ASSESSING TECHNOLOGY ADOPTION AT A UNIVERSITY OF TECHNOLOGY: A CASE STUDY OF ELECTRONIC RESPONSE SYSTEM

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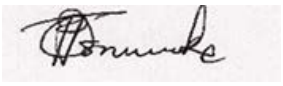
Declaration

I, Onalenna Pearl Tsumake, hereby declare that this work has not been previously accepted in substance for any degree and is not being concurrently submitted for any degree. This dissertation is being submitted in fulfilment of the requirements for the degree Master's in Information Technology at the Department of Information Technology, Central University of Technology, Free State. This dissertation is the result of my own work, except where otherwise stated. Other sources are acknowledged by giving explicit references. A reference list is appended.



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Dedication

I dedicate this project to God Almighty, my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this program and on His wings only have I soared. I also dedicate this work to my husband, Adrian Kabuya Kasongo who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started. To my child, Naledi Esther Kasongo who has been the main motivator in the last chapters of completion to do everything and to work harder, I thank you and God bless you.

Abstract

Technology adoption is defined as accepting and using a new technology in order to improve delivery, service or performance. One such new technology is an Electronic Response System, called clickers that may be used to leverage classroom participation. ERS is a system that consists of a device used by students in conjunction with an electronic USB transceiver, connected to a personal computer. One of the advantages of ERS is to help passive students become more actively engaged with course material during classroom time, while helping academics to monitor student learning. Despite the advantages of using ERS in education, some academics fail to adopt this new technology into their teaching practice. This study aims to present factors that may help to promote the use and adoption of an ERS at a University of Technology. A non-experimental research design, incorporating a descriptive case study with quantitative data is used with convenient sampling. A small-scale preliminary study was undertaken in order to test the questionnaire as the main data collection instrument. A convenient sample of 20 academics from the Central University of Technology participated in this. A total of 57 academics then participated in the main study, using a questionnaire structured around the four main constructs of Venkatesh's Unified Theory of Acceptance and Use of Technology (UTAUT) model.

The four constructs are Performance Expectancy, Effort Expectancy, Facilitating Conditions and Social Influence. Performance Expectancy is the level to which an individual believes that using the system will help him or her to achieve achievements in job performance. Effort Expectancy is defined by the level of ease regarding the use of technology sustained in systems. Social Influence is defined as the level to which an individual perceives the importance of a technology, based on the perceptions of others. Facilitating Conditions refers to the extent to which a person perceives that a technical and organizational infrastructure is available for the intended system. The UTAUT model aims to explain user intentions to use an information system. The main advantage of this model is that it focuses on user behaviour towards new technologies. Three of the four variables in the UTAUT model were selected, being age, experience and gender. The fourth variable, voluntariness of use, was not included as it is associated with mandatory use of a new technology. This is not applicable to this study as academics have the freedom to choose whether to adopt ERS or not, into their teaching practice.

Statistical results suggest that there is a strong relationship between Performance Expectancy, Effort Expectancy and Facilitating Conditions towards the use of ERS. Social Influence has a moderate relationship in this regard. The results also indicate that age, experience or gender, play no significant role in the adoption of such a system. Based on these results, there is a need to create awareness among all academics, irrespective of their age, experience or gender, of the importance of adopting ERS in their teaching practice to further student learning.

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List of Abbreviations

CUT	-	Central University of Technology
ERS	-	Electronic Response System
ICT	-	Information Communication Technologies
IT	-	Information Technology
PU	-	Perceived Usefulness
IDT	-	Innovation Diffusion Theory
TAM	-	Technology Acceptance Model
TTF	-	Task-Technology Fit
TRA	-	Theory of Reasoned Action
TPB	-	Theory of Planned Behaviour
UoT	-	University of Technology
UTAUT	-	Unified Theory of Acceptance and Use of Technology

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

Universities and other organisations have embraced the use of emerging technologies as a way to improve quality education and to create more opportunities in the teaching and learning environment. Emerging technologies have especially made it easy to manage large groups of students who enrol at institutions of higher learning. According to Johari and Bradshaw (2008), other emerging technologies include artificial intelligence, block chains and cloud computing as effective means of boosting performance and productivity. The development of these emerging technologies are also a key to promote the economy and have become one of the strongest competitive factors among countries (Li, et al., 2019). Technology is studied as a resourceful and powerful motivator in enhancing learning through the use of several motivational techniques, with e-learning as an example. The purpose of new emerging technologies are often utilised to accommodate students with diverse learning styles, enabling them to work before or after school times. This technology improves the educational productivity by accelerating the rate of learning and reducing the costs of instructional materials. It further provides interactivity amongst students through immediate formative feedback and conceptual understanding is effective to help student learning (Friedman B, 2007).

According to Deputy Director, Federicon Johansen of Belgrano Day School, one of his teachers uses technology with video screens and interactive whiteboards in most of the classes (Newbery, 2013). This strengthens student learning as they engage more fully with multi-sensory hands-on techniques and methods. The results of this report point to increased student engagement, school attendance and higher test scores. These tools have become more useful to support interactive engagement and to test students' understanding of their current knowledge and collaborative activities. Not only does technology make it easy to manage large groups of students enrolled in a University, but also the response from students is positive as they perceive classroom time to be more interactive (Morrison, 2012). It is through e-learning that some educational platforms have been rolled out, which include mobile apps for Blackboard, Moodle, wikis, online videos and Electronic Response System (ERS). An ERS consists of a device used by students or academics in a classroom or workshop setup, commonly known as "clickers", which works in conjunction with an electronic USB transceiver connected to a personal computer. This system aims to help passive students become more actively engaged with course material during classroom time. ERS also help to monitor attendance, either directly or

indirectly, by determining which students used the clickers. It is an effective method for fostering student collaboration that makes it easy to adopt, helping to improve student learning of the course content.

Lecturers have discovered how an ERS helped in explaining certain concepts among students and in enhancing participation amongst large student groups during classroom lectures. They are being widely used in large or small groups in universities and companies as tools to enhance student engagement, by promoting critical thinking and problem-solving skills during lectures (Dantas, et al., 2009). Researchers explored the use and contribution of an ERS at different universities, while others assessed its effectiveness, some for comparative purposes. This was done to try and improve the quality of education (Hedgcork, 2014). The results revealed that student learning styles continue to evolve, with 64% of students agreeing to bring their own digital devices to classroom lectures, favouring small and portable devices for the classroom. Armbruster, Patel and Weiss (2009) focused on the use of an ERS in terms of the effectiveness of assessment, the development of educational pedagogies and the attitude of academics towards using such a system in an introductory Biology class. The most common concern voiced by multiple faculty members involved in the course were poor student attitudes, which was due to the fact that students were not satisfied with the course as they did not recognise the importance of it. Some students further felt that the lecturers were ‘boring’. The use of an ERS helped improve the learning environment, as a continual process of analysing students’ abilities to gauge their understanding of content was realized (Moss & Crowley, 2010).

Furthermore, a survey conducted by Aime and Levesqu (2011), was used to gather anonymous student responses to different questions, posed in a classroom towards the effectiveness of ERS, which was rated by 88% of the respondents as effective in the teaching and learning process. Despite the advantages of using an ERS as reported in the literature of Kathleen and FitzPatrick (2011), insufficient studies have been conducted to assess factors that may influence adoption of an ERS among University students and academics. Technology is regarded as an essential tool in improving competitiveness of companies and higher educational institutions, which also involves information technology in a broader aspect. Information Technology (IT) is the application of computers and telecommunications equipped to store, retrieve, transmit and manipulate data often in the context of a business or higher education. It is important, therefore to understand the determinants of IT adoption and the theoretical models that have been used in this regard. Limited publications exist from the South African context, which compares

different IT adoption models at the individual level, with even a smaller number at the firm level.

1.1.1 Technology Adoption models

Information Communication Technologies (ICTs) have contributed to the socio-economic development of communities and universities (Turpin, et al., 2013). Preliminary investigations indicate that higher education has been transformed by ICTs, which include ERS (Laxman, 2011). However, despite the impact of an ERS to enhance teaching and learning in higher education, IT adoption models for measuring technology adoption need to be applied. Some of these models include the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB) model, the Initial Trust Model (ITM), the Task Technology Fit (TTF) model and the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Each of these models was developed for a specific goal as discussed below (Venkatesh & James, 2012).

The Technology Acceptance Model (TAM) was developed by Davis (1989), and then extended to TAM2 by Venkatesh and Morris (2003) and to TAM3 (Venkatesh & Bala, 2008). According to Ajzen and Fishbein (2000), TAM assesses the attitude and behaviour of individuals towards technology, using the human action-guided categories. Moss and Crowley (2010) added new variables (e.g. playfulness) to study acceptance of the World Wide Web. A study done by Agarwal and Karahanna (2000) at AMA International University added cognitive absorption, playfulness and self-efficacy to the TAM model, while Chau (1996) reviewed TAM by including two types of perceived usefulness: near-term and long-term and perceived ease of use.

The reason TAM was developed was due to the fact that a number of factors influence people's decision about how and when to use a specific technology. One of the advantages of TAM is consistent with Everett Rogers's (2010) theory on Diffusion of Innovations (DOI) where technology adoption is a function of a variety of factors, including relative advantage and ease of use. According to TAM, ease of use and perceived usefulness are the most important determinants of actual system use. These two factors are influenced by external variables, such as social, cultural and political factors. Social factors include language, skills and facilitating conditions, while cultural factors are identified as a blind spot that relates other cultural beliefs and values within the technology. Political factors measure the use of technology on politics, which are extensively expressed in social media (Facebook, Twitter, forums and blogs). One of the major critics for using TAM is that it does not provide sufficient information on individuals' opinions about novel systems (Ramayah & Ignatius, 2005).

The Theory of Planned Behaviour (TPB) was developed in 1980 by Icek Ajzen who started to predict an individual's intention to engage in behaviour at a specific time and place. TPB helps researchers to better understand the role of subjective norms and perceived behavioural control. It distinguishes between three types of beliefs, namely behavioural, normative and control and the model comprises of six constructs: attitudes, behavioural intention, subjective norms, social norms, perceived power and perceived behavioural control. The advantage of TPB is that, when simplified, it provides a more accurate theory, explaining human behaviour, beliefs and attitudes in other fields, like healthcare. The disadvantage of TPB is that it does not account for other variables that factor into behavioural intention and motivation (Dillion & Morris, 1996). Venkatesh and some of his colleagues (2003) formulated the UTAUT model as a synthesis of its predecessors and described technology use under the influence of use intention. The TPB is an extension of Theory of Reasoned Action (TRA), which includes behavioural control as a construct to measure and account explicitly for the extent to which users have complete control over their behaviours. The TRA is one of the three standard persuasion models of psychology and is also used in communication discourse as a theory of understanding persuasive messages (Sheppard & Sheppard, 1988).

The Initial Trust Model (ITM) was developed to explore the influence of end-customer attitude towards a product. It was developed by Kim (2009) to establish the direct effects of initial trust, attitude and technology characteristics of mobile banking adoption. One of the features of initial trust is "personality-based trust", which is defined as the tendency of a person to believe that they may or may not trust a product due to certain factors (Jason, et al., 2007). Environmental forces, such as service guarantees, also contribute to enhancing trustworthiness in a specific technology or product.

The Task Technology Fit (TTF) model was developed Irick (2008) as a way to demonstrate that users do adopt new technologies to execute tasks efficiently. Hence, the adoption of a new information system depends greatly on the users' daily tasks. This model explains adoption, using four constructs – task characteristics, technology characteristics, task technology fit and use. The advantage about this model is that it's widely applied in information systems that are powerful to analyse adoption and user behaviour of an innovative IT artefact in a specific context. The disadvantage of the model is the performance-based impacts, which are at times difficult to measure.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is a technology acceptance model, formulated by Venkatesh et al. (2003). The UTAUT model aims to explain user intentions to use an information system and ensuing user behaviour and the main advantage of the UTAUT model is that it focuses on usage as a key dependent variable. This model has served as a baseline model and has been applied to the study of a variety of technologies in both organisational and non-organisational contexts. The model consists of four main constructs, namely Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions. The first three are direct determinants of usage intention and behaviour, and the fourth is a direct determinant of usage behaviour. Gender, age, experience, and voluntariness of use are hypothesized to moderate the effect of the four key constructs on usage intention and behaviour. Performance Expectancy is the level to which an individual believes that using the system helps him or her to achieve achievements in job performance. Effort Expectancy is defined by the level of ease regarding the use of technology sustained in systems (BenMessauod, et al., 2011). Social Influence is defined as the level to which an individual perceives that using a system is important to him or her. Facilitating Conditions refers to the extent to which a person perceives that technical and organisational infrastructure is required to use the intended system (Ghalandari, 2012).

