly divided into three types, namely qualitative, quantitative and mixed methods design. This research has been designed using quantitative methods because the researcher wanted to analyse a cause-and-effect relationship between variables. Due to quantitative approaches being formulated objectively, results are more reliable.

Quantitative research is the technique using numerical values derived from observations to explain phenomena that the results can conclude on them. The collected data is then analysed using mathematical methods (Taherdoost 2022: 54). Various reasons encourage researchers to use a quantitative research design, including a lack of existing research on a certain topic; unanswered research questions; or if the research topic of interest has the potential to make a significant impact (Rutberg and Bouikidis 2018: 210). In the current study, this research design was chosen because it enabled the researcher to examine the factors influencing Radiography students' experiences of e-learning, including their perceptions regarding the usefulness, ease of use and utilisation of e-learning technologies.

A cross-sectional design was employed due to its ability to deliver data for describing the status of occurrences or relationships amongst occurrences at a fixed point in time (Cheng and Wang 2020: 65). There was no repeat of measurements on the research participants. Furthermore, Braun *et al.* (2020:1) state that it expresses in-depth and new understandings of social issues. This research design was chosen because the perception and acceptance of Radiography students of e-learning was required. The researcher chose this research design because students' perceptions on e-learning are being captured. It supports the researcher's descriptive aims (what do students think?) and analytical aims (do perceptions differ by year of study, gender, discipline or age?). The cross-sectional design cannot answer questions like "what changes can be expected over time?", as well as causal statements, for example stating that e-learning would cause learner satisfaction (Savitz and Wellenius 2023: 515).

3.4. STUDY SETTING

The study setting can be defined as the environment in which the research is conducted (Austin and Sutton 2014: 437). Garcia (2022:14) defined a study setting as the author telling the reader about where or under what circumstances the study happened, including the place, conditions and surroundings. Data was collected at a university within the eThekweni district. The motivation for choosing this particular study setting was that this was the setting where the research problem was observed. The study population would therefore have the necessary characteristics in relation to the research focus area.

3.5. POPULATION

The study population refers to the complete group of individuals from whom data may be collected in a research study (Majjad 2018:3). The target population for this study comprised all students registered for the Radiography programme at the selected University of Technology in KwaZulu-Natal during the period of data collection. Following consultation with the statistician, the accessible study population was determined to be

206 students. Radiography students were selected as the target population because they were directly engaged with e-learning within their academic programme and were therefore considered suitable to provide relevant information regarding their experiences of e-learning. The institution was selected based on accessibility and the feasibility of conducting the study within the available timeframe.

Table 3.1: Population according to year of study

Year of Study	Number of Students
First year	44
Second year	65
Third year	63
Fourth year	34
Total	206

3.6 SAMPLING

A non-probability convenience sampling technique was used. Convenience sampling is when the researcher announces the study and participants self-select if they wish to participate (Straton 2021: 373). The researcher chose this particular approach to avoid any bias amongst students. It was also a method that maintained objectivity, which is essential to not alter the results in a quantitative research design. The researcher also used this method to not forcefully coerce students into participating.

The sample size is defined by Charan *et al.* (2021: 75) as the number of experimental or observational components that are essential for research, which could be in the form of participants. It is not viable to conduct a study on a whole population related to a study. Therefore, a sample of the population is used to adequately represent the whole population from which these samples are drawn, and the results obtained from experimentation on these samples are considered as true inferences about the whole population (Charan *et al.* 2021: 75). The sample size is of extreme importance and it

should be considered that for qualitative researchers, such decisions often relate to saturation where the decision of how much data to collect and when to stop should be made during data collection. Conversely, quantitative researchers make the decision of how much of data should be collected before data collection begins (Buckley 2023: 82).

Charan *et al.* (2021: 75) advise that the calculation of the exact sample size is an important part of research. The sample size of this study was obtained after discussion with a statistician. The statistician applied the sample size calculator using the Raosoft application. The sample size for the main study was calculated at approximately 206 Radiography students. The researcher received completed questionnaires from 141 Diagnostic Radiography students, 39 from Radiotherapy students, 19 from Sonography students and 7 from Nuclear medicine students producing a 100% response rate.

3.6.1. Inclusion Criteria

- First, second-, third- and fourth-year Radiography (Diagnostic, Sonography, Radiotherapy and Nuclear Medicine) students;
- All genders and races groups have been included;
- Participants over the age of 17 years old; and
- Students that have signed an informed consent form.

3.6.2. Exclusion Criteria

- Students who were not enrolled for the Radiography programmes; and
- Students who have not signed a consent form prior to answering the survey.

3.7. DATA COLLECTION PROCESS

Data is the plural form of datum, which can be defined as a piece of information. This information may be collected as a result of an experiment, during a study, through census or survey, or during an observation (Mazhar *et al.* 2021: 6). Data collection methods are divided into two main categories, namely primary data collection and secondary data collection methods (Taherdoost 2021: 12). Primary data is collected for the first time and this data is original, whereas secondary data is data that was previously collected by someone else and has already been subjected to the statistical process (Taherdoost 2021: 12). There are multiple methods of data collection, namely observation, interviews, questionnaires and schedules, amongst others (Mazhar *et al.* 2021: 7). This study used questionnaires as the method of data collection. Participants were studied at the university of interest. The study environment should not be disruptive and should be fairly quiet to allow for a continuous flow of communication between the participant and researcher so that the participant feels relaxed, safe and able to freely express themselves (Creswell 2014: 144).

3.7.1. Ethical Approval

Once the researcher decided on the methods of collecting data from participants, ethical approval was sought from the Institutional Research Ethics Committee (IREC) of the selected university. The researcher did this by submitting a research proposal to the Departmental Research Committee (DRC). Once the DRC gave the researcher their approval, the proposal was submitted to the Faculty Research Committee (FRC), which approved the research proposal and thereafter submitted it to IREC along with letters of permission from the relevant Gatekeeper. Thereafter, IREC gave the researcher provisional approval subject to corrections, which the researcher had one year to complete. Once the researcher made the corrections to IREC's satisfaction, full approval was granted with the ethical clearance number of IREC 119/24 (Appendix 1). Once this was completed, the researcher began the data collection.

3.7.2. Procedure of data collection

The researcher wrote letters to the Director of Research (Appendix 2a) and the Head of Department (HOD) of Radiography (Appendix 3) requesting permission to conduct the research at the university. The Director of Research gave their approval and this letter was sent to the Institutional Research and Ethics Committee (IREC) of the Durban University of Technology, which initially granted provisional approval pending their final approval to allow the data collection process to begin. The researcher contacted her supervisor requesting a timetable for the first-, second-, third- and fourth-year Radiography students so that the researcher could assess when multiple groups of students had lectures on the same day for convenience. Once the researcher received the timetables, she contacted the relevant lecturers to request some time either before or after their lectures to speak with the students. The rationale was that a lecturer might be able to provide more clarity and structure of the time suited to the students. The researcher selected a day to go to the university and approached each class either before or after the lecture (depending on what their lecturer preferred). The researcher explained the study to the participants, along with explaining their rights to the students.

The information letter (Appendix 4) was handed out to the students first to establish an understanding of the study. The researcher also explained the contents of the information letter. The informed consent form (Appendix 5) was distributed next. Students who wanted to participate signed this form and returned it to the researcher, after which the questionnaires were administered (Appendix 6). The students were not coerced in any way to participate in this study and it was made clear to them that if they wished to withdraw from the study at any point, they could do so without fear of any consequences. The benefits of completing the questionnaire were also explained to the students. They were also allowed to freely leave the classroom in this duration if they wanted. The questionnaire was structured using a Likert Scale, so most students completed this questionnaire within 20-30 minutes. Once the students completed their questionnaires, they returned it to the researcher. Data was collected and stored in a secure place, namely a safe at the researcher's residence. Only the researcher had access to this safe.

All the personal information and the results from the current study will be shredded and discarded accordingly after five years following data collection.

3.7.3. Data Handling

The raw data (originals and duplicates) are kept securely in a safe at the researcher's residence. The safe containing these questionnaires is only accessible to the researcher. The researcher captured this data on an Excel spreadsheet and sent it to the statistician to analyse. All questionnaires will be shredded and discarded five years after the researcher attains her Master's degree to ensure the complete confidentiality of participants. The hardcopies will be shredded, along with any documents with participant details, such as the consent forms. The soft copies will be deleted both from the storage device and the recycle bin.

Participants did not receive remuneration for participating in this research. However, the researcher explained about their contribution to the study and the overall significance thereof. The researcher also expressed her utmost gratitude to the participants for agreeing to take part in this research. If a participant requests to view the results, the researcher will share the thesis via email once it has been completed. The completed dissertation will also be online at the DUT library repository once it has been submitted, after the researcher graduates.

3.8 DATA COLLECTION TOOL

According to Taherdoost (2021: 11), a data collection tool is the tool used by the researcher to collect data to solve the research problem. This study used a self-created questionnaire following a review of literature and receipt of feedback from a statistician. The self-developed questionnaire was designed by the researcher based on the TAM model and other aspects of the literature review. The study by Al-Kurdi, Alshurideh and Salloum (2020: 6486) and Portz *et al.* (2020: 2) were used to formulate this questionnaire.

Mazhar *et al.* (2021: 8) determined that a questionnaire is a predetermined set of questions given to a number of participants and, as with all data collection methods, questionnaires should always adhere to ethical and moral codes of conduct. A properly designed questionnaire is going to provide reliable, good quality information (Mazhar *et al.* 2021: 6). This questionnaire had undergone a pilot study to ensure validity and to understand and alleviate problems with the questionnaire. Once this was completed, a final questionnaire was designed. The questionnaire included a total of 78 multiple choice Likert-scale questions covering student demographics, perceived usefulness, perceived ease of use and intention to use technology for e-learning.

3.9. PILOT STUDY

A pilot study is a preliminary investigation conducted before conducting the actual experiment, and is specifically designed to address many aspects of the research study. Furthermore, a pilot study is usually conducted to test the stability of a data collection tool before conducting the final fieldwork on a larger scale (Bujang 2024: 1). Concurring with the above, Saunders *et al.* (2016: 308) defined a pilot study as a trial in which the research questionnaire is administered to a few participants. In addition, the pilot study participants are requested to comment on the structure of the test. They outline problems of the questionnaire, including the instruction, clarity of requirements, adequacy of formatting and other typographical errors (Saunders *et al.* 2016: 308). A pilot study is also able to evaluate the overall performance features of the study design, measures, research procedures, inclusion and exclusion criteria, and multiple other operational strategies considered for a larger study (Bujang 2024: 1).

Saunders *et al.* (2016: 308) concentrated on the importance of a pilot study by explaining that it avoids problems during the transcription of data, and that a pilot study is intended to improve the questionnaire so that participants will not have difficulties in understanding and answering the questions. It also eliminates problems when analysing this data. In order to achieve good strength of the questionnaire, pre-testing of the questionnaire is

pivotal in allowing a trial run that would unequivocally identify any problems that the students may experience when answering the questionnaire (Taherdoost 2021: 11).

The pilot target population for this study was four students, one from each discipline. The results of the pilot study were not included in the main study. A self-developed questionnaire was designed by the researcher based on the TAM model and other aspects of the literature review. The researcher contacted the relevant Radiography lecturers and communicated with them regarding the distribution of questionnaires to the selected number of students. The consent forms and questionnaires were hand-delivered to the participants and collected after their lecture. The information letter (Appendix 4) was handed to the participants prior to the administration of the questionnaire, informing them about the research. The selection of the pilot study participants was on a voluntary basis. Participants were expected to complete and sign a consent document that included all the information pertaining to the study.

The results of the completed questionnaires were analysed and questions were altered based on the outcome. For example, some questions were removed due to redundancy. The questions were divided into four sections. The first was a demographic/personal data section followed by perceived usefulness, perceived ease of use and actual/behavioural use. The latter sections are devised from the TAM model. The method of handing out questionnaires and collecting them once the students had completed them was devised from the simple understanding that students were more likely to participate once the significance of volunteering was explained to them face-to-face to achieve a maximum response rate. There were no comments warranting changes to the questionnaire.

3.10. DATA ANALYSIS

The output tables from the Statistical Package for the Social Sciences (SPSS), which were originally thought to analyse this research data, were unsuitable to be used in any thesis or document as they contain irrelevant information that is not suitable for this type

of research. The tests used in the analysis of this research included descriptive statistics like means and standard deviations, where applicable. Frequencies were presented in tables, graphs and pie charts. The ANOVA test was used for several independent samples that compared two or more groups of cases in one variable. Pearson's correlation coefficient is a measure of linear association. The one sample t-test were used to determine whether a mean score is significantly different from a scalar value. The independent samples t-test compared two independent groups of cases. Factor analysis was used to simplify the complex datasets by identifying the underlying factors that explained the relationship between the variables. It was used to reduce the rest of the data and to demonstrate the inter-correlations between the variables. A cross-sectional analysis was used to draw interpretations between the different datasets. Lastly, linear regression was used to determine the effect of independent variables on dependent variables.

In order to explore the structure of the data that consists of many items and reduce them to a small number of latent variables, factor analysis with promax rotation was applied to the set of items. During the process, some items were dropped either because they do not load strongly enough onto any factor or because they cross-load onto multiple factors. The reliability of combining the items into a single latent variable was tested using Cronbach's alpha. Items not correlating strongly or sufficiently with other items in the construct and negatively affecting the reliability were removed. The factor extraction was deemed to be successful if the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) exceeded 0.6 and Bartlett's test of sphericity was significant. Factor analysis with promax rotation was applied to the 78 Likert-scale items on the questionnaire perceived to measure the constructs in the model. In all, 18 items were dropped because they did not load strongly enough onto any factor. Four factors were extracted, which account for 43.77% of the variance in the data. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .905 and a significant Bartlett's test indicates that the data was adequate for successful and reliable extraction. Rotation converged in six iterations. The values achieved for Cronbach's alpha indicate that there is good internal consistency amongst

the items on each factor, and the composite variables formed by calculating the average of the agreement scores for all items included in a variable are reliable.