In this study, when applying the constructs using the age, we were expecting the younger lecturers to have more influence and interest in using an ERS than the older generation lecturers since youngsters adapt fast to technology and this easily influences others. Experience can also moderate the relationship between Facilitating Conditions and Behavioural Intention while greater experience can lead to better familiarity with an ERS and better understanding of structures to facilitate user learning, reducing external reliance (Venkatesh & James, 2012). Performance Expectancy is measured by the ability of lecturers to be able to fulfil their job responsibilities using an ERS and this contributes to Behavioural Intention, depending on the gender assessing the usage of the system. With Facilitating Conditions, in this study, we expect that resources and support be available to assist lecturers to perform their duties which may be moderated by age and gender towards the usage of the system. In this study the researcher uses ERS instead of Electronic Response System. The objective of this study is to use the UTAUT model along with the extended constructs to assess factors that may influence the adoption of ERS among University students and academics, as it is a model that is easily adapted to a diversity of studies (Sundaravej, 2003). The UTAUT model is selected from various theoretical models as a result of its ability to adapt to diverse studies, as well as being capable of helping to understand complex technologies (Sundaravej, 2003). Different researchers across a range

of studies have tested the UTAUT model with the aim of contributing towards the validity and applicability of the constructs (Sarah-Jane & Gaby, 2013)

Figure 1.1 demonstrates the original UTAUT model and its four main constructs, namely Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions (shown in white). The bottom concepts (known as moderators) shown in blue are: gender, age, experience and voluntariness of use, which determine the use of behavior towards the system.

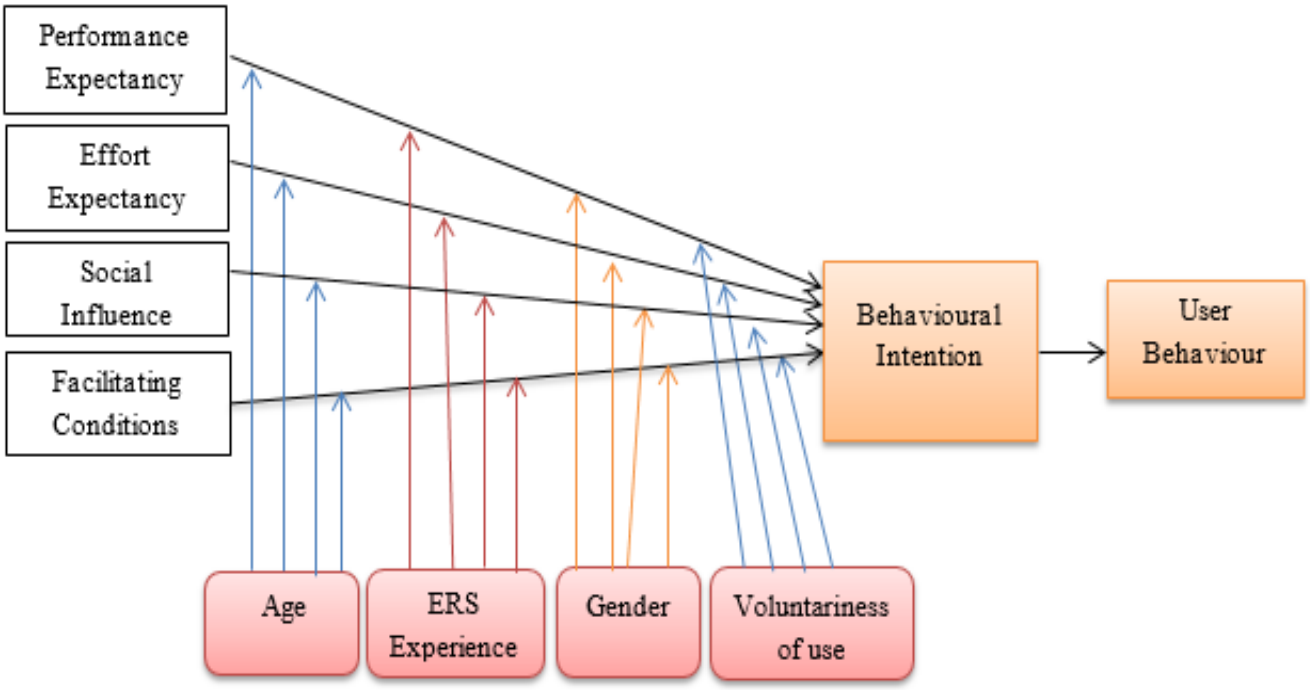

Figure 1. 1 UTAUT model and its original constructs

Voluntariness of use is not considered as a moderator in the extended UTAUT model as the adoption of an ERS is seen to be a voluntary act, and not a compulsory one. A similar study by Muhayiddin et al. (2011) also excluded voluntariness of use where the adoption of an electronic payment system was evaluated, as its use would be purely voluntary in nature. In this study, the UTAUT model is used to focus primarily on the technology adoption of an ERS in education.

1.1.2 Electronic Response System

Figure 1.2 shows the operation of an ERS. Each student has a handheld response card, or clicker, with which they use to answer questions shown in a PowerPoint presentation. Students answer with their handheld device, which may be a hardware response card, their phone or

tablet, or even a laptop. The receiver prompts responses from students that allow lecturers to change the dynamics of what might be a tiresome lecture period (Simelane & Dimpe, 2011).

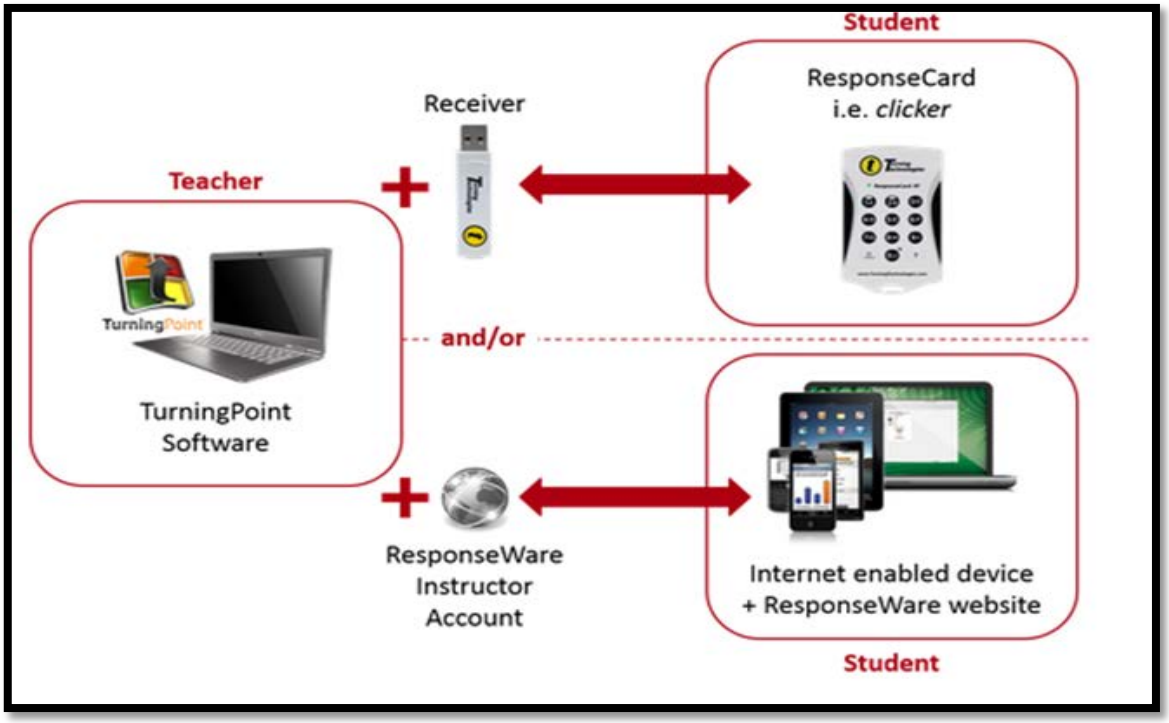

Figure 1. 2 An Electronic Response System

1.2 PROBLEM STATEMENT

The adoption of an ERS among academics at a University of Technology in South Africa is not well reported on, which may be due to negative perceptions of the use of this educational technology. Promoting the adoption of an ERS by academics at a University of Technology has the potential to overcome the challenge of poor student engagement, thereby enhancing students' cognitive thinking abilities! The problem statement for this study reads: "The adoption of an ERS at a University of Technology in South Africa is unsatisfactory, which may be accredited to specific unestablished learning factors".

1.3 RESEARCH QUESTIONS

This study aims to present factors that may help to promote the use and adoption of an ERS at a University of Technology. The following research question therefore exists: "How can the UTAUT model be applied and extended to promote the adoption of an ERS at a University of

Technology?" To unambiguously answer the main research question, the following sub questions need to be answered:

i) What are the factors that may influence the adoption of an ERS at a University of Technology?
ii) What is the degree to which academics believe that using an ERS will improve their job performance?
iii) What factors influence academics to perceive an ERS as difficult to use?
iv) To what extend does Social Influence affect academics' use of an ERS?
v) To what extent do academics feel that they have enough support to use an ERS?
vi) Are academics at a University of Technology behaviourally inclined to use an ERS?

1.4 RESEARCH OBJECTIVES

The main aim of the study is to establish factors that influence the adoption of an ERS at a University of Technology. Given the lack of research on the adoption of ERS at Universities of Technology, the following research objectives are envisaged:

To determine the factors associated with the adoption and usage of ERS by academics using variables in the UTAUT model.

To extend the original UTAUT model and improve the system by proposing new constructs that influences adoption.

To evaluate these constructs relating to the adoption of ERS in terms of academic gender, age and years of experience.

1.5 IMPORTANT DEFINITIONS

The following are important definitions that will be used throughout the dissertation:

Academic - a teacher or scholar in a University or other institute of higher education (Henard & Leprince-Ringuet, 2008).

E-learning - using a computer to distribute the entire course content, or a part thereof, either for a school, a company or full distance learning institute (Husaj, 2015).

ERS - Electronic Response System, which is a type of communication link between a user and a computer, facilitating interactivity between a broadcaster and a specific audience. Systems

for co-located listeners combine wireless hardware with presentation software, and systems for remote listeners may use telephones or web polls for audiences watching through the Internet (Caldwell, 2007).

WEBCT - a Blackboard-based Learning Management System that facilitates the creation of sophisticated World Wide Web-based educational environments. It can be used to create entire on-line courses, or to simply publish materials that supplement existing courses (Pritchett & Pritchett, 2013).

UTAUT - the Unified Theory of Technology Acceptance is a technology acceptance model formulated by Venkatesh and others that aims to explain user intentions to use an Information System as it focuses on usage as a key dependent variable. (Venkatesh & James, 2012).

UoT - a University of Technology is a designation employed for a wide range of learning institutions awarding different types of degrees at variable levels of the educational system. It may be an institution of higher education, an institution for advanced engineering and scientific research or a professional vocational institution (Kathleen & FitzPatrick, 2011).

1.6 VALUE OF THE RESEARCH

This study contributes to the body of knowledge for the UTAUT model by establishing factors that promote adoption of an ERS in the University for teaching and learning. The findings of the study can help response system developers to improve existing systems and the application of the UTAUT model in the adoption of response systems for learning in tertiary institutions and appropriate amendment of the theory in this context. This study benefits the lecturers and universities at large to improve the methods of delivering information to students and for an increased participation of students.

ERS has proven to demonstrate improved student performance on exams results and undergraduate science classes (Trujillo & Tin, Tin, 2011). They have an impact on student learning interaction and have enhanced the level of understanding. An ERS also improved the conceptual understanding of the students and the approach is question-driven as to develop the analytical thinking. The exam or test questions play a huge role in displaying knowledge and information enabling interaction of different student groups to argue their various opinions and intuition to eventually arrive at a solution (Levesque, 2011).

1.7 METHODOLOGY AND RESEARCH DESIGN

The research site is limited to the Central University of Technology (CUT) and involves a mixed data collection approach within an exploratory case study. Quantitative methods are used to collect data in order to understand the research concepts and problem (Plano-Clark & Catherine, 2008). Quantitative approach was chosen to be the primary approach for this study to examine and study the proposed research model. Quantitative data is collected by means of a questionnaire which is developed using the constructs of the UTAUT model.

In the pilot study, a small scale preliminary study was undertaken in order to test the questionnaire as the main data collection instrument. A convenient sample of 20 academics from CUT participated in this. A pilot study usually examines the feasibility of an approach that is intended for a main study (Leon, et al., 2011).

In the main study, the questionnaire is administered to academics from all four faculties at CUT, including Health Sciences, Engineering and Information Technology, Management Sciences and Humanities. Convenience sampling is used since it's fast, easy and cost effective with data readily available for the desired group of participants (Farrokhi & Hamidabad, 2012). The researcher sent a list of research questions to academics that completed the questionnaire in order to analyse and answer the research questions of the study. A sample size of 80 is envisaged for the study. Statistical analysis of the data is undertaken to determine significant relationships, which exist between the five different constructs that make up the extended UTAUT model. Quantitative approach is then used to triangulate the data. Triangulation is defined as a combination of at least two or more theoretical perspectives, methodological approaches, data sources and data analysis methods (Yeasmin & Rahman, 2012). The benefit of using this method is that it decreases the deficiency of a single strategy and increases the ability to interpret the results effectively. Figure 1.3 below shows the proposed UTAUT model with the additional constructs that are to be considered.

In this study, the model is extended by adding Digital Inclusion, which affects the behavioural intentions of individuals to adopt ERS's. The study is conducted within the interpretive research paradigm.

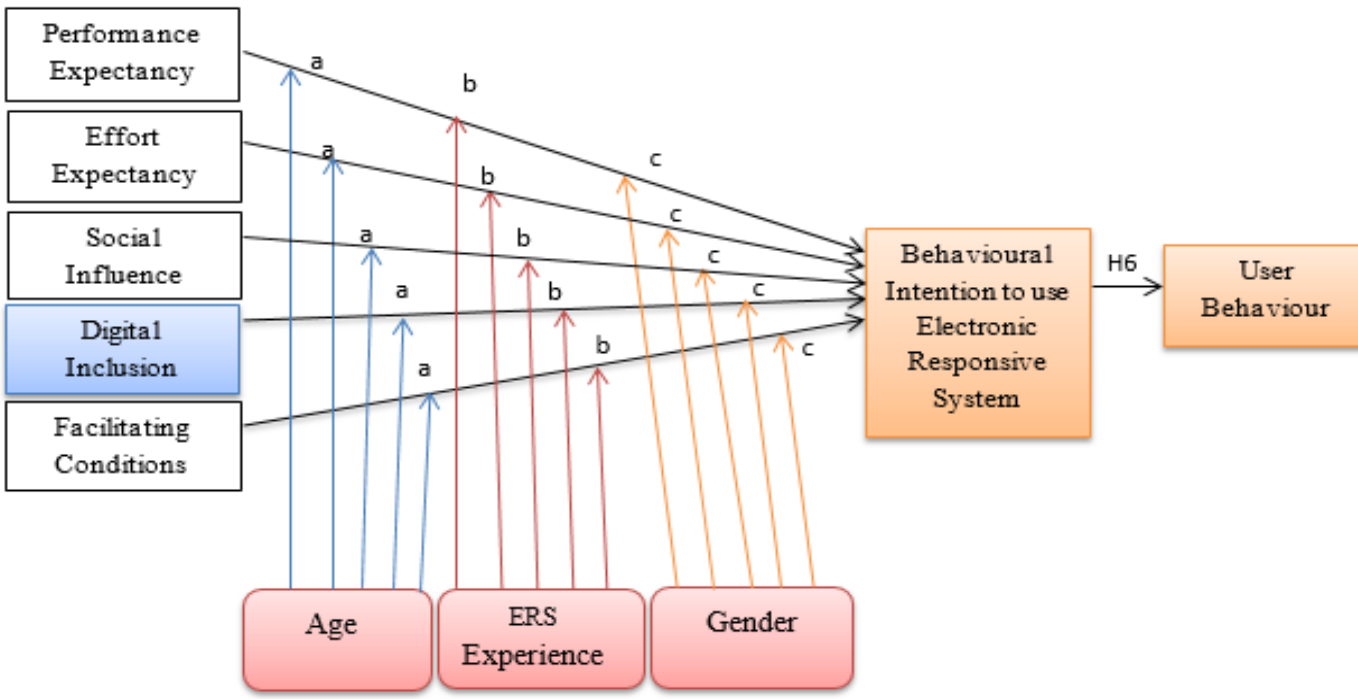

Figure 1. 3 Original UTAUT model with the additional construct

Interviews and questionnaires are the primary data collection techniques. They are used to determine factors that promote the use of ERS's guided by the UTAUT model. Data for the main study is collected from academics in all four faculties at CUT. This ensures that results are obtained from academics of different age groups and with different levels of education and expertise. The focus may be on gathering personal opinions on the use of ERS in education.

1.8 DELIMITATIONS

The researcher may not include the technical description or development of an ERS. The research excludes certain departments at CUT, due to the fact that limited ERS exist in all the faculties, due to financial constraints.

1.9 RESEARCH OUTLINE

This dissertation is divided into five chapters as shown below:

Chapter 1: This chapter covers the introduction by outlining the background of the study, the research problem, the objective of the study, the research questions and approach.

Chapter 2: This chapter presents the literature review, background information about ERS and research from different writers in assessing its effectiveness.

Chapter 3: This chapter presents the methodology and data collection techniques, giving a summary of the statistics which are to be used in the analysis.

Chapter 4: This chapter focuses on the findings of the study along with appropriate discussions.

Chapter 5: This chapter focuses on concluding the thesis, summarizing the previous chapters and providing key recommendations.

1.10 SUMMARY

In conclusion, chapter 1 covered the background information of emerging technologies in Higher Education and its potential to improve the quality of education. This chapter further discusses the different kinds of Technology Adoption Models available, identifying the UTAUT model with new constructs that are to be used in the study. The problem statement outlines the unsatisfactory use of certain types of technology, especially with regard to the use of an ERS at a University of Technology in South Africa. The research questions of the study aim to establish factors that influence the adoption of an ERS at a University of Technology. The target population is limited to academics at CUT where a mixed methods approach is used to collect the data.

Chapter 2 presents the literature review regarding the importance of e-learning, with particular emphasis on ERS. This research may consider existing traditional methods of teaching used in a University of Technology in South Africa.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 outlined the use of Electronic Response System (ERS) as new technology in universities and across the globe to be an important use and to have several benefits to the students and instructors. The chapter further explained concise benefits of ERS as one of the new technology. It further continued to outline the need to improve instructional delivery through technology use and demonstrated with arguments for instructors to adapt to new technologies and to improve classroom participation. The chapter concluded by discussing the UTAUT model as the theory used to assess the factors that promotes the adoption of an electronic response system.

Chapter 2 explains the meaning and the importance of technology, especially in the higher education sector, for Universities in South Africa. This chapter discusses the importance of technology in higher education and the importance of technology adoption. It provides an overview of various adoption models, focusing on the UTAUT model. It further discusses the theoretical framework of the study and explains the use of ERS. The chapter finally summarises the literature review.

2.2 THE IMPORTANCE OF TECHNOLOGY

Technology is defined as a branch of knowledge that includes the use of resources, tools, methods and sources of control, to make life easier and work to be more productive (Choudhury & Barman, 2014). Many researchers state that technology is used both in everyday life and educational environments. While digital technologies are used for fun and communication, they are also used in education and provide a learning process for both teachers and students (Fezile, 2017). The current generation is enticed with technology and quick ways of accessing information, playing games and working with digital devices. The technology has impacted different generations over the years. According to Pew Research Center, they analysed the millennial generation in a meaningful way, and to begin looking at what might be unique about the next cohort. The Pew Research Center decided to use 1996 as the last birth year for Millennials for our future work. Anyone born between 1981 and 1996 (ages 23 to 38 in 2019) is considered a Millennial, and anyone born from 1997 onward is part of a new generation. Since the oldest among this rising generation are just turning 22 this year, and most are still in

their teens or younger, we hesitated at first to give them a name – Generation Z, the iGeneration and Homelanders were some early candidates. (Dimock, 2019)

This current generation is often called the Y-generation that uses technology at a high rate with just a click of a button. We define Generation Y (broadly) as all people born between 1981 and 1999 – regardless of their environments and have typically focused on the social media usage patterns of young people of a moderately high socio-economic status who live in developed countries (Bolton & Parasuraman, 2013). Technology has assisted to connect people from all over the world and has improved the communication, strengthened work productivity and improved efficiency. In the modern workplace, employers have experienced a shift in how time is spent to improve productivity, increased collaboration, improved cost management and heightened levels of security (Becker & Rajwani, 2016).

Improved productivity has led to more research to investigate the use of technology and to understand the use of electronic devices. This discovery (use of technology) has lead researchers to use technology in many forms across the world through the internet like social networking, the use of internet for job hunting and distance learning in the education sector of universities (Ramey, 2013). The advance of technology has also resulted in digital natives.

According to Ramey (2013), a "*digital native*" applies to a new group of students enrolling in educational establishments who are "*native* speakers" of the *digital* language of computers, videos, video games and social media. Digital natives normally relate to someone who grows up in the digital age and being familiar to digital systems. For example, students and children raised in digital age and who are familiarised to the systems. Digital immigrants (people born before the introduction of digital technology) may not be that inclined to use technology. This group of people normally involves our older age groups, or middle-aged groups. Table 2.1 shows a comparison between the digital native and digital immigrants and are faced by both.

Technology is used worldwide in the different sectors of industries across the world and it has benefited people greatly. The following are some of the areas which technology has advanced significantly to hasten things and improve ways of living amongst people:

- Health sector

  Information gathering machines, treatments and communications have given medical workers new tools to work with and fresh ways to exercise medicine for better treatment and help doctors to make better decisions about patient's problems (Ventola, 2014).

- Banking systems

  E-banking has enabled to make the bank system open to all consumers; banks have used a Graphical User Interface (GUI) with this software; consumers can access their bank details on their own computers; make money transmissions from one account to another (Siddiq, 2015).

- Retail Shops

  In retail, technology gives you the platform to better satisfy your customers by helping you concentrate on their needs. Through technology a happier customer means more business with the capability to interconnect digitally with customers (Hoopwood, 2019).

- Roads and engineering

  Technology that uses civil engineering to accomplish the safe and effective movement of people and goods on roadways. It concentrates mainly on research for safe and efficient traffic flow, such as road geometry, sidewalks and crosswalks (Glenn & D'Agostino, 2008).

- Education systems

  Education systems have enhanced teaching and learning through collaboration, distance learning and even advanced the level of engaging students in classrooms through the use of technology (Majumdar, 2006). Education systems have included some added advantages to higher education among instructors and students using education technology and its resources. This has improved productivity and communication across the world and in higher education.

Table 2. 1 Comparison table for Digital Natives and Digital Immigrants

Digital Natives	**Digital Immigrants**
Prefer to text more via message than to call	Prefer more to talk in person than calling
Digital natives prefer receiving information quickly and simultaneously from multiple multimedia and different sources	Digital immigrants take time to adapt or receive information slowly, linearly and sequentially
They may prefer interacting with video, sound and pictures before text	They may prefer reading text books to process information from sound, video and pictures
Prefer asynchronous communication	Prefer synchronous communication

In the education sector, different technology methods exist to deliver education to the students, and include learning management systems (Blackboard and Moodle), mobile learning (iPads and smartphones), simulation models (MS Excel and MATLab) and handheld ERS (clickers).

These technology methods have contributed greatly to the education system with more added advantages and simplifying the work of instructors and increasing student engagement especially an ERS.

2.3 ADVANTAGES OF TECHNOLOGY IN EDUCATION

Educational technology is the study of application of appropriate tools, techniques, or processes that facilitate the application of senses, memory and perception to enhance teaching practices and improve learning results (Chris, 2010). It includes instructional materials, methods and organization of work and relationships, i.e. the behaviour of all participants in the educational process. It offers the opportunity for instructors to become more collaborative and extend learning beyond the classroom. According to Mdlongwa (2012), technology has encouraged more opportunities to instructors to become more collaborative and to even extend learning beyond the classroom and this has included some advantages to education technology. The following are some advantages of using technology in education:

- Foster collaborations and engagement

  Educators have created learning communities composed of students through technology; fellow educators in higher education, museums, libraries and after-school programs (South, 2017).
- Improved resources and quality education

  Elevations of new improved teamwork amongst instructors, facilitated by technology offers, access to instructional resources, as well as the materials and tools used to create, manage and assess the quality and usefulness (Majumdar, 2006).
- Improved learning skills

  Universities support instructors in accessing the needed resources through technology in learning how to effectively use it (Granberg, 2010).
- International learning opportunities

  It enables collaborations with other instructors without any restrictions across the borders. They join across communities to enlarge their perspectives and create opportunities for learning (Lithuania, 2015).
- Encourages creativity in creating one's own content

  Students are challenged to think outside of the box to come up with creative solutions to present a solution to a problem (Swart, 2015).
- Enriches the learning experience

The more exposure to technology, the faster one learns to master these technologies and engage more with the course content, leading to an improved learning experience (Swart, 2015).

- Builds online skills

  The education technology equips students and instructors to have online skills and it enables more interaction use over the internet (Glenn & D'Agostino, 2008).

According to Bimber et al. (2009), history has indicated that instructors have the biggest impact on student learning out of all education factors. Therefore, it is crucial for instructors to be updated with the latest education technologies to easily incorporate technology-based learning practices into their teaching practice (Moeller & Reitzes, 2011). Figure 2.1 demonstrates the relationship between leadership, assessment and teaching and how technology may be used to facilitate teaching and learning. The leadership set the vision for the University, the ways in which instructors and students will communicate via technology and the expectations from the instructors to deliver relevant content to the students. Assessment is the process of collecting and discussing information from multiple and diverse sources, in order to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences (Terenzini, 2015).