The central elements of accuracy are reliability and validity. Reliability is documented by taking several dimensions on the exact same subjects, resulting in precise solitary dimensions and the adequate tracking of measurement adjustments. The reliability of combining the items into a single latent variable was tested using Cronbach's alpha. An alpha value of at least 0.7 was considered adequate. If items did not correlate strongly enough with the other items in the construct and negatively affected the reliability, they were excluded. If they did not affect the reliability, then they were stated. Cronbach's alpha is a reliability coefficient that displays how accurately the findings in a set of data are positively associated with each other (Talib, Rubin and Zhengyi 2013: 1760). The factor extraction was deemed to be successful if the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) exceeded 0.6 and Bartlett's test of sphericity was significant ($p < .05$).

Voluntary involvement was guaranteed to reduce bias. A pilot study was completed to ensure the reliability of the questionnaire. The credibility of the set of questions was maintained by using an operational supervisor and a statistician to review them. Credibility of the research entailed evaluating whether the research study accurately describes the outcome that it is intended to define, which includes the research study layout, approach and final thoughts of the researcher, which are expected to maintain the validity of the process (Thomas, Coleman and Terry 2021: 168).

3.10.1 Univariate analysis

Alpha *et al.* (2025: 179) defined univariate analysis as a single overall statistical test that assesses the effects of the independent variables on all of the response variables. Furthermore, univariate analysis is important because whilst multivariate analyses allow for the simultaneous evaluation of parameters, univariate analysis is a powerful method

for isolating and comparing the direct effects of each research factor on individual traits. In this study, univariate analysis was performed to determine whether there was significant agreement or disagreement to each item. The test performed to determine this was the one-sample t-test. In this test, the average agreement score is tested against the central score of '3' to determine whether it differs significantly from '3'. If there was a significant difference ($p < .05$), the test interpreted this as significant agreement. In addition, when the mean score was greater than 3, the agreement was deemed to be strong. Significant disagreement was declared when the mean score was less than 3. When data was not significant ($p \geq .05$), it meant that there was neither significant agreement nor significant disagreement, therefore nothing more is concluded about the result.

3.10.2 Correlations amongst the composite variables

Gregorutti, Michel and Saint-Pierre (2017: 659) explained that in a situation where the number of variables is larger than the number of observations, not all variables are relevant for predicting the outcome of interest. Therefore, variable selection eliminates irrelevant variables and provides two core advantages: firstly, a smaller number of variables is more easily interpretable and secondly, the model accuracy might be improved and avoid the risk of overfitting. A correlation analysis was conducted to examine the strength and direction of relationships amongst the four composite variables (Perceived usefulness, perceived ease of use, attitude towards e-learning and intention to use e-learning) related to students' perceptions of e-learning. Pearson's correlation coefficients (r) were used, with significance levels set at $p < 0.01$ (2-tailed).

3.11. ETHICAL CONSIDERATIONS

There are four main principles of ethics, namely beneficence, nonmaleficence, autonomy and justice. These are briefly described below.

3.11.1 Beneficence

The principle of beneficence refers to the positive obligation to protect and uphold the rights and wellbeing of others by minimising harm and promoting welfare (Varkey 2020:18). This research was considered worthwhile as the potential benefits of the study outweighed any foreseeable risks or harm. The researcher aimed to maximise the benefits of the research and minimise potential harm to both participants and researchers by ensuring that the study was conducted within a safe and secure environment. Participants were informed that no physical, psychological or academic harm would arise from their participation in the study.

The findings of the study may benefit Radiography students and educators by providing insight into the factors influencing students' experiences of e-learning. The information obtained may assist educators and higher education institutions in improving e-learning methods, teaching strategies and student support systems to enhance the overall learning experience. Furthermore, the study may contribute towards the development of more accessible, effective and student-centred e-learning practices within Radiography education.

3.11.2 Non-maleficence

Motloba (2019: 40) defined non-maleficence as the moral obligation to avoid causing harm or exposing individuals to unnecessary risk of harm. In this study, the researcher ensured that participants were protected from physical, psychological, social and academic harm throughout the research process. Participation in the study was voluntary, and participants were informed that they could withdraw from the study at any stage without penalty or negative consequences. The questionnaire did not contain sensitive or intrusive questions that could cause emotional discomfort or distress to participants. Confidentiality and anonymity were maintained throughout the study to minimise any potential social or academic harm. Participants' names and identifying information were omitted from the questionnaires, and all information obtained during the study was treated confidentially and used solely for research purposes.

3.11.3. Autonomy

This principle stipulates that all individuals have intrinsic and unconditional worth, and should therefore have the authority to make rational decisions and moral choices, and each should be allowed to use their capacity for self-determination (Varkey 2020: 19). In this research, the participants were able to withdraw from the study whenever they chose. They did not face any consequences and their decision was respected by the researcher. Autonomy states that all individuals should have the power to agree or disagree to participate in a study (Varkey 2021: 19). Furthermore, autonomy is the basis of truth-telling and confidentiality.

3.11.4. Justice

Justice can be explained as the fair, equitable and appropriate treatment of participants. Moreover, the selection and recruitment of participants must be completed in a fair manner (Campbell, Goodman-Williams and Javorka 2019: 4766). The researcher treated all participants with equal respect and dignity. No participant was discriminated against. Participants were selected on a volunteer basis without force or pressure.

3.12. SUMMARY OF THE CHAPTER

In this chapter, the researcher outlined the research methodology used to successfully carry out the study. The quantitative design was chosen to acquire a higher number of participants to establish a cause-and-effect relationship between multiple variables. Choosing a quantitative research design also ensured objectivity. The research process consisted of various vigorous steps used to get a satisfactory outcome. Overall, the research design and methodology were successful in attaining the desired results. The next chapter will present the research findings.

CHAPTER 4

PRESENTATION OF THE FINDINGS

4.1 INTRODUCTION

This chapter presents the results from the data collected. The objectives of this research were to determine Radiography students' perceived usefulness, perceived ease of use, attitude and actual use of e-learning. This chapter also includes the demographic factors of participants, represented in pie charts and bar graphs, as well as the grouping analysis, which can be explained as the grouping of items into constructs. Once the groupings are displayed, they will then be presented in the following section as univariate analysis of individual factors. These factors are perceived usefulness, perceived ease of use, intention to use and attitude towards e-learning. This chapter will also include an analysis using the above-mentioned factors, an analysis across demographics, as well as a final analysis.

A statistician advised the use of descriptive statistics, including means and standard deviations, were used in the analysis of data. In addition, frequencies are represented in tables or graphs; ANOVA test for several independent samples that compares two or more groups of cases in one variable; and Pearson's correlation coefficient, which is a measure of linear association. The one sample t-test, independent samples t-test, factor analysis and linear regression were also used. The one sample t-test were used to determine whether a mean score is significantly different from a scalar value. Independent samples t-test were used to compared two independent groups of cases. Factor analysis was used to simplify the complex datasets by identifying the underlying factors that explained the relationship between the variables. It was used to reduce the rest of the data and to demonstrate the inter-correlations between the variables. Cross-sectional analysis was used to draw interpretations between the different datasets. Lastly, linear regression was used to determine the effect of independent variables on dependent variables.

4.2 DEMOGRAPHIC DETAILS OF PARTICIPANTS

The demographic variables included age, gender, Radiography disciplines (Diagnostic, Sonography, Radiotherapy and Nuclear Medicine) and year of study that the student was registered for. The sample size for the main study was calculated at approximately 206 students. The researcher surveyed 135 Diagnostic Radiography students, 19 Sonography students, 37 Radiotherapy students and 6 Nuclear medicine students. This represents a 100% response rate. The participants included first-, second-, third- and fourth-year Radiography students. Figures 4.1–4.5 below represent the demographic factors of the participants.

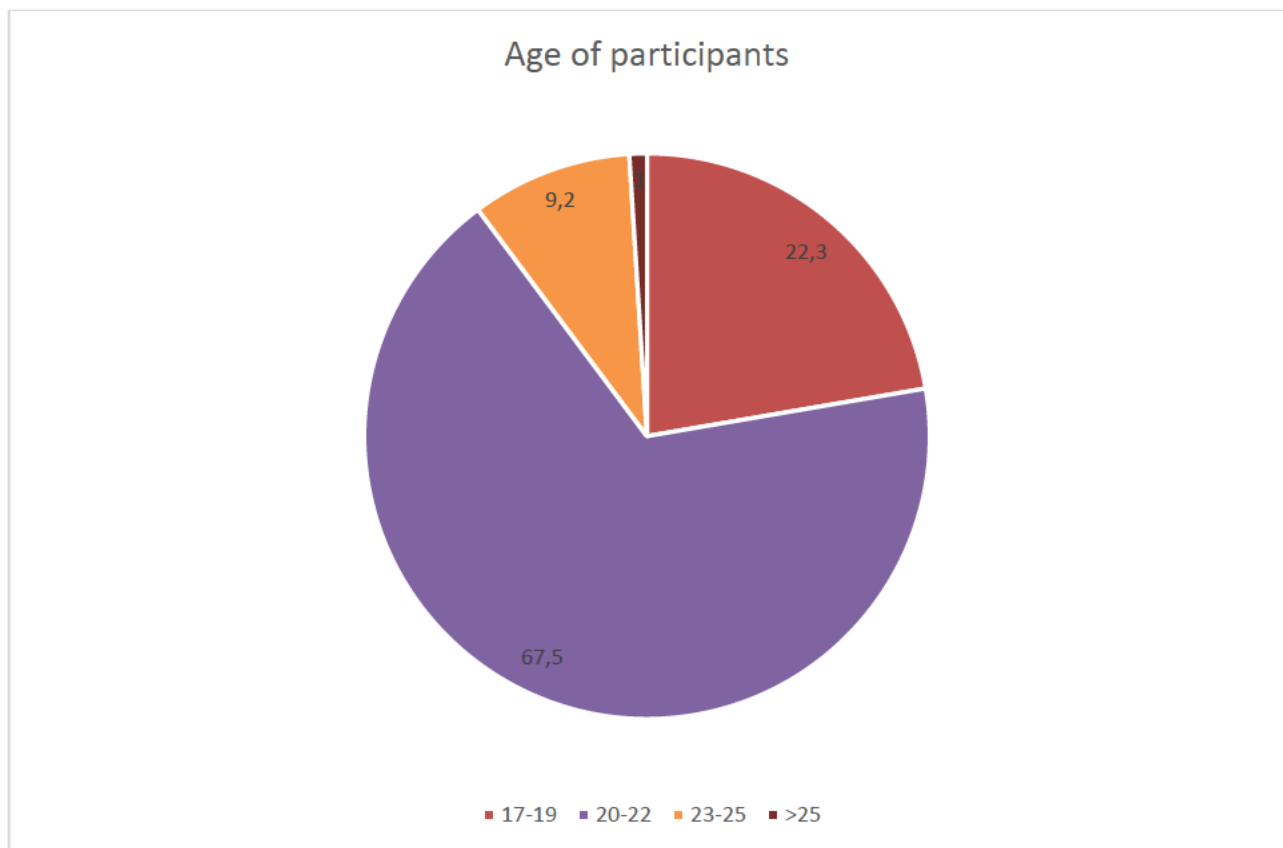


Figure 4.1: Age of Participants

The age of the majority of participants (n=139, 67,5%) was between 20 and 22 years, whilst participants between 23 and 25 years constituted the lowest proportion of the sample (n=2, 1%).

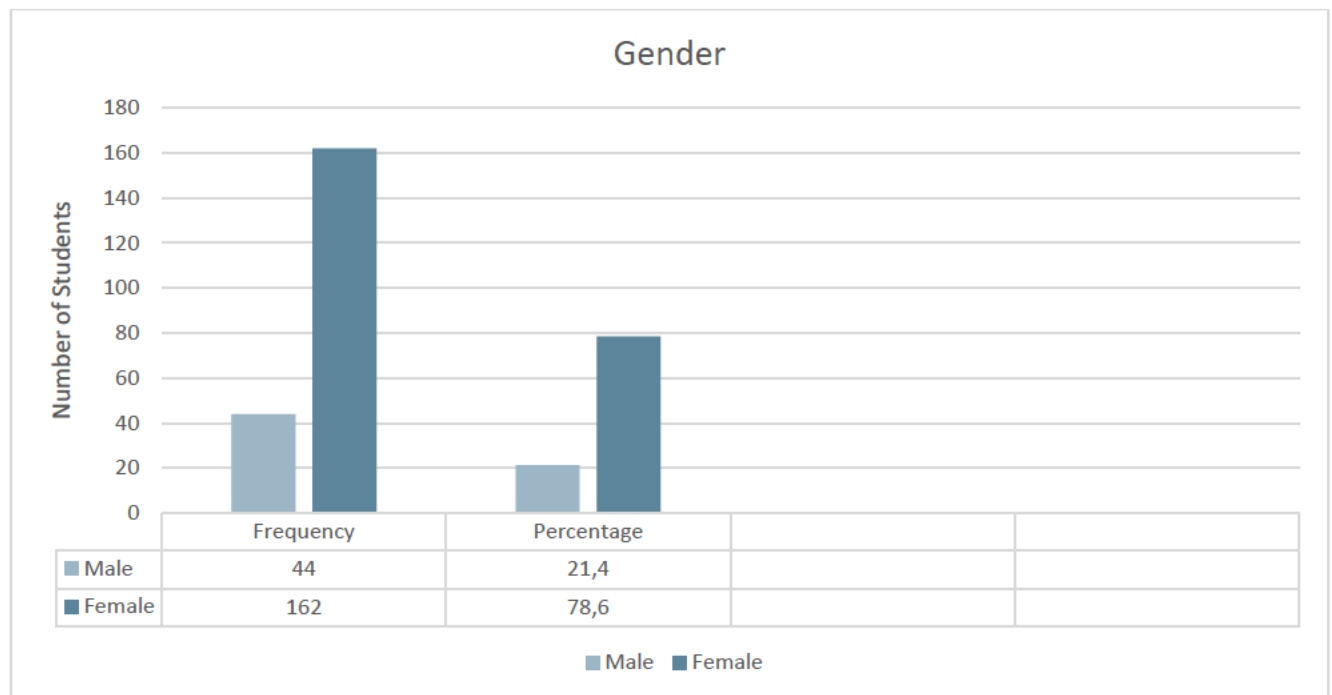


Figure 4.2: Gender of Participants

Most of the participants (n=162, 78.6%) were female, as illustrated in Figure 4.2.