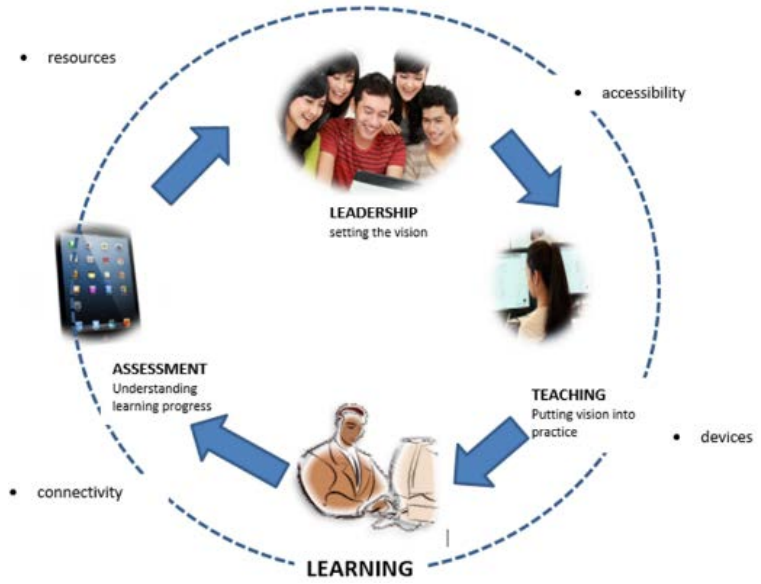

Figure 2. 1 The learning process between students and academics (Duncan, 2016)

Instructors may achieve assessment of this through the use of classroom examinations, computers, learning management systems, smart phones, tablets, reports, assignments, etc. The circular motion of executing information through resources, easy accessibility and connectivity

amongst lecturers and students enables teaching and learning to be carried out in a classroom setup or outside using technology resources. This figure demonstrates how teaching, learning and assessment may easily be facilitated through the use of technology, which has resulted in a number of benefits as discussed above. However, some disadvantages to technology in education also exist.

2.4 DISADVANTAGES OF TECHNOLOGY IN EDUCATION

Instructors can design highly engaging and applicable learning practices through technology (Moeller & Reitzes, 2011). However, technology has also proved to have some negative effects in higher education, including the following:

- Access to inappropriate content: Technology has made searching for information easier for students, exposing them to various forms of information including pornography and violence. This has concerns as some of the material is shared with other students while in the classroom (Lithuania, 2015).
- Poor eyesight and vision: Spending a long time on the internet or using digital devices has been known to affect the eyesight of students. Spending hours on a hand-held device keeps the eyes converged and strains the eye muscles so as to cause headaches (Slany, 2015).
- Time and attention diverted: Internet and technology doesn't necessarily mean that all the things that students discover is good for their minds and studies. There is social media like Facebook and Instagram that can be a distraction during class and they can have unusual information that wastes bandwidth and creates distractions (Zaru, 2016).
- Encouraging bad habits of studying: Technology in education may influence the study habits and skills of students in a negative way. Fast and easy access to information via cell phone may prevent students from visiting the library or going the extra mile to retrieve crucial information (Barnwell, 2016).

As mentioned previously, many different types of educational technologies exist. This study focuses on ERS in higher education as an enabler for students to better understand content and to increase student engagement (Cole, 2012). In this study, ERS will be used in writing instead of ERS throughout. In the next section, focus is shifted to the technology adoption models, the different kinds of adoptions models and the selected theory model selected to assess the behavioural intention towards ERS.

2.5 TECHNOLOGY ADOPTION

Technology adoption has a number of theory models that describes the lifecycle aspect of the product's behaviour, leading to the demographic and psychological characteristics of a defined group. The model specifies the first group of people to use the new product as innovators (Wisdom, et al., 2014). Adopting technology into the educational system is considered by many as a solution to a wide range of educational challenges. Capper (2011) claims that adopting technology into the lecturer rooms can change the instructor's roles from being a distributor of information to those of a moderator and coordinator in the learning activities. Kendrick (2010), states that teaching and learning would be more operational when students are actively involved in the classroom events. Hence this will have a major contribution in the instructional process when using digital technology by planning, design, actual, teaching and learning assessment. Capper (2011) says the supportive purposes of adopting technology in education include the intention to:

- Develop teaching and learning content areas;
- Cultivate students' communication, critical thinking, creativity and cooperative skills;
- Increase motivation for teaching and learning; and
- Enhance interaction among students and between teacher and students.

Digital technologies may be infused into the instructional process to bridge the communication gap between academics and students. It is very important to understand the determinants of technology adoption and the theoretical models that are addressing technology adoption to better understand the behavioural intention of using these devices. In this section, a brief overview of the main technology adoption models is given with the most appropriate model being substantiated.

2.5.1 Technology Adoption Models

Information System (IS) research has a variety of technology adoption models. These are the most used theories in technology adoption: the Theory of Reasoned Action (TRA) followed by the Theory of Planned Behaviour (TPB) (Ajzen & Fishbein, 1975), the Technology Acceptance Model (TAM) (Davis, et al., 1989) and Task–Technology Fit model (TTF). The final model will be the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, et al.,

2003). These different technology adoption models are outlined and further explained below.

Theory of Reasoned Action (TRA) model

The TRA, known as the fundamental model, was developed by social psychologists to study the conscious intentional behaviour of individuals (Ajzen & Fishbein, 1975). This model defines the links between beliefs, attitudes, norms, intentions, and behaviours of individuals. It has been used for a wide range of behaviours (Sheppard & Sheppard, 1988). According to Davis et al. (1989), this model was used to study acceptance of new technologies and achieved results that were reliable with former readings of other behaviours. An example, the TRA was used to investigate the adoption of a technology on people's attitude and their expectations towards the use of the technology (Moore & Benbasat, 1991). Figure 2.2 demonstrates the TRA with its constructs and the expansions of the perception towards the actual behaviour control.

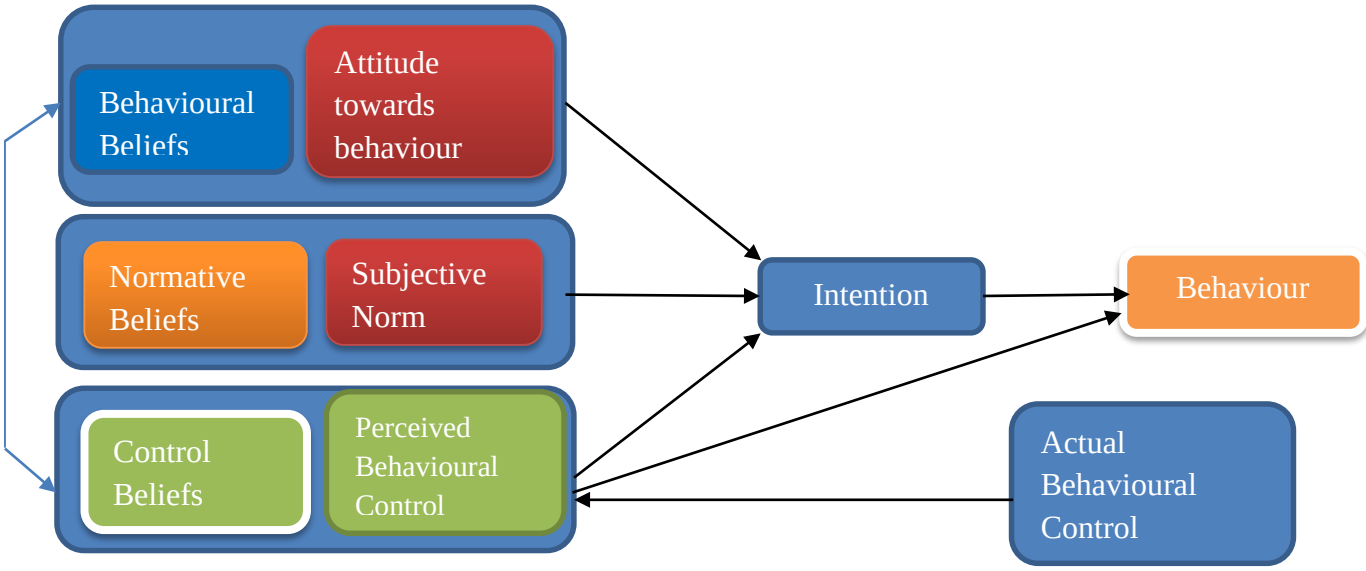

Figure 2. 2 Theory of Reasoned Action model

The following are the constructs for TRA:

- **Attitude:** A person's evaluation of the anticipated positive or negative outcomes associated with engaging in a given behaviour. Consider belief about behaviour and evaluate that behaviour as good or bad (Ajzen, 2015).
- **Subjective Norm:** The idea that people are motivated by their precepts of what is considered normative and accepted by others (Fang, et al., 2017).

- **Normative belief:** The perceptions that an individual has about what others think they should do in regards to the said behaviour. Weigh each normative belief by a person's motivation to comply with the referent (source of the normative) (Ajzen, 2015).
- **Behavioural intention:** A key construct in TRA and last step before the actual behaviour. It is defined as the time frame for performance of the behaviour (Alanazi & Lee, 2017).
- **Perceived behavioural control:** Icek Ajzen (2015), extended the theory of reasoned action to cover non-volitional behaviours for predicting behavioural intention and actual behaviour.

Theory of Planned Behaviour (TPB)

The TPB model is used with the TRA and includes the additional construct of "perceived behavioural control". Ajzen (1975) used the TPB to study a wide collection of intentions and behaviours. It has been effective in predicting acceptance and use of many different skills (Harrison, et al., 1997). A study on cigarette smoking and the intention to smoke cigarettes were predicted by an attitude and perceived behavioural control, showing no direct effect of subjective norm on the use of cigarettes (Alanazi & Lee, 2017) The only difference between the two theories (TPB and TRA) is that the TPB includes behavioural control as an additional determinant of intentions and behaviour while the TRA includes the beliefs and norms for the constructs and behavioural intention. Figure 2.3 demonstrates the TPB model and its constructs.

The following explains the TPB constructs:

- **Attitude:** The overall behaviour depends on the attitude of the persons affected. e.g. 'referring the patient for an x-ray will decrease future consultations' and the corresponding positive or negative judgements about these features of the behaviour (Francis, et al., 2004).
- **Subjective norm:** a person's own measure of the social pressure to perform or to not perform the targeted behaviour. The subjective norm has two compounds which work in interaction: beliefs about how other people think and beliefs of the person who in some way is important to them (Knabe, 2012).
- **Perceived behavioural control**: is the extent to which a person feels able to enact the behaviour. It has two aspects: how much a person has control over the behaviour and the role of perceived behavioural (e.g. low control over measuring blood pressure if the BP machine often malfunctions) (Ahmad & Shahar, 2014).

- **Intention**: The behavioural intention and actual behaviour may not have a perfect relationship, but they can be used as a proximal measure of behaviour (Francis, et al., 2004).

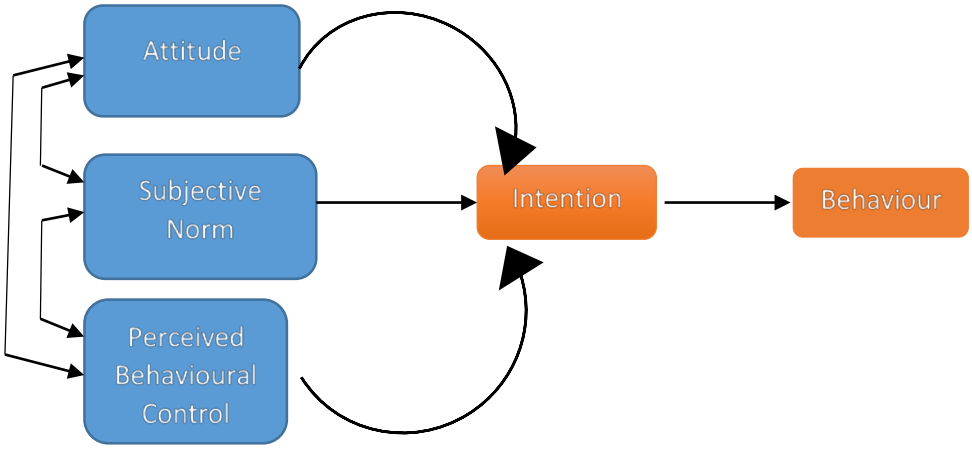

Figure 2. 3 Theory of Planned Behaviour

Technology Acceptance Model (TAM)

TAM was designed to predict technology acceptance and usage related to labour. Unlike the TRA, the final concept of TAM does not include the attitude construct. The attitude construct is a conceptual state comprising beliefs, feelings, values, and characters to act in certain ways. The TAM has been widely used as a theoretical framework to analyse a set of technologies and users in the ICT field (Venkatesh, et al., 2003). The TAM was derived from TRA and was originally developed to understand the causal links between external variables like attitude, subjective norm, perceived behavioural control and intention (Figure 2.4). The TAM was used to try and understand academics' behavioural intention to use Learning Management Systems with all the adopted variables, either directly or indirectly affecting the behavioural intention to use the system (Alhabri & Saleh, 2014). Figure 2.4 shows the TAM and its constructs which focuses on attitude towards using a particular technology. The following are the constructs of TAM (Davis, et al., 1989):

- **Perceived Usefulness:** Perceived usefulness and perceived ease of use are both belief constructs. Davis et al. (1989) defined perceived usefulness as "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context".
- **External Variables:** TAM asserts that the influence of external variables upon user behaviour is mediated through user beliefs and attitudes.

- **Perceived Ease of Use:** Perceived usefulness and perceived ease of use is both belief constructs. Perceived ease of use is "the degree to which the prospective user expects the target system to be free of effort".
- **Behavioural Intention to Use:** Behaviour intention to use is determined by the Perceived Usefulness and Perceived Ease of Use of any system that eventually contributes to the actual use of a system.

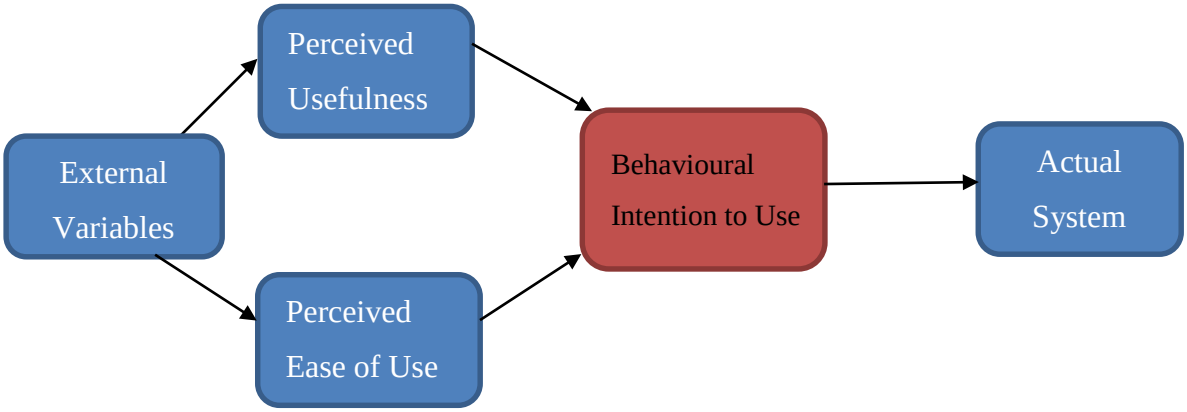

Figure 2. 4 Technology Acceptance Model

Task–Technology Fit model

The ability of IT to support a task is expressed by the formal construct known as task–technology fit (TTF), which implies matching the capabilities of the technology to the demands of the task. The TTF model points out that IT will be used if and when the functions available to the user, support (fit) the activities of the user (see Figure. 2.5). Rational, experienced users will choose those tools and methods that enable them to complete the task with the greatest net benefit. An example is the same principle of turning inputs (e.g. tacit business problems) to outputs (e.g. solutions), which also applies in a broader set of organizational studies, such as in mere knowledge and intensive jobs (Ammenwerth, et al., 2006). Another example is to assess how well the use of e-books meets the requirements of academics and how they perceive the adoption of e-books using the TTF model. This study was surveyed online and administered to the medicine faculty making a contribution to the model (D'Ambra & Wilson, 2013). Figure 2.5 presents the TTF model where the constructs and their relationship are shown.

The TTF model is a key but often overlooked construct in understanding the impact of technology on individual performance. Figure 2.5 demonstrates the TTF model initiated by

Goodhue (1995) as an important aspect of assessing and explaining IS success. The following are the TTF model constructs and their explanations:

- **Task Requirements:** is the degree to which a technology assists an individual in performing his or her tasks. If either the fitting of the task to the technology or its utilization is lacking, the technology will not improve performance (Lee, et al., 2003).
- **Tool Functionality:** may be defined as a decision of one's ability to use a computer. The CSE construct is a specialized definition of the relationship between "compatibility", thus a more complete definition of task (Rahardjo, 2006).
- **Individual Performance: i**ndividuals may use technologies to assist them in the performance of their task to reach a desired performance level (Ajzen & Fishbein, 1975).
- **Actual Tool Use:** may be defined as a judgment of one's ability to use a computer. This construct is a specialized definition of self-efficacy, i.e. a person's belief in their ability to complete a specific task (Compeau & Higgins, 2011).
- **Task-Technology Fit:** is at the core of all of discovery and was made by Chen (2002) in their exploitation for the relationship between "compatibility", a more comprehensive definition of task (Lee, et al., 2003).

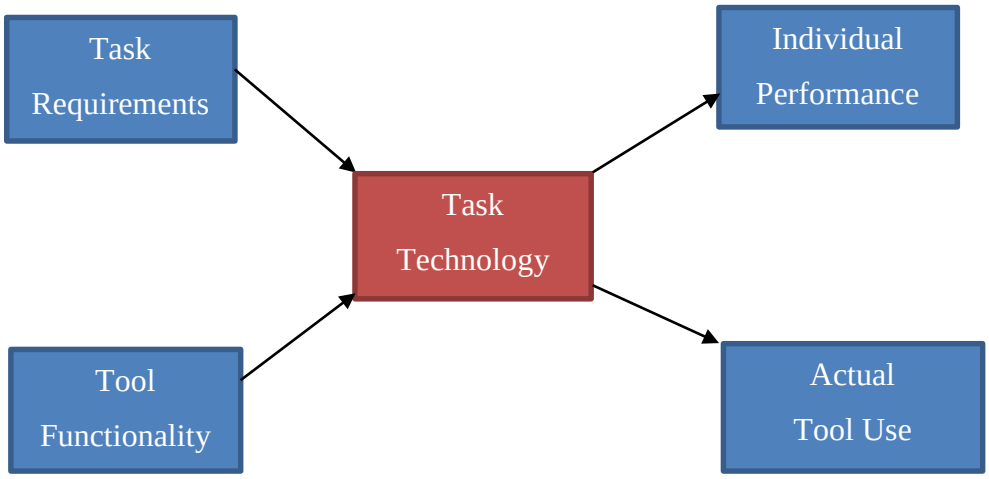

Figure 2. 5 Task Technology Fit

Unified Theory of Acceptance and Use of Technology

The UTAUT model is composed of eight models and theories (TRA, TAM, MM, TPB, C-TAM-TPB, MPCU, IDT, and SCT) (Venkatesh, et al., 2003). The purpose of conveying UTAUT was to incorporate the uneven theory and research on the individual acceptance of information technology into a unified theoretical model (Venkatesh, et al., 2003). Davis and

collaborators (1989) have argued that in order to make informed design decisions on future technological solutions and achieve the full potential of information systems, it is important to comprehend the key factors of user adoption and intention of use within a particular domain and organizational context. His proposed model of Technology Acceptance (TAM) has looked into factors of usability and perceived usefulness, in order to study users' individual variability in their future intention to use and adopt technology (Davis, et al., 1989). As such, TAM could help designers to evaluate and assess the appropriateness of particular technological solutions. Since its original inception, Davis' model has been tested and applied by numerous researchers on various system types and within the context of many domains (Lee, et al., 2003). This popularity resulted on gradual improvements to the theory and the most comprehensive version of this model today is: The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, et al., 2003). Figure 2.6 UTAUT shows the original Unified Theory of Acceptance and Use of Technology with the original constructs (Taiwo & Downe, 2013) and the meaning of the constructs. According to the UTAUT model, age, gender, years of experience and voluntariness were specified as moderators of Behavioural Intention. These moderators are usually seen to have a moderating effect on Behavioural Intention.

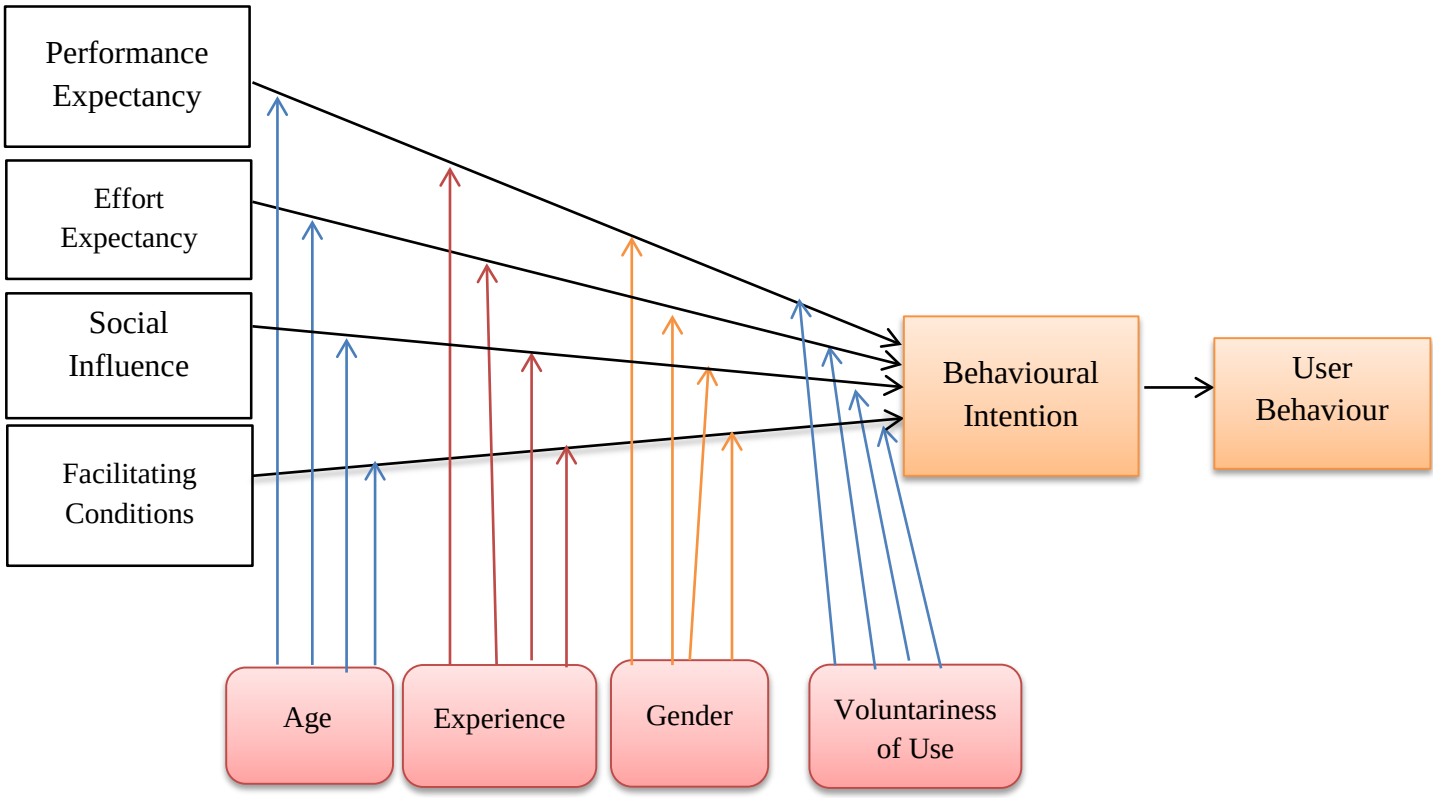

Figure 2. 6 UTAUT and its constructs

The following are the constructs and the explanations of the original UTAUT model:

- **Performance Expectancy:** is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance. (Ghalandari, 2012).
- **Effort Expectancy:** is defined as the degree of ease associated with the use of the system. The authors propose that Effort Expectancy will be most salient for women, particularly those who are older and with relatively little experience with the system (Taiwo & Downe, 2013).
- **Social Influence:** is defined as the degree to which an individual perceives that it is important that others believe he or she should use the new system (Taiwo & Downe, 2013).
- **Facilitating Conditions:** are defined as the degree to which an individual believes that an operational and technical infrastructure occurs to support the use of the system (Davis, et al., 1989)

2.5.2 The Selected Model

This model has been used in a variation of settings to ascertain the use of technology and facilitating conditions and behaviours. The UTAUT model consists of four constructs, namely Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions. Digital Inclusion is added to these constructs, which has an impact upon the behavioural intention of people (Ghalandari, 2012). The UTAUT model may help to determine the cause of underutilization of technology in Universities. Various researchers have tested and used the UTAUT across a wide range of studies with the intention of validating its constructs (Taiwo & Downe, 2013). This model shares many constructs from other models, including from TAM (Wang & Wang, 2010), from TRA (Ajzen & Fishbein, 1975) and from the Innovation Diffusion Theory (IDT) (Moore & Benbasat, 1991). The UTAUT model is selected from various theoretical models as a result of its ability to adapt in diverse studies and its capability to solve complex technologies. In this study, the UTAUT model is used to focus on the adoption of technology in education and to assess the behavioural intention in using ERS amongst academics.