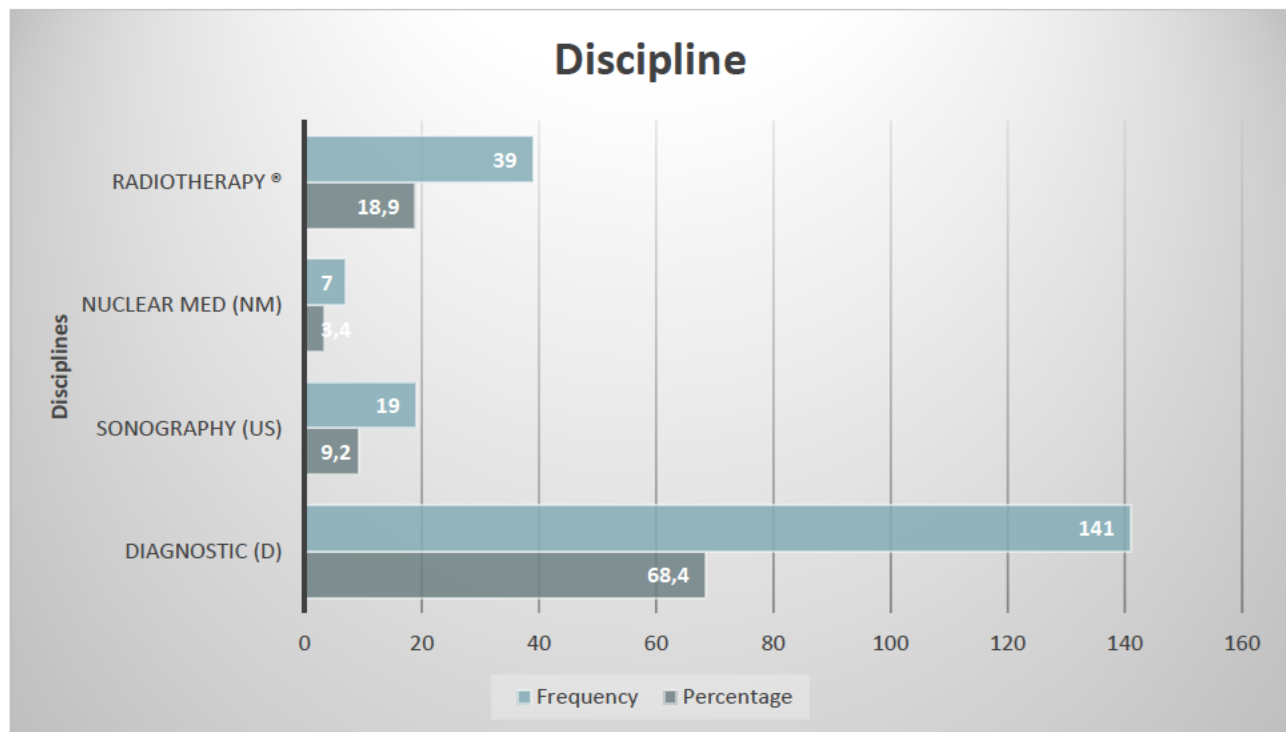


Figure 4.3: Discipline of Participants expressed in frequency and percentage

Most participants were enrolled in the Diagnostic Radiography discipline (n=141, 68.4%) whilst the lowest number of participants (n=7, 3.4%) were enrolled in the Nuclear Medicine discipline (Figure 4.3).

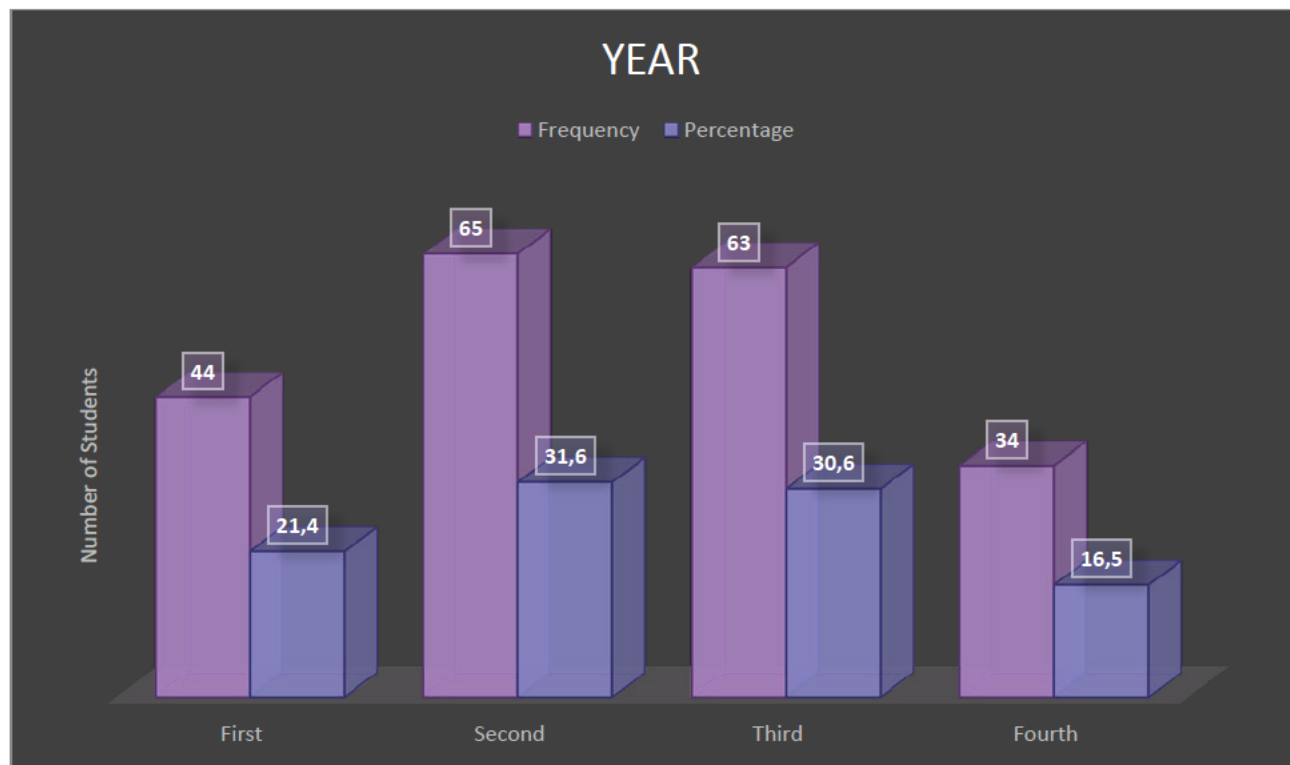


Figure 4.4: Number and percentage of participants per year of Study

Most students were in their second year of study ($n=65$, 31.6%) and final-year students constituted just more than half those in third year ($n=34$, 16.5%). Furthermore, there was a small difference between the number of second and third-year students, at a 2% margin between the two.

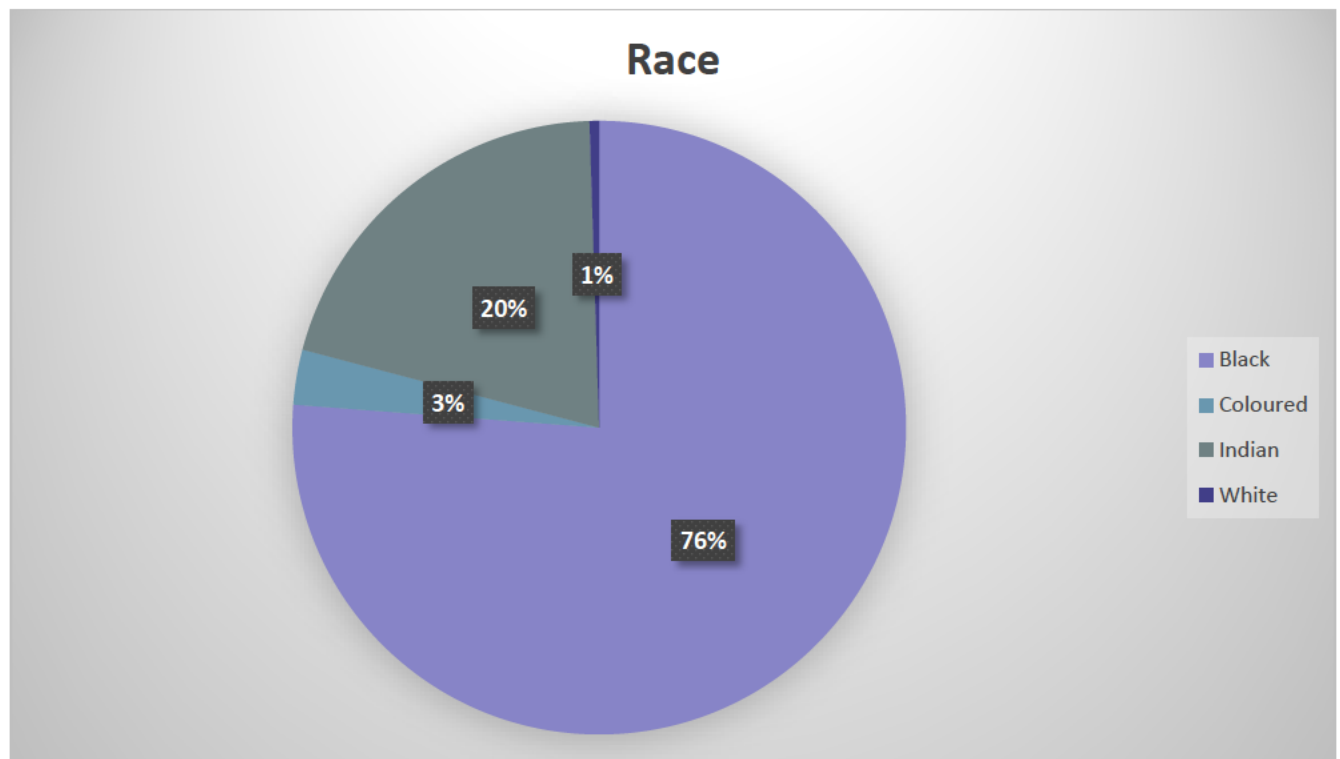


Figure 4.5 Race of participants expressed as a percentage of the sample

Lastly, Figure 4.5 depicts the different categories of race. Most participants were black Africans (76.2%), the coloured population only constituted 2.9%. The Indian population consisted of 20% and the White population consisted of 1%.

4.3 RESULTS PER OBJECTIVE

Results pertaining to each objective are presented below.

4.3.1 Objective 1: Perceived usefulness of e-learning

The Kaiser-Olkin Measure of sampling adequacy (KMO) presented in Table 4.1 illustrates that most variables contributed meaningfully to the study on e-learning. This was evidenced by high KMO values in the .8 range.

Table 4.1: KMO for variables measuring Perceived Usefulness (PU)

Variables	Kaiser-Olkin Measure of Sampling Adequacy (KMO)
Using e-learning will improve my education	.883
Using e-learning will increase the effectiveness of my studying	.816
E-learning content is rich	.804
I find e-learning to be imperative to my degree	.772
Using an e-learning system will allow me to accomplish tasks more easily relative to classroom learning	.764
Using e-learning allows me to accomplish more tasks than otherwise possible	.720
Participating in e-learning has improved my education and understanding of concepts	.706
Using an e-learning system has led to my improved retention of tertiary educational content	.656
I think that performing educational tasks occur faster with e-learning	.621
E-learning supports critical aspects of receiving a tertiary education	.618

Variables with KMO values in the .6 range are considered mediocre and these were observed in 30% of the variables measuring this objective, as illustrated in Table 4.1.

4.3.2 Objective 2: Intention to use e-learning

As illustrated in Table 4.2, five of the seven variables had good KMO values. The other two variables had KMO values in the .6 range. The variable regarding efforts made by the participants to become more skilful in e-learning scored the highest KMO value, implying a higher correlation in this regard.

Table 4.2: KMO factor for variables measuring Intention to Use (ITU)

Variable	Kaiser-Olkin Measure of Sampling Adequacy (KMO)
I am making an effort to become more skilful in e-learning	.797
I intend to invest more time in understanding how to use e-learning systems	.788
I will recommend e-learning to other students	.771
I intend to increase my use of technology for e-learning	.732
I intend to use more technological devices for e-learning	.705
I will continue to use e-learning for as long as it's available	.645
I believe that using e-learning systems are beneficial to me	.633

4.3.3 Objective 3: Attitude towards the use of e-learning

After removing variables with lower KMO values, there were three variables left to measure this objective, as illustrated in Table 4.3.

Table 4.3: KMO factor for variable measuring Attitude (ATT)

Variable	Kaiser-Olkin Measure of Sampling Adequacy (KMO)
I feel more comfortable with e-learning relative to traditional classroom learning	.714
Classroom learning should eventually be obliterated	.651
I find myself to be solely dependent on e-learning and no longer see the need for classroom learning	.634

The variable with the highest KMO was whether participants were comfortable with using e-learning relative to traditional classrooms. These results suggest that the three variables measuring attitude towards eLearning share sufficient common variance to warrant further analysis. This analysis will be explored later in this chapter.

Table 4.4: Extracted Factors

Factor	Construct	Variance extracted	Cronbach's alpha
1	Perceived usefulness (PU)	28.95	.929
2	Usage/ Intention to use (ITU)	6.88	.911
3	Perceived ease of use (PEOU)	4.60	.816
4	Attitude (ATT)	3.35	.784

The Cronbach's alpha values indicated good internal consistency amongst the items on each factor and the composite variables formed by calculating the mean of the agreement scores for all items included in a variable were reliable. A fourth factor, Attitude towards e-learning (ATT), was strongly extracted from the data. This factor was included in the framework and was added to the objectives. As indicated in Table 4.4, there was high agreement amongst participants regarding the perceived usefulness of online learning, followed by the intention of the participants to use online learning.

4.4 UNIVARIATE ANALYSIS PER VARIABLE

As explained in Chapter 3, univariate tests were performed to ascertain significant agreements or disagreements amongst the participants regarding each variable. The results are presented below under the four composite variable (perceived usefulness, perceived ease of use, attitude towards e-learning and intentions to use e-learning).