2.6 ELECTRONIC RESPONSE SYSTEM

In the mid-1980s, the first generation of clicker emerged when several scientists came up with a prototype of the new teaching tool called Classroom Communication System (CCS). The CCS system 'Class talk' was first tested in a physics classroom with great results. It became commercially available in the early 1990s and it was used successfully by a number of universities (Bruff, 2005). The CCS, later called clickers, was developed further in the late 1990s, where the second generation of Electronic Response System appeared. These systems used infrared or radio frequency signals to transmit data as they used handheld response pads. An example of using an ERS was to observe students' viewpoints on the effectiveness of clicker technology in facilitating educational approaches that involve students in their own learning (Majid & Foo, 2005). This enabled maximum participation from students and enable them to engage in the classroom and to learn better.

Various ways and interests have been expressed to explore the instructional potential of ERS, with few scholarly sources present on the adoption of ERS in classrooms in Universities. The development of ERS and its use in higher education has enabled it to become a teaching tool to improve student learning outcomes Kubica et al. (2019). These learning outcomes encouraging student participation in the classroom which may be promoted by the use of ERS. A study done with Macroeconomics students found that the use of ERS can increase student satisfaction, enjoyment, and engagement. Salemi (2009) and Ghosh also observed student enthusiasm, as evidenced by multiple choice question response levels, higher attendance rates.

Companies that developed and improved this kind of student response system are I-clicker, Turning point and Inter-Write. The development of the third generation of ERS is currently underway. This technology uses laptops and PDAs instead of handheld response pads as student response devices and the data is transmitted via a wireless network that laptops and PDAs connect to (Graffiti, 2002). History has garnered a positive feedback from audiences and academics from over the past 40 years. ERS have taken place in an ever increasing number of classes at all the different levels of education due to their transformational qualities coupled with the seeming unending lowering of price and technology (Laxman, 2011). Some past examples demonstrate the advantages of using ERS amongst students and instructors during classroom participation.

2.6.1 Advantages of ERS

For example, Bimber et al. (2009) noted that ERS can enhance the learning performance of students in class, while Yi-Chun (2011) established in their study on clicker-assisted theoretical change that students in the experimental group, who used ERS, outperformed in a comprehension test where students in a control group with normal instructional methods, were used. ERS have shown many advantages over the non-technical methods for collecting anonymous feedback with the ability to display responses immediately. Some of the advantages are as follows (Swart, 2015):

- It leads to active learning. Active learning enables academics to be involved in discussions and moving away from passive learning.

- Fulfilment of learning, this results when each academic learns from his or her own misconceptions, as their viewpoints were shared and analysed by others in a secluded way.

- Academics tend to have ownership over the decisions they make which allows them to participate by choice.

- This also allows the academics to act independently and make their own free choices.

Educational technology is the study and ethical practice of facilitating learning and refining performance by creating, using and managing appropriate technological processes and resources (Mayer, et al., 2009). These technologies represent different efforts to advance and use technology to achieve a never-ending array of desirable educational outcomes, including improving learning, enhancing teaching effectiveness, reducing costs and increasing access through different aspects, including ERS (Cater & Garza, 2015).

Research studies have explored the effects of ERS on numerous aspects of students' classroom experiences. The educational benefits of ERS have enabled professors to rely on teaching by providing real-time feedback and assessment as the students participate in the lecturer rooms (Laria & Hubball, 2008). Lecturers can evaluate the student's understanding on concepts and also students can assess their own understanding on different concepts. Research have begun to show new statistics of new paths to the potential that ERS are improving both the student

learning and performance and delivery of pedagogy. The use of ERS over the years by many professionals, have indicated that using an ERS has increased the attendance in classrooms as more students may participate freely (Kendrick, 2010). Table 2.2 demonstrates the summary of advantages and disadvantages for ERS among students.

Instructors who incorporate technology like ERS shift face-to-face and rote memorization “to a more open minded and student-centred approach to teaching and learning” (Cakmak, 2011). 63% of students from one study reported on how the use of ERS made them more focused and allowed them to be more active. A student remarked: “I got custom feedback” This feedback defined by the student was exactly related to clicker use (Bojinova & Oigara, 2013).

2.6.2 Disadvantages of ERS

ERS do have certain downsides, including struggling to design essay and critical thinking questions with an ERS. The system does not enable students to respond in an essay or paragraph manner to get results in a classroom for analysing the results. During or after lecturer times, collecting and distributing traditional ERS and ensuring that students bring them if they are on an individual loan, can be cumbersome and too much work to keep the order (Caldwell, 2007). The use of an ERS in a classroom can limit the interpretation of analysing complex data, due to the design of the system and the limitations it consists of. For example, essay type of questions is not able to be analysed. There are also reports of ERS being a distraction from learning, especially if there are technical faults during the polling time (Langford & Narayan, 2016).

Table 2. 2 Table displays advantages and disadvantages of using ERS

Advantages	Disadvantages
A profound impact on the educational experience of students	More time is required for preparing for the class
ERS have proven to demonstrate student improved performance on exams results	Handheld devices can be heavy and demand more labour
Impact in student learning interaction and have enhanced the level of understanding	Adoption to technology by older lecturers takes time.
The application part of thinking and the students would answer individually without peer discussion	Not all students are technologically informed or advanced
An ERS encourage students to participate in class and express their understanding of the presented material due to the anonymity of the system	Not effective for opinion-based answers from students. It limits the students to discuss a question in an essay format, which affects the overall effect
The immediate feedback and results enable students to engage more at that point in time with the instructor and to understand the reasons as to why they got any answers wrong	It takes time to educate students regarding the use of ERS in the classroom

2.6.3 Using an ERS during a classroom discussion

The modern ERS generally consist of three elements: a wireless transmitter/receiver or handheld system for the viewers (the clicker); a transmitter/receiver system for the lecturer hardwired to a computer (USB or plug-and play); and computer software to gather, analyse and project the responses. The trademarked software may be one package or may consist of many different programs, allowing for selection for particular curricular needs. On account of the popularity of Microsoft PowerPoint presentation software, most companies have a plug-in so that questions can be included with PowerPoint presentations (Bruff, 2005). More time is required by preparing for class and taking time to prepare students and giving more attention to this, is also expected. ERS also promote active discussions and learning in classroom and high scores in examinations are expected as well (Freeman, et al., 2016). ERS are also used to store

response data for assessment and future analysis. There are three different stages of phases that involve the equipment while using an ERS:

- Presentation and questioning
- Student response and display
- Data management and analysis

Kendrick (2010), provides a step-by-step guide for using an ERS as follows:

Step 1: Instruction and questioning: The instructor presents concepts and materials, interspersed with slides asking for feedback from students. Questions are typically in true or false or in a multiple choice format. Many instructors then ask students to discuss the possible answers in groups, and to reach an agreement about the best response (Mayer, et al., 2009).

Step 2**:** Response: Students key in their responses using small remote transmitters. These transmitters send signals to a receiver that is connected to the instructor's laptop or lecture's PC (Bruff, 2005).

Step 3: Display: Software on the instructor's machine instantly tabulates and graphs students' responses and these simple graphs can be displayed on the following presentation slide. One of the more captivating phases of using ERS is that students can compare their own responses to the responses of other students in the class, which can encourage a level of thinking that might not otherwise occur (Bojinova & Oigara, 2013).

Step 4: Data management and analysis. Most Electronic Response Systems allow one to transfer and save response data for future assessment and evaluation. Some systems also link to learning management systems, like Blackboard, to enable students to review their scores. Software on the instructor's machine instantly tabulates and graphs students' responses, and many instructors then ask students to discuss the responses in groups, and to reach an agreement about the best response (Aime & Levesque, 2017).

An ERS is a system used to collect information from students via a face-to-face setting to poll and give immediate feedback by instructors. A traditional example of an ERS is an instructor asking students to show by raise of hands to disagree or agree with the given question. An ERS has interchangeable names that can be used and they include:

- Audience response systems
- Personal response systems
- Classroom response systems
- Interactive voting systems
- Electronic voting systems
- ERS
- Interactive response systems

According to Bojanala and Oigara, (2013), there is a need for students in science classes to switch from an academic-centred approach to a more student-centred approach for learning content to increase classroom participation and performance amongst students. In today's century, students expect technology to be infused within their classes. Figure 2.7 shows an example of an ERS used by an instructor with her students in a classroom to capture the response from the students during a biology quiz and then later it displays a summary feedback.

The feedback is given on the PPT slide, which helps students to further discuss concepts with the instructor and amongst themselves, especially with regard to the questions that they failed. This helps to improve the thinking analysis for better decision-making. In the example of Figure 2.7, only 29% of the students were correct and the instructor was able to discuss the other options with the students to eventually explain why option C was the correct answer. This example demonstrates how useful an ERS are as they enabled them to focus and keep track with response to the correct answers.

ERS are a new emerging technology that is being adopted by Universities as a way to enhance critical thinking, improve assessments and participation amongst students in the classrooms (Jim, 2010). The impact of technology in higher education has inspired innovative approaches to teaching and learning. It has enhanced learning through a few techniques, based on the theories of learning technology use and this has not only improved the education sector of higher education, but also across the different sectors (Youssef & Dahmani, 2008). In this study, ERS will be used as a technology assessed in higher education for the behavioural intention among instructors, using the technology adoption model. The theoretical framework further demonstrate how the UTAUT will be used to assess the user's behaviour with an ERS.

Figure 2. 7 ERS used by instructors (Chen, et al., 2017)

2.7 THEORETICAL FRAMEWORK

The study will further extend the UTAUT model by including one construct that may affect the adoption of an ERS system. The original UTAUT model will be extended in this study by adding Digital Inclusion which affects the Behavioural Intentions of ERS's. Digital Inclusion is defined as the degree to which people are made aware of technology (Carlsson, et al., 2006). Figure 2.8 shows the extended UTAUT model. Voluntariness of use is not considered as a moderator in the extended UTAUT model as the adoption of an ERS is seen to be a voluntary act, and not a compulsory one. A similar study also excluded voluntariness of use where the adoption of an electronic payment system was evaluated, as its adoption would be purely voluntary in nature (Muhayiddin, et al., 2011).

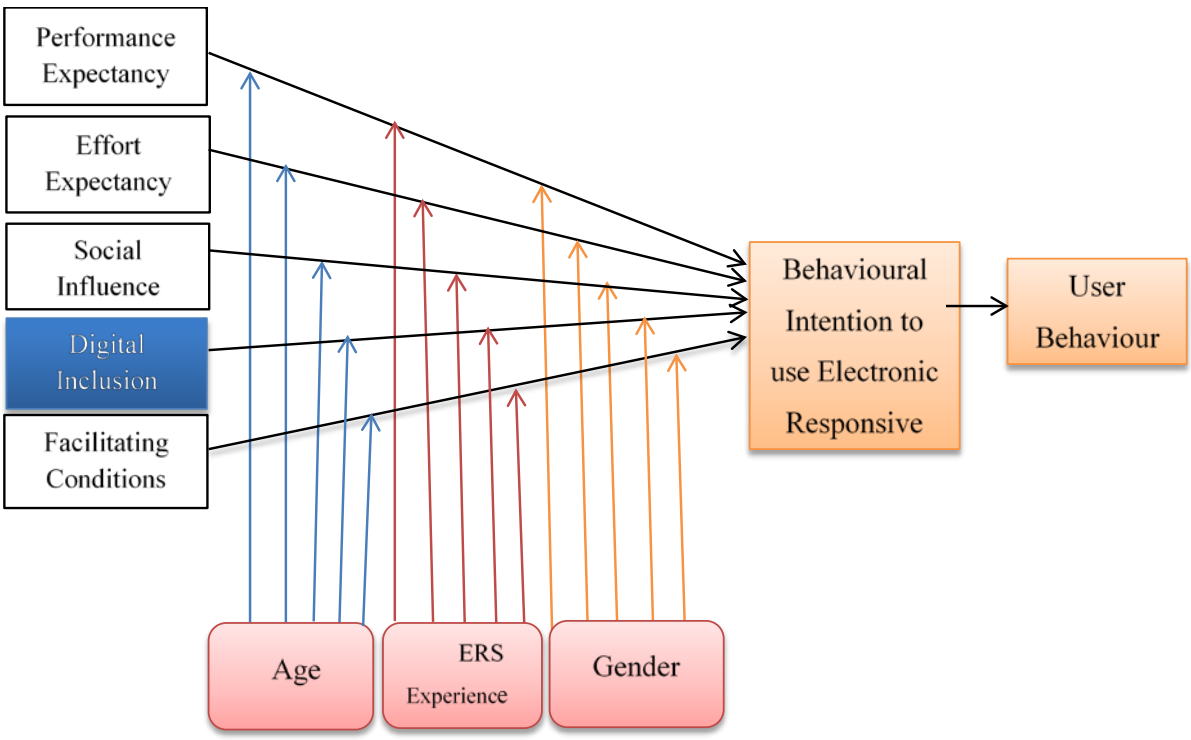

Figure 2. 8 The extended UTAUT model and its constructs

The constructs of the extended UTAUT model are defined as follows for this study:

- **Performance Expectancy:** is defined as the degree to which an instructor believes that using an ERS will help him or her to gain in job performance of teaching in the classroom.
- **Effort Expectancy:** is defined as the degree of ease with an ERS during the classroom times with the instructors.
- **Social Influence:** is defined as the degree to which an instructor perceives that important instructors believe he or she should use an ERS.
- **Facilitating Conditions:** are defined as the degree to which an instructor believes that an operational and technical infrastructure occurs to support use of an ERS.
- **Digital Inclusion:** the ability of an instructor and groups to access and use information and communication technologies in an ERS.

UTAUT aims to explain user intentions to use an ERS and subsequent usage behaviour. The research hypotheses are based on the extended UTAUT model and are:

H1a: Performance Expectancy influences behavioural intention positively more for younger instructors than for older academics.

H1b: Performance Expectancy influences positively towards the behavioural intention of an ERS for experienced users.

H1c: Performance Expectancy influences positively towards the behavioural intention more of female than male users.

H2a: Effort Expectancy has a positive effect on behavioural intention towards ERS more for younger academics than older academics.

H2b: Effort Expectancy has a positive effect on behavioural intention towards an ERS for academics with more educational technology experience.

H2c: Effort Expectancy has a greater positive effect on female than on male academics regarding their behavioural intention.

H3a: Social Influence has a greater positive effect on the use of an ERS by younger academics than for older ones.

H3b: Social Influence has a greater positive effect for experienced users of an ERS than experience technology experience.

H3c: Social Influence has a greater positive effect on the use of an ERS by males than for females.

H4a: Digital Inclusion has a greater positive effect on the use of an ERS by younger academics than for older ones.

H4b: Digital Inclusion will have a greater positive influence on the behavioural intention of academics with more educational technology experience.

H4c: Digital Inclusion will have a greater positive influence towards males than towards females in terms of their Behavioural Intentions.

H5a: Facilitating Conditions has a positive effect towards the Behavioural Intention for younger academics than older academics.

H5b: Facilitating Conditions has a greater positive effect for experienced users of an ERS than less experience technology users.

H5c: Facilitating Conditions has a greater positive effect for male users than female users on the support given regarding the use of an ERS.

H6: Users Behavioural Intentions to use ERS positively affect the users' use behaviour of actually using ERS.

These hypotheses will be used to assess the Behavioural Intentions towards an ERS; each hypothesis is aligned to the questions assigned to the instructors in the University.

2.8 SUMMARY

In conclusion, chapter 2 included the background information for technology, its usage and how important technology should be to universities. The chapter further outlined the different kinds of technology adoption models that are available. The main advantage of using the UTAUT model suggested by Venkatesh, is that it has included the age and experience as factor in the model itself. This makes it more suitable to be used for a product or service oriented research in a university setup where many young and older experienced academics work. The history and advantages of ERS were presented along with a step-by-step guideline as to how instructors use the system during the classroom and the results displayed for the students. Research done in different areas of the world shows that ERS can improve on academic feedback given to students, encourage participation in the classroom, and help the academic to better understand what students have mastered during the classroom. The next chapter will discuss the methodology used for the study and the research tools used in detail to assess the adoption of technology in the University.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter presented a detailed review of literature, relevant to the selected model for the present study, regarding the use of ERS at a University of Technology. This chapter deals with the methods and principles that are used in the research and how the research was conducted. The chapter introduces the following sections: research purpose and questions 3.2, the research onion 3.3, the research philosophies and paradigms 3.4, research strategies 3.5, the research choices 3.6, time horizon 3.7, data collection 3.8, sampling techniques 3.9, techniques and procedures 3.10 and the research model 3.11. The last section of this chapter will discuss the ethical clearance and present the summary of the chapter.

3.2 RESEARCH PURPOSE AND QUESTIONS

This study aims to present factors that may help to promote the use and adoption of an ERS at a University of Technology. The following research question therefore exists: “How can the UTAUT model be applied and extended to promote the adoption of an ERS at a University of Technology?” To unambiguously answer the main research question, the following sub questions need to be answered:

- What are the factors that may influence the adoption of an ERS at a University of Technology?
- What is the degree to which academics believe that using an ERS will improve their job performance?
- What factors influence academics to perceive an ERS as difficult to use?
- To what extend does social influence affect academics’ use of an ERS?
- To what extent do technical support services influence academics to use an ERS?
- Are academics at a University of Technology behaviourally inclined to use an ERS?

This study uses a case study to gather quantitative data that investigates a current occurrence within its real-life environment. The type of statistics used includes the reliability and normality test, multi-collinearity and multiple regression analysis. The problem of the study has indicated that the adoption of ERS amongst academics at Universities of Technology in South Africa is not well reported on. This may be due to the negative perception amongst academics on the use

and benefits of educational technology. This study focuses on ERS in higher education as an enabler for students to better understand content and to increase their engagement (Cole & Spence, 2012).

3.3 THE RESEARCH ONION

The research onion framework adopted from Saunders & Lewis (2012) serves as the starting point. The research onion provides an effective progression through which a research methodology can be designed. Valuable information is also explained about the adoption and use of an ERS in the University of Technology. In principle, addressing a research philosophy includes being aware of and articulating one's beliefs and principles. According to Figure 3.1, the identification of the research philosophy is located at the outer layer of the 'research onion'. Accordingly, it is often the first topic to be explained in a research methodology chapter. The research onion starts with the outer layer (Philosophies), moving down to the inner layer (Techniques and procedures). These sections are covered in the study and explained further. Each stage of the research process is based on an assumption about the sources and the nature of knowledge. The research philosophy reveals the author's important assumptions that serve as the basis for the research strategy.

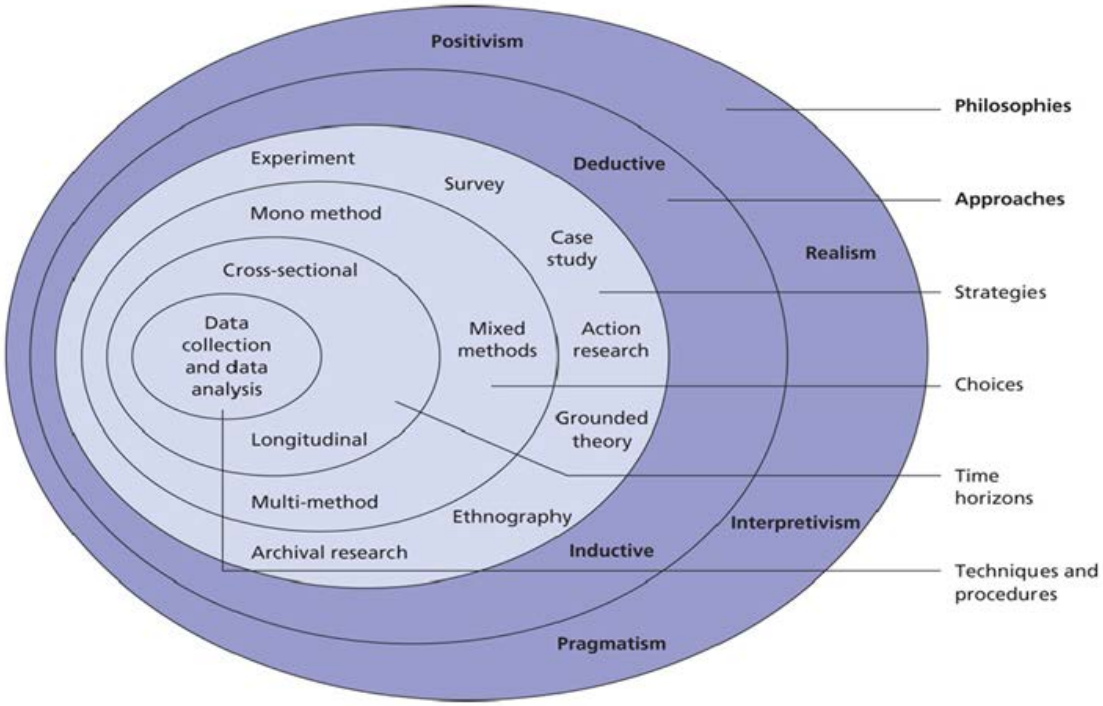

Figure 3. 1 The Research Onion (Lloyd, 2014)

3.4 RESEARCH PHILOSOPHIES AND PARADIGMS

Philosophy is a belief about the ways in which data is gathered, analysed and how it should be collected and used (Martinez-Mesa, et al., 2016). Philosophy has to deal with the source, environment and development of knowledge. Addressing the research philosophy in a dissertation involves being aware of and formulating beliefs and assumptions. Information collected should be primary data where data analysis is used to answer the research questions (Dudovskiy, 2018). There are different philosophies of research, which includes the following:

- Ontology
- Axiology
- Epistemology

3.4.1 Ontology

Ontology is a concept that deals with the science or study of being and develops the description for the social sciences to encompass ‘claims about what reality is to look like’. In other words, ontology is associated with a central question of whether social entities need to be perceived as objective or subjective. In short, ontology describes the view or assumptions made on the environment of reality, specifically to the objective that the reality exists (Thomas, 2010).

3.4.2 Axiology

Axiology mainly refers to the ‘aims’ of the research. This branch of the research philosophy attempts to describe if you are trying to explain or predict the world (Dudovskivy, 2011). It is related to values that we possess in the fields of ethics, which is also a process of social enquiry. Although this may include values we possess in the fields of aesthetics and ethics, it is the process of social enquiry with which we are concerned. The role of one’s own values plays a significant role in the research process (Thornhill, 2009).

3.4.3 Epistemology

Epistemology (what is known to be true) is a term opposed to doxology (what is believed to be true) and includes numerous research approaches (Myeko, 2014). What one perceives as reality affects the knowledge in our world and these are perceptions from different paradigms, which

affects the knowledge in the world. What one thinks of as real, affects the in which way one gains knowledge. de Gialdino (2009) defines epistemology as 'expressing how you can know' and encourages one to further ask how is knowledge generated, what measures distinguish good knowledge from bad knowledge, and how should reality be described.

Methodology is accepting the understanding of the reality that affects the way in which we gain information of reality. This, in turn, affects how one conducts research about the reality (which is termed 'methodology'). There is a link, or a relationship, between ontology, epistemology and methodology. Taylor and Edgar (1995) say that 'the belief about the nature of the world, (ontology) adopted by an enquirer, will affect their belief about the nature of knowledge in that world (epistemology), which in turn will influence the enquirer's belief as to how that knowledge can be uncovered (methodology)'.

The ontology of this study relates to views (or perceptions) of why academics are reluctant to adopt an ERS, which can affect student engagement in a university. The epistemology of this study seeks to determine valid conclusions with regard to these views, or perceptions. The methodology serves as the bridge between ontology and epistemology in terms of explaining how these conclusions can be drawn scientifically. The methodology indicates that lecturers are not willing to use an ERS, because of not having an interest to change and the age and experience demonstrate no relevance to why lecturers do not use an ERS. The next section covers the different paradigms and which one is applicable to the study.

3.4.4 Paradigms

A paradigm is a term often used in social sciences, but one which can be misleading, as it tends to have many interpretations. One definition states that it is a way of investigating social phenomena from which particular understandings of these phenomena can be increased and explanations attempted (Thornhill, 2009). Scotland (2012) presented a class on social science paradigms, which can be used in management and business research to produce fresh insights into real life problems. Most researchers in social or natural science disciplines are dependent upon one of the following philosophical paradigms; positivist, interpretivist, realist and pragmatist.

3.4.4.1 Positivists

The positivist is usually associated with scientific methods and believes that social sciences can be as rigorously scientific as the natural sciences (Dudovskiy, 2018). The researcher trusts that the reality is stable and can be practical and labelled from an objective viewpoint. A characteristic of positivist studies is that it attempts to test theory in order to increase the understanding of the phenomena. Hypotheses and questions are put forward in advance as assumptions which may undergo empirical testing with carefully controlled conditions (Neuman, 2006).