4.4.1 Perceived Usefulness

The construct 'Perceived Usefulness' is demarcated as the degree to which students believe that using an e-learning system will positively impact their academic performance (Vululleh 2018: 142). Table 4.5 below is an output table of the mean values of Perceived Usefulness, indicating the KMO scores.

Table 4.5: Output table of Perceived Usefulness

Perceived usefulness	Mean	Standard deviation	p-value
I use multiple programs for e-learning	3.70	1.000	<.001
I find e-learning to be advantageous to me	3.66	1.079	<.001
Participating in e-learning has improved my education and understanding of concepts	3.38	1.042	<.001
E-learning content is rich	3.35	.934	<.001
Using e-learning will improve my education	3.45	.960	<.001
Using an e-learning system will allow me to accomplish tasks more easily relative to classroom learning	3.53	1.112	<.001
Using e-learning will increase the effectiveness of my studying	3.36	1.099	<.001
I find e-learning to be imperative to my degree	3.33	1.059	<.001
The time I invested in e-learning was worth it	3.46	1.024	<.001
I think that performing educational tasks occur faster with e-learning	3.71	.973	<.001
Using e-learning addresses my studying related needs	3.42	.932	<.001
E-learning supports critical aspects of receiving a tertiary education	3.49	.893	<.001
Using e-learning allows me to accomplish more tasks than otherwise possible	3.62	.979	<.001
Using an e-learning system makes it easier for me to keep track of weekly educational tasks	3.62	1.065	<.001
The e-learning system provides ease to communicate with lecturers and my peers	3.53	1.044	<.001
E-learning provides guidance on achieving my educational goals	3.51	1.020	<.001

As illustrated in Table 4.5, the overall mean scores ranged from 3.33 to 3.71. This is evidence that the participants strongly agreed that e-learning is useful in supporting their academic activities. The highest mean score was recorded for the variable *“Educational tasks occur faster with e-learning”* (M = 3.71, SD = 0.973), suggesting that participants perceived e-learning as enhancing efficiency. Similarly, *“I use multiple programs for e-learning”* (M = 3.70, SD = 1.000) and *“E-learning allows me to accomplish more tasks”* (M = 3.62, SD = 0.979) also received high mean ratings. The lowest mean was for *“E-learning is imperative to my degree”* (M = 3.33, SD = 1.059), although still above the neutral point (3.00). This variable recorded moderate agreement amongst the participants. In addition, all items were statistically significant ($p < .001$), indicating that

students' responses differed significantly from neutrality, thus confirming a positive perception of e-learning's usefulness amongst the participants.

4.4.2 Perceived Ease of Use

Perceived Ease of Use can be described as “the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use” (Al Khurdi, Alshurideh and Salloum 2020: 6487). Figure 4.6 illustrates the mean scores obtained when measuring the perceived ease of use.

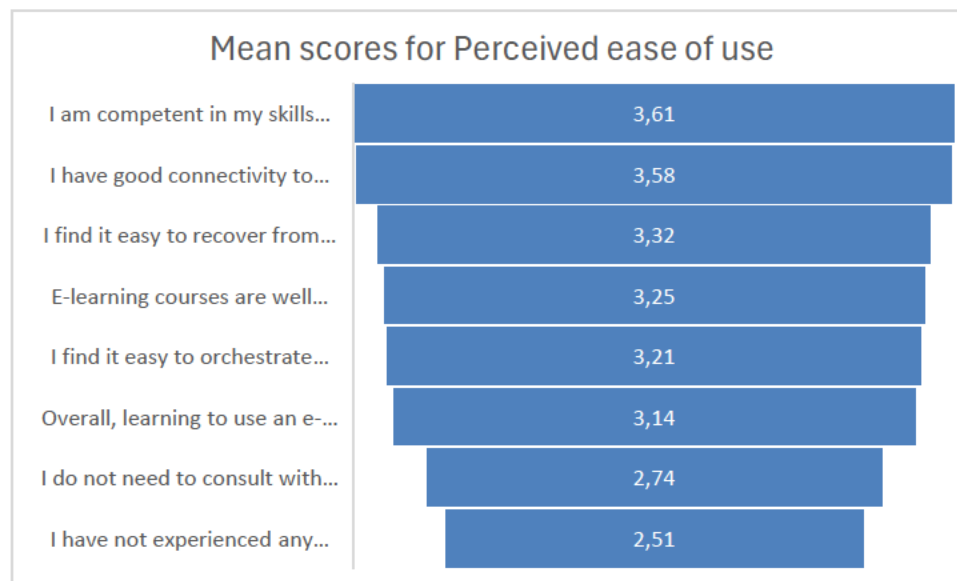


Figure 4.6: Mean scores for Perceived Ease of Use

The variable “*I am competent in my skills regarding the use of technology for e-learning*” recorded the highest mean ($M = 3.61$). On the other hand, the variables “*I do not need to consult with friends or the internet often when using e-learning in order to understand concepts*” and “*I have not experienced any problems with e-learning*” recorded scores below the neutral point (3.00). Furthermore, 27.8% of the participants were not competent in their skills, 28.4% did not have good connectivity to internet and 49.8% still experience problems with e-learning.

Table 4.6: KMO factor for variables measuring Perceived Ease of Use (PEOU)

Variable	Kaiser-Olkin Measure of Sampling Adequacy (KMO)
I do not frequently err when using e-learning	.716
I do not easily get confused and flustered when using e-learning	.712
I do not need to consult with friends or the internet often when using e-learning in order to understand concepts	.672
Overall, learning to use an e-learning program does not require a lot of mental effort	.610

The statements in Table 4.6 were extracted from the questionnaire administered to the participants. Results with insignificant mean scores which were close to three and p-values greater than 0.05 were excluded, as mentioned earlier. The four variables recorded sufficient variance to warrant a further analysis of the perceived usefulness of e-learning.

4.4.3 Intention to use e-learning

Behavioural intention is the main reason for the actual use of technology for e-learning. Figure 4.7 below indicates the mean scores for variables measuring intention to use e-learning.

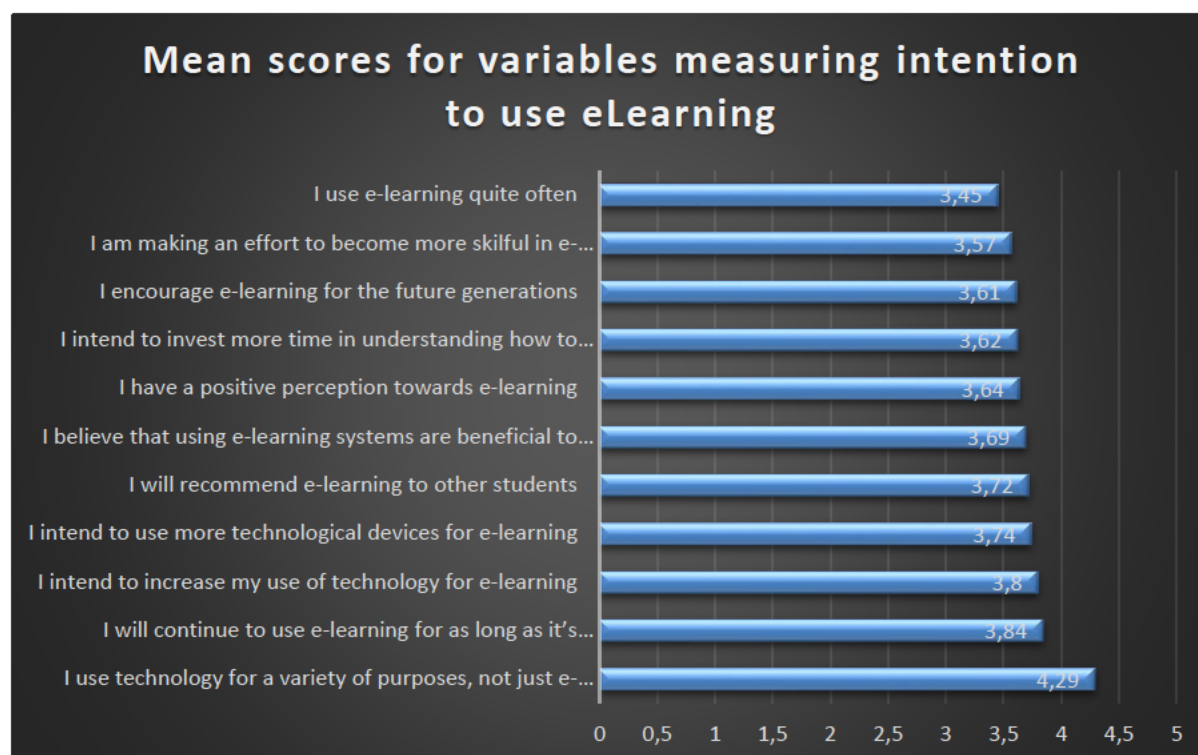


Figure 4.7: Mean scores for variables measuring intention to use e-learning

As illustrated in Figure 4.7, the variable *“I use technology for a variety of purposes, not just e-learning”* scored the highest mean score ($M = 4.29$), whilst the variable *“I use e-learning quite often”* recorded the lowest mean score ($M = 3.45$). This was an indication that there was significant agreement amongst the participants regarding their intentions to use e-learning. Generally, all the scores were significantly higher than the neutral value of three ($p < .001$).

4.4.4 Attitude towards e-learning

Perceived Usefulness and Perceived Ease of Use are considered distinct factors that influence a student’s attitude towards using technology for e-learning. Attitude towards e-learning was a fourth factor that was strongly indicated in the findings. Table 4.7 below demonstrates the significant agreement or disagreement of participants’ attitude to use technology for e-learning.

Table 4.7: Output table of attitude towards e-learning

Attitude towards e-learning	Mean	Standard deviation	T	p-value
C45 I find myself to be solely dependent on e-learning and no longer see the need for classroom learning	2.32	1.186	-8.281	<.001
C48 Classroom learning should eventually be obliterated	2.17	1.157	-10.358	<.001
D66 I can easily avoid distractions when using e-learning	2.35	1.141	-8.183	<.001
D67 I feel more comfortable with e-learning relative to traditional classroom learning	2.90	1.257	-1.108	.269
D68 I prefer to avoid physical interaction when studying	3.00	1.305	.053	.957

The variable “*I find myself to be solely dependent on e-learning and no longer see the need for classroom learning*” recorded a mean score of 2.32 (SD = 1.186). This mean score is below the neutral midpoint of 3 on the Likert scale. The negative *t*-value ($t = -8.281$, $p < .001$) indicates that students significantly disagreed with this statement, suggesting that most students still value classroom learning and did not perceive e-learning as a complete substitute for face-to-face instruction. Furthermore, the variable “*Classroom learning should eventually be obliterated*” scored the lowest mean score of 2.17 (SD = 1.157), with a highly significant *t*-value ($t = -10.358$, $p < .001$). This finding confirmed that students strongly opposed the idea of eliminating classroom-based education, highlighting their preference for a blended learning approach where e-learning complements rather than replaces traditional instruction.

The variable "*I can easily avoid distractions when using e-learning*" ($M = 2.35$, $SD = 1.141$) and significant result ($t = -8.183$, $p < .001$) indicated that students generally struggle to maintain focus during e-learning lectures. This implied that self-discipline and concentration may be more challenging in online environments compared to physical classrooms. On the other hand, the variable "*I feel more comfortable with e-learning relative to traditional classroom learning*" ($M = 2.90$, $SD = 1.257$) was close to neutral, and the t -test ($t = -1.108$, $p = .269$) showed no statistically significant difference. This suggests that students neither strongly agree nor disagree, reflecting a mixed attitude—some students may appreciate the flexibility of e-learning, while others still feel more at ease in a physical classroom setting.

4.5 ANALYSIS USING THE COMPOSITE VARIABLES

Each construct was formed by calculating the average of the items in the construct. These were analysed to determine whether there was significant agreement or disagreement to the construct in overall. This analysis was also performed to investigate the relationships between the constructs as per the objectives and to determine if there was any significant difference in these constructs across demographic variables.

The study investigated Radiography students' perceptions towards e-learning through the analysis of four composite variables (perceived usefulness, perceived ease of use, attitude towards e-learning, and intention to use e-learning). The results revealed that students generally perceive e-learning as beneficial and practical ($M = 3.45$, $SD = 0.69$). The high t -value ($t = 9.433$, $p < .001$) demonstrated a statistically significant positive perception. This implied that students believed that e-learning enhances their academic performance and access to educational resources.

Table 4.8 Output table of composite variables

Composite Variable	Mean	Standard deviation	T	p-value
Perceived usefulness	3.4525	.68845	9.433	<.001
Perceived ease of use	3.1214	.59778	2.914	.004
Attitude	2.5476	.88652	-7.325	<.001
Intention to use	3.6375	.70092	13.055	<.001

Interestingly, as noted in Table 4.8 above, the composite variable on the intention to use e-learning recorded the highest mean score of 3.64 (SD = 0.70), with $t = 13.055$ and $p < .001$. This signified that participants were likely to continue using e-learning in the future, possibly due to its flexibility, convenience and growing integration into academic programmes. Perceived ease of Use recorded a mean score of 3.12 (SD = 0.60), with $t = 2.914$ and $p = .004$, suggesting that students moderately agree that e-learning platforms are user-friendly. This demonstrated that although some participants adapt well to digital tools, others may encounter technical or accessibility challenges that affect their learning experience.

Conversely, the composite variable on the attitude of participants to e-learning produced a mean score of 2.55 (SD = 0.89) and a significant negative t -value ($t = -7.325$, $p < .001$), reflecting an overall less favourable attitude towards e-learning. This suggests that despite recognising the usefulness of e-learning, participants may still prefer traditional face-to-face learning or express concerns about engagement, motivation or interaction in online environments. Overall, the findings reveal that while students acknowledge the benefits and usability of e-learning, their attitudes remain mixed, emphasizing the need for a balanced approach that integrates both online and traditional learning methods. Enhancing platform design, increasing interaction and providing technical support could help improve student experiences and attitudes towards e-learning.

4.6 CORRELATIONS BETWEEN THE FOUR COMPOSITE VARIABLES

As illustrated in Table 4.8, perceived usefulness showed strong positive correlations with Perceived ease of use ($r = .368$, $p < .001$), Attitude towards e-learning ($r = .411$, $p < .001$) and Intention to use e-learning ($r = .664$, $p < .001$). This implied that participants who found e-learning useful also tend to perceive it as easier to use; have a positive attitude toward it; and express stronger intentions to continue using it. The strongest relationship was observed between perceived usefulness and intention to use e-learning, indicating that the usefulness of e-learning is a key determinant of future decisions to adoption e-learning.

Table 4.9: Correlations amongst the four composite variables

Composite variable		PU	PEOU	ATT	ITU
PU	Pearson Correlation	1	.368**	.411**	.664**
	Sig. (2-tailed)		.000	.000	.000
PEOU	Pearson Correlation	.368**	1	.127	.231**
	Sig. (2-tailed)	.000		.069	.001
ATT	Pearson Correlation	.411**	.127	1	.473**
	Sig. (2-tailed)	.000	.069		.000
ITU	Pearson Correlation	.664**	.231**	.473**	1
	Sig. (2-tailed)	.000	.001	.000	

Correlation is significant at the 0.01 level (2-tailed).

In addition, as depicted by Table 4.9 above, the relationship between Perceived Ease of Use and other variables revealed that this variable positively correlated with Perceived Usefulness ($r = .368$, $p < .001$) and Intention to use e-learning ($r = .231$, $p = .001$). However, perceived ease of use showed no significant relationship with attitude towards e-learning ($r = .127$, $p = .069$). This suggests that while participants who found e-learning

easy to use are more likely to view it as useful and intend to use it, ease of use alone may not directly influence their overall attitude toward e-learning.

Furthermore, Attitude towards e-learning was significantly correlated with Perceived Usefulness ($r = .411$, $p < .001$) and Intention to use e-learning ($r = .473$, $p < .001$). This indicated that positive attitudes were associated with perceptions of usefulness and a stronger intention to adopt e-learning. However, attitude was not significantly related to ease of use, suggesting that usefulness is a stronger predictor of positive attitude than technical simplicity. Lastly, the intention to use e-learning had significant positive correlations with Perceived Usefulness ($r = .664$, $p < .001$), Perceived ease of use ($r = .231$, $p = .001$) and Attitude towards e-learning ($r = .473$, $p < .001$). This implies that participants' willingness to continue using e-learning was influenced by how useful, easy to use and engaging they perceive the system to be. The strongest predictor of intention remains perceived usefulness.

4.7 ANALYSIS TO DETERMINE DIFFERENCES ACROSS DEMOGRAPHICS

There was no significant difference in the four demographic variables across gender, age or discipline. Results from ANOVA to determine if there are any significant differences in these constructs across race shows that PEOU differs significantly across race ($F(3, 202) = 5.367$, $p = .001$). Tukey's post hoc analysis shows that Indians (mean = 3.42) perceived e-learning to be easier to use than Blacks (mean = 3.04), $p < .001$.

Table 4.10 Correlating year of study with constructs

		PU	PEOU	ATT	ITU
A5 Year Pearson Correlation		.294**	.092	.230**	.245**
Sig. (2-tailed)		.000	.190	.001	.000
Correlation		Moderate positive	Very weak positive	Weak positive	Moderate positive

Table 4.10 explains that there is a: moderate positive correlation between the year and perceived usefulness, $r=.294$, $p<.001$; very weak positive correlation between the year and perceived ease of use, $r=.092$, $p=.190$; weak positive correlation between the year and attitude towards e-learning, $r=.230$, $p=.001$; and a moderate positive correlation between the year and intention to use, $r=.245$, $p<.001$.

4.8 LINEAR REGRESSION ANALYSIS

As a final analysis, linear regression was applied to determine the effect that the three independent variables (perceived usefulness, perceived ease of use and attitude towards e-learning) have on the dependent variable (usage). These three independent variables were entered into the model at the same time so that their effect on usage could be seen when all variables are considered to be in play.

Table 4.11: Final Analysis

IV	R ²	F	df1; df2	p-value	B (regression coefficient)	T	p-value
PU	.489	64.437	3; 202	<.001	.578	9.645	<.001
PEOU					-.011	-.169	.886
ATT					.190	4.365	<.001

The independent variables PEOU, PU and ATT account for 48.9% of the variance in ITU, $F(3, 202) = 64.437$, $p<.001$. Moreover, PU ($\beta = .578$, $p<.001$) and ATT ($\beta = .190$, $p<.001$) are both significant predictors of ITU.

4.9 SUMMARY OF THE CHAPTER

This chapter presented the results from the data collected. The objectives of this research were to determine the Radiography students perceived usefulness, ease of use, attitude and actual use of e-learning. This chapter also included diagrams to depict the demographics of the participants. The grouping and univariate analysis was demonstrated in tables and bar graphs. The mean values above three indicated significant agreement, whereas those below three indicated significant disagreement. Insignificant constructs were excluded from the tables. Descriptive statistics, including means and standard deviations, were used in the analysis of the data. The tests that were used are ANOVA, Pearson's correlation coefficient, one sample t-test, independent samples t-test, factor analysis and cross-sectional analysis. As a final analysis, linear regression was applied to determine the effect of the three independent variables (PEOU, PU and ATT) on the dependent variable (ITU) and it was found that the independent variables PEOU, PU and ATT account for 48.9% of the variance in ITU. The next chapter will discuss the findings presented in this chapter.

CHAPTER 5

DISCUSSION OF THE FINDINGS

5.1 INTRODUCTION

This chapter integrates Chapters Two and Four into a detailed comparative chapter and includes a discussion of the results in relation to existing literature and prior research. Key objectives identified include perceived usefulness, perceived ease of use, and the behavioural/actual use of e-learning. The discussion also incorporates additional themes that emerged during the study, such as attitude to use e-learning.

5.2 DEMOGRAPHIC DETAILS OF THE PARTICIPANTS

The demographic data used in this study included age, gender, Radiography disciplines (Diagnostic, Sonography, Radiotherapy and Nuclear Medicine), and year of study that the student was registered for. These were already represented in the previous chapter as pie charts and bar graphs. Even though this study does not explicitly discuss the relationship or draw correlations between the demographics and the results, it was necessary to include this section into the questionnaire so that it can be proven that datasets were collected over a large and diverse group, with the intention to remove any other causation factors.

5.2.1 Discussion of demographic variables

The diverse nature of the sample in terms of the representation of all four Radiography disciplines (Diagnostic Radiography, Sonography, Radiotherapy and Nuclear Medicine) was a strength in this study. The representation in terms of disciplines was in keeping with studies by Dalmolin *et al.* (2018: 175) and Moreira *et al.* (2019: 47). This strength is usually well recommended in research as it provides a well-rounded perspective about a phenomenon.

The high representation of the female gender in this study was in keeping with the South African understanding that Radiography is historically a female-dominated career. Many studies performed amongst radiographers have revealed similar

results (Dalmolin *et al.* 2018: 177; Alhasan and Al-Horani 2021: 68). This is an indication that the sampling of participants was performed in line with the demographics of the population.

The predominance of participants between the ages of 20 and 22 years in this study was reflective of the typical age range of undergraduate university students enrolled within healthcare-related programmes. Younger students are often considered more familiar and comfortable with digital technologies due to increased exposure to technological devices and online platforms within educational and social environments. This familiarity may positively influence students' perceptions regarding the usefulness and ease of use of e-learning technologies (Chikasha 2021: 140). However, despite younger students often demonstrating greater digital adaptability, age alone does not necessarily determine successful engagement with e-learning, as factors such as motivation, access to resources, institutional support and digital literacy may also influence students' experiences of online learning (Queiros and De Villiers 2016: 117). The findings of this study therefore suggest that the predominantly younger age profile of participants may have contributed positively towards students' acceptance and engagement with e-learning platforms within the Radiography programme.

The representation of students across all four years of study strengthened the diversity of the sample and allowed for broader insight into students' experiences of e-learning throughout different stages of the Radiography program. The higher representation of second- and third-year students may indicate increased engagement with institutional e-learning platforms due to greater exposure to course-specific online learning activities and assessments. Senior students may also demonstrate greater confidence and familiarity with digital learning systems due to prolonged exposure to e-learning platforms and online academic activities within higher education environments. Previous studies have suggested that increased familiarity with digital tools and online assessment systems may positively influence students' perceptions and engagement with e-learning technologies (Domínguez-Figaredo and Gil-Jaurena 2024: 309). In contrast, first-year students may require additional academic and technological support as they transition into university learning environments that

increasingly incorporate digital teaching and learning methods (Queiros and De Villiers 2016: 117). Differences in year of study may therefore influence students' perceptions regarding the usefulness, ease of use and continued engagement with e-learning technologies. For example, some students may engage more actively with e-learning platforms during periods of assessments or assignment submissions, while others may utilise these platforms more consistently throughout the academic year.

The racial diversity represented within the study sample further strengthened the inclusivity of the research findings. The predominance of Black African participants was reflective of the demographic profile of many South African public higher education institutions. Although inequalities relating to socioeconomic background and digital access remain important considerations within the South African higher education context, the findings of this study suggested that most participants generally had access to adequate internet connectivity and digital resources to support their engagement with e-learning. This may reflect ongoing institutional and national efforts aimed at improving digital access and broadband connectivity within higher education environments. Nevertheless, ensuring equitable access to stable internet connectivity and technologically supportive learning environments remains important for sustaining inclusive and effective e-learning practices among diverse student populations.

5.3 FACTORS INFLUENCING E-LEARNING AMONGST RADIOGRAPHY STUDENTS

The sections below will discuss the results presented in the previous chapter in more detail. This discussion will include comparisons to other studies for a more comprehensive understanding of the results in this study.

5.3.1 Perceived Usefulness

The strong agreement amongst participants that e-learning was useful in supporting their academic activities was a positive finding. A similar finding was observed in studies by Vululleh (2018:142) and Sakarji *et al.* (2019:19). Whilst the findings in a study by Teo *et al.* (2020: 359) obtained opposing results, it is

important for e-learning to be useful to students so that they are encouraged to engage in their studies. This finding suggested that participants perceived e-learning as enhancing efficiency, which can assist in yielding good academic performance. Furthermore, the high agreement amongst participants that they used multiple programs for e-learning and that e-learning allowed them to accomplish more tasks were also considered positive findings. In summary, the confirmation by the results that e-learning was considered useful was an indication that participants would be more propelled towards using e-learning in their studies.

5.3.2 Programs used for e-learning

The results from this study indicated that students at the institution of interest used multiple programs for e-learning. This was a positive finding. In a study by Al Kurdi, Alshurideh and Salloum (2020: 6484), platforms used for e-learning include Moodle, Blackboard and Microsoft Teams. Additionally, platforms such as Google, email and Youtube can be used to complement e-learning (Amir *et al.* 2020: 2). The results from this study are similar to the study by Al Kurdi, Alshurideh and Salloum (2020: 6484) in that the students at this institution also used multiple programs, similar to the above mentioned platforms, to study, and a plausible conclusion could be draw that these programs were also used by the students of the institution of interest as most of these programs were developed specifically for e-learning. In summary, if students used more than one program for learning, it would be beneficial to them as each student may have more than one preference. Multiple programs would allow students to perform multiple tasks more efficiently.

5.3.3 Advantages of e-learning

There was strong agreement in this study that e-learning was advantageous to a majority of the students. Students in this study believed that e-learning improved their knowledge by increasing their understanding of concepts. This is a positive finding that correlates with the study by the scholars such as Zavala-Cerna (2025: 2), whose study revealed that students strongly believed that technology can be used to enrich their learning and see their futures as using technology for learning as well as to prepare them for the competitive job market. It is critical that institutions

of higher learning adequately prepare their prospective graduates for the world of work to enhance their capabilities (Zavala-Cerna 2025: 2).

The results from this study revealed that students made an effort to improve their e-learning skills and even invested more time to understand how to use the e-learning system. Likewise, the study by Amir *et al.* (2020: 2) revealed that students are able to adapt to e-learning and find it useful, regardless of the challenges they might experience. However, the effectiveness of e-learning varies between students in that older students may find e-learning less useful since older students generally struggle with e-learning systems, whereas younger students may find e-learning more effective (Xu *et al.* 2025: 2). Latest research by Gumede, Hazell and Lewis (2025: 4) also had varying results. Some students preferred e-learning because it was time and cost effective, whilst others believed it was productive to go to university and interact with peers and lecturers. The above statement differs with the data found in the current study in that most of the participants in this study concurred that the e-learning system provides ease of communication with peers as well as lecturers. In summary, the confirmation by the results that e-learning was considered advantageous was an indication that participants would be more propelled towards using e-learning in their studies.

The findings showed that the advantages of e-learning, accentuated by most of the students, can be attributed to the fact that students believed that e-learning was cost-effective. The study by Amir *et al.* (2020:2) showed that students supported e-learning because it is less time-consuming, cost and user-friendly, and it allowed individuals to focus on a specific area. The Radiography students at DUT in the study conducted by Gumede, Hazell and Lewis (2025: 4) also agreed that online learning was cost-effective because they did not need to travel to university, thereby drastically reducing travel expenses. Participants in the current study suggested that e-learning was less time-consuming. The Radiography students in the study by Gumede, Hazell and Lewis (2025: 4) also agreed that e-learning was less time-consuming, which positively contributed to their studies because they had more time to study and as a result achieved higher marks in their examinations.

Another advantage of e-learning, as depicted by the participants, was the ease when communicating with lecturers and peers. Conversely, according to the theory, participants expressed that they found themselves being easily distracted by social media whilst e-learning in an informal setting (Amir *et al.* 2020: 2). Babu and Reddy (2015: 260) mention that the most common challenge that students face in a developing country is accessibility issues. Huang and Liu (2024: 3) also found that e-learning comes with the responsibility of self-discipline. This indicates a certain level of neutrality and subjectivity, stating that e-learning could either prove advantageous or disadvantageous depending on the student. On the contrary, the study by Gumede, Hazell and Lewis (2025: 4) stated that participants actually preferred having face-to-face lectures because they could interact better with peers and lecturers. To summarize overall, students believed e-learning to be advantageous, which is a positive finding as it will assist in increasing their use thereof.

5.3.4 Degree of usefulness of e-learning

The strong agreement amongst participants that the e-learning system enabled them to accomplish tasks more easily compared to traditional classroom learning was a positive finding. This may be attributed to the flexibility, accessibility and convenience associated with e-learning platforms, which allow students to access learning materials, recorded lectures and assessments at their own pace and from various locations. E-learning systems may also simplify administrative and academic tasks through online submission portals, digital communication tools and immediate access to educational resources. Similar findings were reported by Yang (2024: 4), who noted that students perceived e-learning as beneficial in improving accessibility to academic content and supporting independent learning practices.

This contrasts with the results of Teo *et al.* (2020: 359), whose study reported that students experienced frustration due to barriers such as poverty and limited access to the technological resources required for e-learning. Teo *et al.*'s (2020: 359) findings suggested that students in their context found classroom learning more effective for accomplishing academic tasks. The inconsistency between the findings of Teo *et al.* (2020:359) and those of the current study highlights the

importance of contextual factors, particularly resource availability, in shaping students' experiences with e-learning.

Another positive finding was the strong agreement amongst participants that e-learning made communication with peers and lecturers easier. However, this result diverged from those of other studies. Sadegi (2019: 84) reported that in traditional classroom settings, students found it simpler to ask questions and seek assistance from lecturers when faced with challenges. Similarly, Amir *et al.* (2020: 4) emphasised that the disadvantages of e-learning were largely linked to reduced interaction and limited feedback from lecturers and peers. These studies therefore conflicted with the findings of the current study, which indicated that most participants believed that e-learning contributed positively to improving their overall education.

The positive perceptions reported in the current study may be attributed to increased familiarity with digital communication platforms, improved institutional support for online learning and the convenience associated with electronic communication methods such as discussion forums, emails, messaging applications and virtual learning platforms. E-learning may also provide students with more flexible opportunities to communicate with lecturers and peers outside formal classroom hours, thereby improving accessibility to academic support and learning resources. Additionally, students who are more technologically adaptable may perceive online communication as less intimidating and more convenient than traditional face-to-face interaction.

In summary, while global literature often reports communication-related challenges in e-learning environments, the results of the present study suggest that participants perceived e-learning as supporting, rather than hindering, their understanding of learning content.

5.3.5 E-learning compared to classroom learning

The high level of agreement amongst participants that e-learning enabled them to complete tasks more easily and that it was both effective and essential was

considered a positive finding. This result aligned with the study by Hempel *et al.* (2016: 298), who found that case-based e-learning effectively prepared Radiography students for practical training. However, Teo *et al.* (2020:359) reported contrasting results, noting that Radiography students in their context did not receive sufficient information through e-learning alone and required clinical education to reinforce their learning. The study by Pang *et al.* (2024: 73) supported both perspectives by acknowledging that although e-learning has substantial positive outcomes, it should not entirely replace classroom learning. Their findings suggested that blended learning may be a more suitable long-term approach, warranting further research. Overall, the strong affirmation of e-learning's usefulness in this study indicates that participants viewed it as a beneficial component of their academic development.

Another positive finding was the agreement amongst students that educational tasks could be completed more quickly using e-learning. This differed from Sadeghi (2019: 84), who found that students in traditional classroom environments experienced fewer distractions because they lacked constant access to social programs and relied on peer reminders to stay aware of upcoming deadlines. According to Sadeghi (2019: 84), these factors made classroom learning more conducive to maintaining focus. Conversely, students in the current study reported completing more tasks through e-learning due to its flexibility, particularly the ability to manage their time independently. While peers in other studies depended on face-to-face interactions to keep track of deadlines, participants in this study utilised the e-learning system itself for weekly academic planning. These opposing findings reflect a theoretical conflict regarding whether e-learning enhances or hinders task management.

Participants in the present study also indicated that communicating with peers and lecturers about academic content was relatively easy within the e-learning system. This finding contrasted with Sadeghi (2019: 84), who maintained that traditional classroom learning provided more immediate and personal opportunities for students to seek help from lecturers and interact with peers. In Sadeghi's (2019: 84) study, face-to-face discussion was viewed as more efficient than

communication through online platforms (responses, particularly via email, may be delayed). However, the present study demonstrated a general consensus that students could access lecturers and peers effectively using e-learning, and that communication did not need to occur face-to-face for comprehension to improve. The study by Radović-Marković (2010: 292) supported these results, concluding that e-learning facilitated a higher degree of interaction and allowed students to adapt quickly due to its flexibility and innovative features. These findings further reinforced the perception that e-learning enhanced rather than restricted academic communication.

The results of this study differed from those of Gumede, Hazell and Lewis (2025: 4), who examined the experiences of DUT Radiography students and found that some participants preferred classroom learning because they described e-learning as overwhelming and stressful. Although several students in their study initially struggled to adjust to e-learning, they eventually adapted through repeated use. In contrast, none of the participants in the present study reported feeling overwhelmed or stressed by e-learning. Students who were initially unfamiliar with the system indicated that they adjusted with ease after consistent use. This consistent adaptability suggested that the participants in the current study experienced a smoother transition to e-learning than those in comparable research.

5.4 BEHAVIOURAL INTENTION TO USE/ ACTUAL USE

Various students in the current study owned multiple devices that they could use for e-learning. There was a certain degree of ambivalence regarding students' feelings and attitudes towards e-learning. However, it can be concluded that most of the students, whether they preferred e-learning or not, eventually adjusted to the technology and devices used for e-learning. The quality of e-learning is influenced by instructor factors, student factors and institutional factors (Hadullo, Oboko and Omwenga 2018: 153). Course design, course assessment and course support also affect the quality of e-learning delivered (Hadullo, Oboko and Omwenga 2018: 153). Hadullo, Oboko and Omwenga (2018: 154) believe that the failure to successfully implement, adopt and use e-learning is closely associated with a lack

in quality of e-learning techniques. Students' attitude also affects how they perceive the quality of learning, according to Amir *et al.* (2020: 6).

5.4.1 Student Attitudes towards e-learning

The strong support expressed by participants in this study indicated that most students held a positive attitude towards e-learning. This favourable perception suggested that students were more likely to engage with e-learning platforms frequently. These findings were consistent with those of Dalmolin *et al.* (2018: 178), who reported that students in their study were generally comfortable using technology and demonstrated a positive attitude toward e-learning, which in turn contributed to increased usage. Overall, the results of the present study reflected a similar trend, emphasising the relationship between positive attitudes and sustained engagement with e-learning.

5.4.2 Students' willingness to use e-learning

The results of this study indicated that students demonstrated a strong interest in e-learning. Even those who initially experienced difficulties expressed an intention to spend more time using the system in order to strengthen their skills, although the majority already possessed adequate competence to perform the required tasks. This finding aligned with the work of Al-Gahtani (2016: 31) and Salloum *et al.* (2019: 128450), who identified behavioural intention as a key predictor of actual system use. Salloum *et al.* (2019: 128450) emphasised that behavioural intention reflects students' commitment to utilising e-learning consistently and their willingness to adopt it as an ongoing mode of learning. Similarly, Samsudeen and Mohamed (2019: 225) argued that behavioural intention represents students' readiness to engage in a particular behaviour and noted that the intention to use e-learning has a direct positive effect on its actual use. In the present study, students generally displayed positive attitudes toward e-learning because they believed it would enhance their overall educational outcomes. In summary, the alignment between existing literature and the findings of this study highlighted the significant role of behavioural intention in influencing students' engagement with e-learning systems.

5.4.3 Technological devices

Although students in this study did not purchase additional devices specifically for e-learning, many indicated that they intended to make greater use of the technological devices already available to them. This suggested a positive behavioural intention toward engaging with e-learning platforms. Statistical analyses further supported this, showing that most students used multiple devices for e-learning. These findings aligned with Eom (2022: 80), who noted that mobile devices play a critical role in facilitating dialogue and self-regulated learning processes, thereby enhancing e-learning outcomes. However, Nouraey and Al-Badi (2023: 195) raised concerns regarding excessive device use, introducing the concept of 'computer fatigue', which includes physical risks such as back pain, eye strain and numbness in the lower limbs. These contrasting perspectives highlight both the benefits and challenges associated with increased device usage in e-learning environments.

Despite most participants in the present study having access to the technological devices required for e-learning, the findings differed from those of Nouraey and Al-Badi (2023: 196). Their study reported that many students struggled to access essential resources such as computers and printers, and even those with technological access often faced challenges such as insufficient computer skills. Furthermore, the study emphasised that the reliance on technological devices imposed additional financial strain not only on students but also on institutions, which were required to develop or strengthen digital infrastructure prior to implementing e-learning. These contrasting findings illustrate the varying contextual demands associated with technological readiness in different learning environments.

5.5 PERCEIVED EASE OF USE OF E-LEARNING

Perceived Ease of Use can be defined as the degree to which the student perceives that their use of the e-learning system would be mentally and physically uncomplicated (Luo *et al.* 2024: 3). Furthermore, the TAM model posits that perceived ease of use is most likely to influence perceived usefulness and in turn results in improved performance. The overall finding that the e-learning platforms

were easy to navigate and uncomplicated was maintained through most of the participants. Most students have access to the internet.

5.5.1. Skills with technology

The results of this study showed that most students believed they possessed sufficient skills to operate technological devices effectively for e-learning. Those who initially lacked adequate technological skills reported that they became more competent with continued use, indicating a process of adaptation through practice. These findings contrasted with Louw (2016: 2), who observed that many academics and students lack the necessary skills to make full use of e-learning features. However, the results aligned with Amir *et al.* (2020: 2), whose study found that although students experienced challenges during the transition to e-learning, they were still able to adapt to distance learning, with some even perceiving it as more efficient than traditional classroom instruction. Conversely, the results differed from those of Nouraey and Al-Badi (2023: 196), who reported that many students struggled with technological difficulties, including inadequate computer skills. In the current study, the results indicated that those unfamiliar with technology gradually became competent as they used e-learning more frequently, suggesting a continuous improvement in skill through repeated exposure.

Further support for these findings can be drawn from the work of Moghavvemi *et al.* (2017: 4), who explained that students who enjoy using technology are more likely to appreciate its usefulness and find it easier to navigate. Increased exposure to technology in learning environments was also associated with a more enjoyable educational experience. This aligns with the notion that students develop the intention to use e-learning when they perceive it as enjoyable. According to Hussein (2018: 854), feelings of pleasure, satisfaction and positive engagement play a significant role in shaping user acceptance and usage behaviour in e-learning environments. Similarly, Huang and Liu (2024: 3) defined perceived enjoyment as the satisfaction derived from using technology, independent of any direct academic performance outcomes. These perspectives collectively support the idea that enjoyment and positive user experience contribute meaningfully to students' willingness to engage with e-learning systems.

5.5.2 Satisfaction of students when using e-learning

Intrinsic motivation refers to the satisfaction an individual gains from performing a behaviour, acting based on personal enjoyment rather than external rewards or pressures (Huang and Liu 2024:4). This concept is supported by Hussein (2018: 854), who found that intrinsic motivators, particularly perceived enjoyment, significantly influenced students' intention to use information systems such as e-learning. The study indicated that when students experienced enjoyment while using e-learning, they were more inclined to engage with the system consistently. This aligns with the broader understanding that intrinsic motivation plays an important role in shaping positive attitudes toward technology use.

However, Hussein (2017: 163) concluded that perceived usefulness and perceived ease of use did not significantly influence students' intention to use e-learning. This may be attributed to students already having prior exposure to technology, leading them to feel comfortable and satisfied with e-learning regardless of its perceived usefulness or ease of operation. In contrast, Sakarji *et al.* (2019: 19) argued that perceived usefulness and perceived ease of use are distinct factors that shape students' attitudes toward adopting e-learning technologies. These differing perspectives conflict with the findings of the current study, which revealed that many students experienced difficulties when using e-learning and frequently relied on peers or online resources to understand various aspects of the system. This indicated a lack of ease of use, which could negatively impact their willingness to rely on e-learning. These results may be linked to the possibility that students in the present study did not have substantial prior experience with e-learning, unlike participants in studies where ease of use played a lesser role. In summary, the findings of this study suggest that perceived ease of use remains a relevant factor influencing student engagement with e-learning.

5.5.3 Access and quality of internet

The findings of this study indicated that all students had access to the Internet, either through Wi-Fi or mobile data. These results differed from the challenges

highlighted in the literature. Babu and Reddy (2015: 260) and Aboagye, Yawson and Appiah (2020: 6) identified accessibility issues, particularly limited connectivity and incompatible devices, as some of the most common barriers faced by students in developing countries. Similarly, Nouraey and Al-Badi (2023: 196) reported that many students in their study lacked reliable Internet access, placing financial strain on them as they were required to secure their own connectivity to access educational materials. Although students in the present study did have access to Wi-Fi or mobile data, some participants still reported that their connection was of poor quality and sometimes unreliable. This may be attributed to differences in network coverage, intermittent connectivity disruptions, varying mobile data quality and external factors such as load shedding, which may affect the consistency of internet access among students. These contrasting findings emphasise the variability in students' technological environments and the challenges that remain, even when access is available.

5.5.4 Students' characteristics

The findings of this study highlighted the importance of student characteristics, namely willingness, satisfaction and prior experiences, in influencing the acceptance and success of e-learning. Rhema and Miliszewska (2014: 170) emphasised that traits including self-efficacy, technological anxiety, technological competence and attitudes toward e-learning all contribute to how students engage with online learning platforms. They further cautioned that a student's attitude is shaped by factors such as course quality, computer skills, and the ease with which they can access and use e-learning systems. In support, Hussein (2016: 163) argued that a student's attitude plays a critical role in shaping their intention to use e-learning, noting that positive attitudes are likely to enhance the willingness to engage with such systems. Similarly, Khalilia (2020: 54678) observed that students generally hold favourable attitudes toward e-learning, attributing this to increased motivation; greater flexibility in time and location; and improved communication beyond traditional academic hours. The Radiography students in the present study echoed these sentiments, reporting that e-learning was relatively easy to operate and that even when errors occurred, they found it simple to recover and continue

working. Overall, the consensus amongst participants was that e-learning was easy to use, reinforcing the link between positive attitudes and successful engagement.

5.6 ATTITUDE TOWARDS E-LEARNING

A fourth factor, Attitude Towards E-Learning (ATT), emerged strongly from the data and was therefore incorporated into the study's framework and objectives. The results demonstrated that students' attitudes varied, with some participants reporting positive experiences and viewing e-learning as a beneficial way forward, while others reported poorer experiences. Contributing factors to negative attitudes included limited technological skills and reduced interaction. Although several participants had grown accustomed to e-learning and appreciated its convenience, many still expressed a preference for traditional classroom learning. These findings were partially supported by Dalmolin *et al.* (2018: 178), who noted that students are generally comfortable using technology and tend to exhibit positive attitudes toward e-learning.

The results also aligned with the study by Rhema and Miliszewska (2014: 170), who argued that student attitudes may be either positive or negative depending on course quality, students' computer skills, and the ease with which e-learning platforms can be accessed and used. Similar to their findings, participants in the present study reported difficulties when using e-learning and often relied on peers or online resources for assistance. As previously mentioned, Khalilia (2020: 54678) observed that students' attitudes toward e-learning are generally positive, highlighting benefits such as increased motivation; greater flexibility in time and place of study; and enhanced communication beyond normal contact hours. However, the results of the current study diverged from some of this literature by showing that students did not rely solely on e-learning and did not support the complete replacement of classroom learning. Many participants reported that e-learning made them more susceptible to distractions, which hindered their academic progress. These findings reinforce that while e-learning offers notable advantages, student attitudes remain influenced by both contextual factors and personal learning preferences.

5.7 RESULTS IN RELATION TO THE AIM OF THE STUDY

The aim of this quantitative, cross-sectional study was to identify the factors influencing Radiography students' experiences of e-learning at a university of technology in KwaZulu-Natal. Davis's Technology Acceptance Model (TAM) was used as the theoretical framework for this research. The current study achieved this aim by researching and identifying the Radiography students' experiences by identifying the perceived usefulness, perceived ease of use and behavioural use of technology for e-learning. Attitude towards e-learning was also analysed as this was a fourth factor that was strongly extracted from the data. The results in relation to the objective, to determine Radiography students' perceived usefulness, ease of use, attitude and actual use of e-learning, was also adhered to.

5.8. SUMMARY OF THE CHAPTER

This chapter discussed the findings presented in Chapter Four in relation to the four key constructs of the study: perceived usefulness, perceived ease of use, actual use, and attitudes towards e-learning. Based on the overall results, it can be concluded that the implementation of e-learning was largely successful, with students demonstrating positive perceptions and a general willingness to engage with online learning systems. These findings highlight the importance of institutions continuing to invest in the development and enhancement of students' technological skills to support effective e-learning engagement.

While e-learning has existed for many years, its adoption accelerated significantly in 2020 following the onset of the COVID-19 pandemic, which underscored its necessity in Higher Education globally. Despite this progress, the rapid evolution of technology presents ongoing challenges as some students may struggle to keep pace with emerging digital tools and platforms. Addressing these challenges requires institutions not only to integrate e-learning but also to adapt and strengthen instructional approaches that support technological competence. By evolving teaching strategies alongside technological advancements, institutions can better equip students to navigate digital learning environments confidently and effectively.

The following chapter will conclude this dissertation and explain the limitations of the research and the recommendations.

CHAPTER 6

SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

This study intended to determine the factors influencing Radiography students' experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal. This chapter concludes based on the aims and objectives of the study, considers the limitations, and provides recommendations for future research on e-learning for Radiography students, thereby contributing valid research to the field of Radiography.

6.2 CONCLUSION

The purpose of this quantitative cross-sectional survey study was to identify the factors influencing Radiography students' experiences of e-learning at a University of Technology in KwaZulu-Natal. The aim and objectives of the study were achieved. The findings revealed that students' experiences of e-learning were influenced by several interconnected factors, including the perceived usefulness of e-learning, ease of use of online learning platforms, accessibility to wireless internet connectivity, quality and relevance of digital learning content, and students' attitudes towards the use of e-learning technologies. In addition, behavioural intention and actual use of e-learning were found to influence students' engagement with digital learning practices within the Radiography program.

The study further demonstrated that although students generally acknowledged the value, flexibility and convenience associated with e-learning, several challenges continued to affect their overall experiences. These challenges included inconsistent internet connectivity, technical difficulties, limited access to digital resources and varying levels of institutional and technological support. Despite these barriers, students recognised the increasing importance of e-learning within

higher education and the role it plays in supporting modern teaching and learning practices within healthcare education.

By integrating quantitative findings obtained from Radiography students with relevant literature, the study provided valuable insight into the experiences and perceptions of students regarding e-learning within a South African higher education context. The findings contribute to the growing body of knowledge relating to digital learning within Radiography education and may assist educators, departments and institutions in improving the design, accessibility and effectiveness of e-learning strategies for students enrolled in healthcare-related programmes.

Furthermore, the findings of this study contribute towards the achievement of Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. By identifying factors that facilitate and hinder effective e-learning experiences, this study supports ongoing efforts to improve access to quality digital education, strengthen student support systems and enhance technologically enabled teaching and learning within higher education institutions. The study may therefore contribute towards the continued advancement of Radiography education and the broader integration of innovative and inclusive educational practices within South Africa.

6.3 LIMITATIONS OF THE STUDY

The following weaknesses were identified whilst conducting the study and interpreting the results. These limitations if addressed in further research will produce additional meaningful insights into the issue investigated. This study was limited to Radiography students at the DUT due to budget and time constraints. Other faculties at the DUT were also not included as including multiple faculties would have created a dissertation of great volume that can only be achieved with large amounts of time. This dissertation was planned to be completed over a span of time that did not include the luxury of increasing the sample size. The requirements of a Master's degree in terms of sample size were also achieved so

it was not entirely necessary to increase the population unless other variables of the research demanded it, which in this study was not the case.

In addition, the quantitative nature of the study limited the depth of understanding regarding the underlying reasons behind students' perceptions and experiences of e-learning. While the study was able to identify factors relating to perceived usefulness, perceived ease of use, behavioural intention and actual use of e-learning, the questionnaire design did not allow participants to elaborate extensively on the reasons underlying their responses. A qualitative or mixed-methods approach may therefore provide deeper insight into students' attitudes, motivations, challenges and experiences associated with e-learning within Radiography education.

6.4 RECOMMENDATIONS TO IMPROVE THE CURRENT STUDY

Researchers could use a qualitative methodological approach to obtain information on the students' in-depth perspectives and experiences on e-learning and their relationship therewith. The researcher could also consider interviewing a broader population group. Instead of including only Radiography students, students from other disciplines could also be included to assess whether the information received is applicable to Radiography students exclusively, or most students in general. A branch of research could be conducted on lecturers and hosts of e-learning classrooms to understand their perspective on the whole topic and the work that goes into the project from their angle. This could also provide students with a better understanding of why programs are structured in a certain way.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

In relation to future research, the researcher makes the following recommendations:

From this topic, it is evident that e-learning training programs should be created and offered to students in university, especially during their first year to enable

students to adequately use e-learning to their advantage. These programs could be offered as an introductory course for beginners and a more advanced course for frequent users. Performing such tasks could lead to the development of tech-savvy healthcare professionals, which could in-turn progress to completing tasks in a shorter period of time with less difficulty. This could be explored as a doctoral topic. The researcher hopes that this study will inspire future scholars to explore this topic in greater depth and that it will provide valuable insights to the academic community, serving as a stepping stone for further research.

This research study has shown that whilst there is significant research regarding the experiences of Radiography students with technology use for e-learning, there is ample room for further exploration of this topic. Technology, and therefore e-learning, is constantly changing with new developments and the frequent detection of errors. Therefore, research has to be conducted constantly to understand these technologies and their roles in the world of academia.

6.6. DISSEMINATION OF THE FINDINGS

The findings of this study will be disseminated through several academic and professional platforms. Firstly, the researcher intends to prepare a manuscript based on this dissertation for submission to a peer-reviewed journal focusing on Radiography, medical imaging or health professions education. Secondly, the findings may be presented at national and international academic conferences to share insights with researchers, educators and healthcare professionals interested in technology-enhanced learning within Radiography education. Finally, the findings will be made available to the Radiography department at the University of Technology where the study was conducted to inform future teaching practices and support the continued improvement of e-learning strategies for Radiography students.

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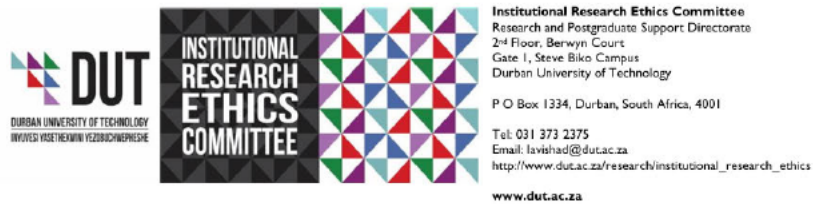
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APPENDICES

APPENDIX 1: DUT ETHICS CLEARANCE



23 September 2024

Ms A Patel
2 Torwood Drive
Hayfields
Pietermaritzburg

Dear Ms Patel

Factors influencing radiography students' experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal
Ethics Clearance Number: IREC 119/24

The DUT-Institutional Research Ethics Committee acknowledges receipt of your notification regarding the piloting of your data collection tool.

Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the DUT-IREC acknowledges receipt of your gatekeeper permission letter.

Please note that **FULL APPROVAL** is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the DUT-IREC according to the DUT-IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the DUT-IREC as outlined in the DUT-IREC SOP's.

It is compulsory for a student or researcher to apply for recertification on an annual basis. The failure to do so will result in withdrawal of ethics clearance. It is the responsibility of the researcher and the supervisor to apply for recertification.

Please note that you are required to submit a Notification of Completion of Study form together with an abstract to the DUT-IREC office on completion of your study.

Yours Sincerely

Professor P Mashau
Chairperson: DUT-IREC

APPENDIX 2a: LETTER REQUESTING PERMISSION FROM THE DIRECTOR OF RESEARCH AND POSTGRADUATE SUPPORT AT DUT



Date: 8th August 2024
IREC CLEARANCE NUMBER: 119/24

To: Dr V Govender
Acting Director : Research and Postgraduate

Madam,

Re: Permission to Conduct Research: Subjects Students at DUT

I am a student who is registered at DUT as per student numbers 21711143, in the Department of Radiography, Faculty of Health Science. My prior qualification is Bachelor of Health Sciences in Diagnostic Sonography and I am currently registered for my Masters of Health Sciences in Radiography.

I am required to research, investigate and compile a thesis in order to complete my Master's degree. As you are aware the completion of this thesis culminates in enriching students, enhancing the image of the university and finally, to contribute to students and also assist researchers.

The year 2020 has been a challenging year with the emergence of the Covid-19 pandemic however, with every impediment and challenge in life creates a breeding ground for innovation and initiatives. One of the significant outcomes of this period has been the difficulties for students to study and attend university as we have conventionally done during the prior years. This incited me, as a student, when deciding on a topic for the thesis, to investigate radiography students' acceptance of technology used for e-learning, as a medium of instruction.

For the research to be relevant, significant and valid, it will be required of me to survey first to fourth year radiography students of the DUT and these surveys will adhere to the following guidelines:-

1. I will request a time from the lecturers to distribute questionnaires to students.
2. I will hand students the questionnaires, wait for them to fill it in and collect it thereafter.
3. The venue for meetings with supervisors and lecturers at times will be at the DUT premises with prior arrangements being made.

4. The institution will be mentioned in the research however, I will strictly maintain confidentiality of the participants surveyed.
5. All research outcomes will not be disseminated outside the DUT without the prior written permission being sought first, if so required.
6. Students will be given a consent and authorization form to complete and sign prior to the surveys to ensure that they fully understand the nature and purpose of the survey.
7. Participants will also be given an information sheet so that they understand the details of the research being conducted.

If consent is granted to me, please confirm by signing the requisite authority hereunder.

Yours sincerely,

AISHA PATEL

Supervisor (DR S NAIDOO)

I, THE UNDERSIGNED _____, HEREBY GIVE CONSENT AND AUTHORITY TO AISHA TO CONDUCT HER RESEARCH AS OUTLINED IN THIS LETTER, WITH THE RADIOGRAPHY STUDENTS OF DUT.

_____ (Signed)

Dated: _____

APPENDIX 2b: APPROVAL LETTER RECEIVED FROM THE DIRECTOR OF RESEARCH AND POSTGRADUATE SUPPORT AT DUT



13 August 2024

Ms A Patel
c/o Department of Radiography
Faculty of Health Sciences
Durban University of Technology

Dear Ms Patel

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Gatekeeper Permission** for you to conduct your research "Factors influencing radiography students' experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal" at the Durban University of Technology. **Kindly note that this letter must be issued to the IREC for approval before you commence data collection.**

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

Upon completion of your research project, you are requested to share the summary of your key research findings.

Yours sincerely

Dr F Akpa-Inyang
(for) Dr V Govender
Director (acting)
Research and Postgraduate Support

APPENDIX 3: LETTER TO THE HEAD OF DUT REQUESTING PERMISSION TO CONDUCT RESEARCH



Date: 8th August 2024

To: Dr T Khoza
(Head of the Department of Radiography at the Durban university of technology (DUT))

Sir,

Re: Permission to Conduct Research :Subjects Students at DUT

I am a student registered at DUT as per student number 21711143, in the Department of Radiography, Faculty of Health Science. My prior qualification is Bachelor Of Health Sciences in Diagnostic Sonography and I am currently registered for my Master's of Health Sciences in Radiography.

I am required to research, investigate and compile a thesis in order to obtain my Master's Degree. As you are aware the completion of this thesis culminates in enriching students, enhancing the image of the university and finally, to contribute to students and also assist researchers.

The year 2020 has been a challenging year with the emergence of the Covid-19 pandemic however, with every impediment and challenge in life creates a breeding ground for innovation and initiatives. One of the significant outcomes of this period has been the difficulties for students to study and attend university as we have conventionally done during the prior years. This incited me, as a student, when deciding on a topic for the thesis, to investigate radiography students' acceptance of technology used for e-learning, as a medium of instruction.

For the research to be relevant, significant and valid, it will be required of me to survey the first to fourth year radiography (diagnostic and sonography) students of the DUT and these surveys will adhere to the following guidelines:-

1. I will request a time from the lecturers to distribute questionnaires to students.
2. I will hand students the questionnaires, wait for them to fill it in and collect it thereafter.
3. The venue for meetings with supervisors and lecturers at times will be at the DUT premises with prior arrangements being made.
4. The institution will be mentioned in the research however, I will strictly maintain confidentiality of the participants surveyed.

5. All research outcomes will not be disseminated outside the DUT without the prior written permission being sought first, if so required.
6. Students will be given a consent and authorization form to complete and sign prior to the surveys to ensure that they fully understand the nature and purpose of the survey.
7. Participants will also be given an information sheet so that they understand the details of the research being conducted.

If consent is granted to me, please confirm by signing the requisite authority hereunder.

Yours sincerely

AISHA PATEL

Supervisor (DR S NAIDOO)

I, THE UNDERSIGNED _____, HEREBY GIVE CONSENT AND AUTHORITY TO AISHA TO CONDUCT HER RESEARCH AS OUTLINED IN THIS LETTER, WITH THE STUDENTS OF DUT.

_____ (Signed)

Dated: _____

APPENDIX 4: LETTER OF INFORMATION FOR RADIOGRAPHY STUDENTS



LETTER OF INFORMATION

Title of the Research Study :

Factors influencing radiography students' experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal.

Principal Investigator/s/researcher:

Aisha Patel. Cellphone number: 0827953590 Email: aishapatel0003@gmail.com. Qualification: BHSc in Diagnostic Sonography.

Co-Investigator/s/supervisor/s:

Ms S Naidoo, Tel Number (W): 031 3732875, Cell Number: 0792252011, Email: nalenen@dut.ac.za. Qualifications: Master of Applied Sciences, B.Tech: Rad NM), HED(Tech), N.D.Rad.(D).

Brief Introduction and Purpose of the Study:

A challenge with e-learning faced in developing countries is lack of wireless connection, whereas in developed countries it is formulating e-learning strategies to keep up with the competitive global market. There are high levels of e-learning implementation at universities in South Africa however, many academics lack skills to properly use features of e-learning. There are no known studies regarding e-learning that has addressed the actual use of e-learning, perceived usefulness and ease of use of e-learning in the province of KwaZulu-Natal. The purpose of this study is to investigate the factors influencing radiography students' acceptance of technology for e-learning. The theoretical framework used is the Technology Acceptance Model (TAM). Positivism paradigm and quantitative methodology will be used. The chosen research design is a questionnaire. This study will be conducted at the Radiography Department at the Durban University of Technology in KwaZulu-Natal and will be performed on first-, second-, third- and fourth- year radiography students. Informed consent will be obtained. Participants may withdraw from the study at any point. The confidentiality of all participants will be maintained. The total sample population for the pilot study will be four students and the total for the main study will be 197 students. 135 diagnostic radiography, 19 sonography, 37 radiotherapy and 6 nuclear medicine students. The students will be recruited based on volunteers. The researcher will request a time from the lecturers and distribute questionnaires for students to complete after which they will be collected.

Greeting:

Welcome, you are invited to be a part of a research study regarding the factors influencing radiography students' acceptance of technology for e-learning at the Durban University of Technology in KwaZulu-Natal. This study will be carried out by Aisha Patel, who is currently completing her Masters of Health Sciences degree in Radiography.

Introduce yourself to the participant: I have qualified from the Durban University of Technology in the year 2021 with a BHSc in Diagnostic Sonography and I have decided to further my education by pursuing my Master's Degree of Health Sciences in Radiography.

Invitation to the potential participant:

I would like to invite you to participate in this research as it will provide new information regarding radiography students and e-learning. This information could be used to help students in the future by improving e-learning methods and it could also be used by other researchers to further their research.

What is Research

Research is a systematic search or enquiry for generalized new knowledge

Outline of the Procedures:

The aim of this quantitative cross sectional study is to explore the factors influencing radiography student's acceptance of technology for e-learning. Davis's technology acceptance model (TAM) will be used as the theoretical framework for this research. The data instrument used will be questionnaires. The data will be stored and only accessed by the researcher and the statistician. A participant will be able to withdraw from the study if or when they choose to do so without having to face any consequences. Informed consent will be obtained prior to the surveys. Participants will be expected to complete and sign a consent document (Appendix D) that will include all the information pertaining to the study. It will also include the rights of the participants and what is expected of them. The participants will include 197 radiography students in total from each level of study.

Risks or Discomforts to the Participant:

This research will not bring potential risks and discomfort to you.

Explain to the participant the reasons he/she may be withdraw from the Study:

The research may be terminated early in particular circumstances viz. Non-compliance, illness, adverse reactions, etc. You are entitled to withdraw from the study at any time should you wish to do so and will still continue to receive the appropriate standard of care. The researcher may, under certain circumstances, decide to withdraw you from the study if you do not comply in an ethical and appropriate manner.

Benefits:

There will be no direct benefit to the participant, however using the data they provide may result in the expansion of knowledge on this particular subject.

Remuneration:

You will not receive any remuneration for participating in the above study.

Costs of the Study:

There will be no monetary costs to yourself.

Confidentiality:

The confidentiality of all participants will be maintained throughout the study. Participants will be treated with respect, integrity and dignity, and will not be discriminated against. The researcher will ensure objectivity when analyzing data. The collected questionnaires will be collected and stored in a safe place by the researcher. Only the researcher will be able to access them. The researcher will hand it to the statistician for analysis after which it will again be collected by the researcher and stored away. The questionnaires will be destroyed five years after the Master's degree is obtained.

Results:

Once completed, the research dissertation will be accessible online on the DUT library website.

Research-related Injury:

There are no anticipated injuries or adverse reactions to the participants of this study.

Storage of all electronic and hard copies including tape recordings:

The researcher will collect and store the data in a safe place. The researcher will hand the questionnaires over to the statistician for analysis and collect them there after. All data will be destroyed five years upon completion of the Master's degree.

Persons to contact in the Event of Any Problems or Queries:

Please contact the researcher, Aisha Patel, on 0827953590. My supervisor Dr S Naidoo (031 373 2450) / nalenen@dut.ac.za or the DUT-Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Acting Director: Research and Postgraduate Support, Dr Govender, on researchdirector@dut.ac.za

APPENDIX 5: CONSENT FORM FOR RADIOGRAPHY STUDENTS



Appendix D: Consent Form

Full Title of the Study:

Factors influencing radiography students' experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal.

Names of Researcher/s:

Aisha Patel (BHSc in Diagnostic Sonography).

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Aisha Patel, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: 082 795 3590.
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

**Full Name of Participant
Thumbprint**

Date

Time

Signature / Right

I, Aisha Patel, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Researcher

Date

Signature

Full Name of Legal Guardian (If applicable) Date

Signature

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level- use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counselling (Department of Health, 2004).

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. a wrong date or spelling mistake, a new document has to be completed. The incomplete original document has to be kept in the participant's file and not thrown away, and copies thereof must be issued to the participant.

References:

Department of Health: 2004. *Ethics in Health Research: Principles, Structures and Processes* <http://www.doh.gov.za/docs/factsheets/guidelines/ethnics/>

Department of Health. 2006. *South African Good Clinical Practice Guidelines*. 2nd Ed. Available at: http://www.nhrec.org.za/?page_id=14

APPENDIX 6: QUESTIONNAIRE

Please use a tick for the most appropriate answer

STUDENT QUESTIONNAIRE

TOPIC: Factors influencing Radiography students'

experiences of e-learning: a study conducted at a university of technology in KwaZulu-Natal.

SECTION A:						
BIOGRAPHICAL AND DEMOGRAPHICAL DATA						
A1	Please state your age in years	<17	17-19	20-22	23-25	>25
A2	Indicate your gender	Female	male			
A3	Which discipline do you belong to?	D	US	NM	R	
A5	Which year are you registered for?	1 st	2 nd	3 rd	4 th	
A6	Please indicate your race	A	C	I	W	
SECTION B:						
PERCEIVED EASE OF USE						
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
B7	I have access to data or WiFi					
B8	My access to data or WiFi is adequately strong for e-learning					
B9	I am competent in my skills regarding the use of technology for e-learning.					
B10	The e-learning system provides ease to communicate with lecturers and my peers					
B11	Using an e-learning system requires training					
B12	E-learning courses are well structured and clear					
B13	Learning to operate e-learning systems are easy for me					

B14	I find it easy to orchestrate the e-learning system to do what I want it to do					
B15	My interaction with the e-learning system is clear and understandable					
B16	It is easy for me to become skillful with the e-learning systems					
B17	I found that e-learning is flexible to interact with					
B18	I have not experienced any problems with e-learning					
B19	Overall, learning to use an e-learning program does not require a lot of mental effort					
B20	I have complete control over e-learning technology					
B21	I do not easily get confused and flustered when using e-learning					
B22	I do not frequently err when using e-learning					
B23	Interacting with e-learning is not frustrating					
B24	I do not need to consult with friends or the internet often when using e-learning in order to understand concepts					
B25	I find it easy to recover from errors whilst using e-learning					
B26	E-learning systems often behave in unpredictable ways					
B27	Using e-learning has not become cumbersome					
B28	E-learning provides guidance on achieving my educational goals					

B29. On a scale of 1-10 rank your perceived ease of use of e-learning - where 1 is least easy and 10 is most easy.

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
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SECTION C: PERCEIVED USEFULNESS

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
C30	I use multiple programs for e-learning					
C31	I find e-learning to be advantageous to me					
C32	Participating in e-learning has improved my education and understanding of concepts					
C33	E-learning content is rich					
C34	Using e-learning will improve my education					
C35	Using an e-learning system will allow me to accomplish tasks more easily relative to classroom learning					
C36	Using e-learning will increase my productivity					
C37	Using e-learning will increase the effectiveness of my studying					
C38	Using technology for e-learning will make it easier for me to study					
C39	I find e-learning to be imperative to my degree					
C40	The time I invested in e-learning was worth it					
C41	I think that performing educational tasks occur faster with e-learning					
C42	The process of e-learning is simpler than traditional classroom learning					
C43	I think e-learning has more advantages than disadvantages					
C44	Using an e-learning system has led to my improved retention of tertiary educational content					
C45	I believe that studying would be a lot more difficult if I did not use e-learning					
C46	Using e-learning addresses my studying related needs					
C47	E-learning supports critical aspects of receiving a tertiary education					

C48	Using e-learning allows me to accomplish more tasks than otherwise possible					
C49	Using e-learning reduces the time I spend on unproductive activities					
C50	Using an e-learning system makes it easier for me to keep track of weekly educational tasks					
C51	An e-learning system allows me to better manage my time					
C52	Studying will become difficult without an e-learning system					
C53	I can accomplish a higher quantity of work by using e-learning relative to classroom learning					
C54	The quality of my work has improved with e-learning relative to classroom learning					
C55	Using e-learning streamlines the execution of my tasks					
C56	The e-learning systems provide sufficient content in order to complete my tertiary education					
C57	The e-learning systems provide relevant content					
C58	I find myself to be solely dependent on e-learning and no longer see the need for classroom learning					
C59	I encourage e-learning for the future generations					
C60	The switch to e-learning was necessary even without the onset of Covid-19					
C61	Classroom learning should eventually be obliterated					

C62. On a scale of 1-10 rank your perceived usefulness of e-learning - where 1 is least useful and 10 is most useful.

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
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SECTION D: ACTUAL USE/ BEHAVIOURAL INTENTION TO USE E-LEARNING

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
D63	The e-learning objectives are clearly stated					
D64	E-learning course difficulty is appropriate					
D65	E-learning course load is appropriate					
D66	I use e-learning quite often					
D67	I use technology for a variety of purposes, not just e-learning					
D68	I will recommend e-learning to other students					
D69	I will continue to use e-learning for as long as it's available					
D70	I intend to increase my use of technology for e-learning					
D71	I intend to use more technological devices for e-learning					
D72	I intend to invest more time in understanding how to use e-learning systems					
D73	I have the knowledge, resources and ability to use e-learning					
D74	I believe that using e-learning systems are beneficial to me					
D75	I think that transitioning to e-learning was a fruitful idea					
D76	I have a positive perception towards e-learning					
D77	I am making an effort to become more skillful in e-learning					
D78	I have purchased more technological devices to assist me with e-learning					
D79	The ease of use of technology is directly correlated to my actual use of e-learning					

D80	The usefulness of technology is directly correlated to my intention of actual use of e-learning					
D81	The cost of technological devices inhibits my actual use of e-learning					
D82	I can easily avoid distractions when using e-learning					
D83	Using e-learning systems does not lead to an increase in time taken to complete tasks					
D84	I feel more comfortable with e-learning relative to traditional classroom learning					
D85	I prefer to avoid physical interaction when studying					
D86	DUT has committed efforts to improve online learning systems					
D87	DUT has invested in increasing the number of technological devices that can be used to learn					
D88	I invest time in finding new methods to learn					
D89	Using e-learning is enjoyable					
D90	It is more cost effective to use e-learning					
D91	I use technological devices mainly for socializing / creativity relative to e-learning					
D92	I find that constantly using e-learning does not negatively affect my health e.g., headaches, eyesight problems, etc.					
D93	Fortunately, I am able to afford technology used for e-learning					
D94	I have a sufficient number of devices to ensure effective e-learning					
D95	I do not feel more prone to mistakes when using e-learning instead of classroom learning					

D96	I see a rapid increase in e-learning in the near future.					
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D97. On a scale of 1-10 rank your behavioural/actual use of e-learning. 1 being the least amount of time and 10 being the most amount of time spent on e-learning.

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
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END!

My sincere and heartfelt gratitude goes towards everyone who has completed this survey in the interests of the progress of research in the health sciences field, specifically Radiography.

APPENDIX 7: ETHICS CERTIFICATE



Zertifikat Certificat

Certificado Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants



Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Aisha Patel

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2020/11/18
CID: 120396/542g

PROFESSEUR DOMINIQUE SPRUMONT
Coordinateur TRREE Coordinator



Continuing Education Program (CEP)
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(REV - 20170110)