3.4.4.2 Interpretivists

The interpretivist approach to social sciences usually involves qualitative research, being a method of inquiry in many different disciplines. It is a school of thought in contemporary jurisprudence and the approach of law. The study of phenomena in their natural environment is key to the interpretivist philosophy, together with the thought that scientists cannot escape affecting those phenomena they study. They admit that there may be many interpretations of reality, but continue that these interpretations are in themselves a part of the scientific knowledge they are pursuing (McLaughlin, 2015).

3.4.4.3 Pragmatism

A pragmatism claims that the most vital determinant of the research philosophy adopted, is the research question where one approach may be ‘better’ than another for answering specific questions. The discussion is often enclosed in terms of a choice between either the positivist or the interpretivist research philosophy. Guba and Lincoln (1994) noted that questions of method are secondary to questions of epistemology and ontology. However, Tashakkori and Teddlie (1998) suggest that it is more suitable for the researcher in a particular study to think of the philosophy adopted as a continuum rather than opposite positions.

3.4.4.4 Research paradigm to be used in this study

The aim of this research will be achieved by utilising the UTAUT model to collect the research data. Positivism focuses on testing hypothesis from existing theory and understanding the

individual behaviour to confirm the hypothesis (Gray, 2010). The positivist paradigm approach is the most appropriate for this study, which has nine hypotheses that are to be tested using UTAUT model. This study uses a quantitative measurement and the positivism studies test the applicability of the theory and increases the predictive understanding of the phenomena. The applicable theory is the proposed UTAUT model and the phenomena is why academics do, or do not, adopt an ERS. The following section explains the research approaches involved in research studies.

3.5 RESEARCH APPROACH

There are two primary research approaches which includes, inductive and deductive. The following sections discuss these two approaches, while Table 3.1 provides a concise contrast between the two approaches.

3.5.1 Inductive

An inductive approach is a type of a research that prompts a researcher to go to the field and obtain a feel and understanding of the nature of a problem to generate a new theory (Stuckey, 2014). The task of the researcher is to make sense of data collected by observation. This analysis would be the formulation of a theory. For example, a researcher may discover that there are other opposing reasons for work absence that may or may not be related to work age or length of service. The researcher will formulate a theory based on the patterns observed and experience of the process to reach a conclusion. This approach is normally referred to as bottom-up approach.

3.5.2 Deductive

The deductive approach is usually based on developing a hypothesis or general theory, working down to a conclusion based on the evidence. It includes the development of theory, based on an existing theory that is subjected to a rigorous test (Soiferman, 2010). As such, it is the dominant research approach in the natural sciences where laws are present and the basis of clarification allows the expectation of phenomena, calculate their occurrence and therefore permit them to be measured (Collis & Hussey, 2003). The deductive approach is usually tested against observations with specific variables being used. Namunyela (2008) lists five successive stages through which deductive research will progress: 1 deducing a hypothesis; 2 expressing

the hypothesis in operational terms; 3 testing this operational hypothesis; 4 examining the specific outcome of the inquiry; 5 if necessary, modifying the theory in the light of the findings

Table 3. 1 Difference between Inductive and Deductive

Deductive	Inductive
- Based on developing scientific principles and testing theory	- Gaining understanding of phenomena
- Explained by means of hypothesis which is derived from a proposed theory	- The collection of data is explained and analysed from observation
- Need to explain variables and casual relationships between variables	- Formulation of theory from observed pattern to reach a conclusion
- Tested against observations	- Referred to as bottom up approach

3.5.3 Justification for using the deductive approach

The deductive approach is the method that is applied in this study. This research is using the existing UTAUT model to help assess the user's intention towards adopting an ERS. There is a development of the current theory, assessing the variables and relations links between the constructs. The aim of this approach is to generate meanings from the theory to the data and to be able to identify the relationship between the constructs and to conclude the data portrait.

3.6 RESEARCH STRATEGIES

There are various kinds of research strategies to use when collecting data and analysing important evidences (Zainal, 2007). A number of research strategies exist, including experiment, survey, archival analysis and case study. Each strategy has its own advantages and disadvantages. This research utilises the case study since its main goal is to find factors that influence technology adoption and it focuses on contemporary events, not requiring a control over behavioural events. Table 3.2 shows the different types of research strategies when collecting data and their definitions.

3.6.1 Justification for using case study

This research uses a case study that considers only one university of technology. According to Yin (1994), a case study is defined as an empirical inquiry that explorers a contemporary phenomenon in detail and within its real-life context, mainly when boundaries exist between a phenomenon and context are not clearly evident. This is an empirical inquiry that examines the case by addressing the "how" or "why" questions concerning the phenomenon of interest. Yin (1994) continues to describe three types of case studies as exploratory, explanatory and descriptive case study. The exploratory case study examines distinct phenomena characterized by a lack of detailed preliminary research and formulated hypotheses that can be tested on a specific research environment that limits the choice of methodology. The explanatory case study examines and describes phenomena along with the casual relationships to develop a theory. It uses both qualitative and quantitative research methods. A descriptive case study is one that questions a phenomenon that should be carefully analysed and articulated in detail. This study may also help to answer the research question relating to what factors can contribute to the adoption of an ERS.

Table 3. 2 Types of research Strategies

Research Strategy	Definition	Example
Experiment	Experimental research defines an approach that is conducted with a scientific way where a set of variables are kept constant while others set of variables are being measured as a subject of the experiment (Williams, 2017).	Laboratory test
Survey	A researcher uses this method mainly for collecting information about a population of interest and it encompasses any measurement procedure that involves asking questions to respondents (Martinez-Mesa, et al., 2016).	Online questionnaire or a face-to-face interview
Archival analysis	Data that is collected from primary sources located in archives or libraries. Archival sources can be manuscripts, documents, records (Gale, et al., 2013).	Electronic records
Case study	A case study can be produced by a formal research method. Most of the case studies are more likely to appear in a formal research venue, journals and professional conferences. It involves an up-close, detailed or in depth examination of a subject of a study (Yin, 2017).	Small groups

3.7 RESEARCH CHOICE

Two major research choices exist, namely, quantitative and qualitative research approaches. The emphasis and the use of multiple methods for data collection guarantees an in-depth understanding of the phenomenon under study (Scotland, 2012), and may be correlated to the mixed-method approach. In this study, the researcher uses an explanatory case study which examines the phenomenon of the adoption of an ERS by academics at a university using the UTAUT model. It further considers the relationships between the various constructs that make up the UTAUT model.

3.7.1 Quantitative

Quantitative research is used to measure the problem by way of producing numerical data or data that can be transformed into usable statistics (Neuman, 2006). There are three main guidelines for quantitative data analysis as follows: creating variables; distributing variables across the sample and creating relationships. The Statistical Package for the Social Sciences(SPSS) software and supplement AMOS (Version 19) were found to be appropriate and the most suitable tools for analysing the quantitative data for this study. The current study used one exploratory procedure, namely the UTAUT model, which is used to specify the relationships between these constructs (Gajewski, et al., 2014). Quantitative research is very productive in providing thorough planning prior to data collection and analysis since it provides tools for measuring concepts, planning designing phases and dealing with population and sampling problems.

3.7.2 Qualitative

Qualitative research is a scientific method of observation to gather non-numerical data (Schoonenboom & Johnson, 2017). This type refers to meanings, concepts, definitions and characteristics. It is a type of analysis of data that is drawn from the research, which is firmly rooted in the data. All analyses and conclusions are grounded directly in the evidence that has been collected. This involves a process of interpretation in which the researcher produces meaning out of the raw data. Each piece of raw information is important (Neuman, 2006). Qualitative research involves the numeric representation and manipulation observation for the purpose of describing and clarifying the phenomena that those observations reflect. Qualitative research emphasises the process and understandings that are not examined or measured. Adding

on to qualitative research, it utilizes a deductive model in testing the relationship between variables and to show evidence for or against pre-specific hypothesis (Saunders, et al., 2009).

3.7.3 Mixed Methods

A mixed method is a type of method to combine both qualitative and quantitative techniques and this method deserves more attention from IS researchers. This method is not a new concept in the IS field, but researchers have not yet fully accepted this technology domain. Mixed methods offers “new ways” for collecting and analysing data and the findings must in some ways have a follow of logic integration (Rodrigues, et al., 2016). There are various ways of mixing quantitative and qualitative methods within or across the different stages of research. Mixed methods approach is used to triangulate the quantitative and qualitative data. Triangulation is defined as a combination of at least two or more theoretical perspectives, methodological approaches, data sources and data analysis methods (Schoonenboom & Johnson, 2017). Table 3.3 demonstrates the difference between quantitative and qualitative research.

Table 3. 3 Quantitative vs Qualitative

	Qualitative	Quantitative
Objective	To get more understanding and the reasons behind	To quantify the data and generalized results from sample
Sample	Small number of cases	Large number of cases
Data Collection	Unstructured	Structured
Data Analysis	None statistical	Statistical
Results	Develop an initial understanding	Give a final course of action

3.7.4 Justification of the Quantitative method

Quantitative and qualitative researches have their own strengths and weaknesses. It is usually for this reason that combining them in a mixed method approach has become a favoured approach in a variety of research fields (Creswell, 2003). In most of the cases it depends upon the definition of the problem and the nature of the information sought for the researcher to select one approach, or combine the two of them (Harrison, et al., 2017). Quantitative data is collected by means of a questionnaire, which is developed using the constructs of the UTAUT model.

This study utilized the UTAUT model as the base theoretical model. The model was evaluated using a series of quantitative data and analysis steps to result in a final product that best explains the predominant of the collected data. This study aims to also test a set of hypotheses to understand and study the effect between the models constructs. Therefore, a quantitative approach was chosen to be the primary approach for this study to examine and study the proposed research model. It should be noted that there is gap in the literature in identifying 'what' the factors are that influence and affect the adoption and use of ERS in the University.

3.8 TIME HORIZON

Korzybski (2011) articulates that time taken to research the phenomena is independent to the research methodology the researcher chose or the choice of research technique. The following explains the cross sectional and longitudinal horizons.

3.8.1 Cross Sectional

A cross sectional horizon is designed to obtain information on variables in different contexts, but at the same time. Normally, different organizations or groups of people are selected and a study conducted to ascertain how factors differ. This means collecting data on more than one case at a single point of time (Setia, 2016). For example, if you are investigating labour turnover, one needs to select a sample of work groups where you know that labour turnover is different. You can then conduct a statistical test to find out whether there is any correlation between variables. The data is collected once, over a short period of time before it is analysed and interpreted.

3.8.2 Longitudinal

A longitudinal horizon is done by investigating the same situation or people several times or continuously, over the period in which the problem runs its course. Repeated observations are taken with the view to revealing the relative stability of the phenomena. This allows the researcher to examine and change processes. Therefore, it would be likely to suggest probable explanations from an examination of the process of change and pattern which emerge (Dis, 2015).

3.8.3 Justification of Cross Sectional

This study uses a cross sectional horizon, as data is collected from academics in different departments at a University of Technology during the same time-period. According to Kazdin & Nock (2003), the cross-sectional case control study examines the factors that are associated with a particular characteristic of interest. In this case study we examined the factors that influence the academics to use an ERS system.

3.9 TECHNIQUES AND PROCEDURES

In this study, data was collected through a web-based survey. A web-based survey was chosen as the internet was the most appropriate medium to contact the target group of the survey. It is one of the cheapest methods of data collection for the study and also it would allow the respondents to respond to the survey at their convenience.

3.9.1 Google Forms

Google forms is an app that is used for administrative purposes, which is included in the Google drive office suite along with other apps like Google Docs, Google sheets and Google slides (Gildred, 2018). This tool allows us to collect information via a personalised survey or a quiz. The information is collected and automatically connected to a spreadsheet.

3.9.2 Survey Monkey

Survey Monkey is an online survey software that is used to simplify and run online surveys. It mainly helps to collect feedback, criticism, opinions and suggestions from the public and customers (Gildred, 2018). Previously in the older years' people will normally print papers out and pass it on to people for them to complete it. Nowadays the Survey Monkey has made it easy for people to give feedback online and receive it immediately.

3.9.3 Justification for the use of Google Forms

In this study, the researcher used Google forms to collect data from the academics, as it is free to use. It is a web-based app and it is easy to share the link with respondents by sending an

email with the relevant link attached. Data gathered is usually stored online in a spreadsheet. This app makes it easy to send emails to academics, as it summarizes the results in charts and it makes it easy to track a record of how many respondents have completed the online questionnaire. In this study, the researcher primarily used multiple choice questions to determine the demography of the participants and checkboxes to cover the questions linked to the constructs of the UTAUT model. The checkboxes featured a Likert scale (strongly agree, agree, disagree, strongly disagree) to provide a wider range of options.

3.10 SAMPLING

According to Espinosa & Bieski (2012), sample size refers to the numbers of elements to be in the study. Two main categories of sampling exist, namely, non-probability and probability sampling. There are different non-probability types namely, quota sampling, convenience sampling, purposive sampling, self-selection sampling and snowball sampling. Non-probability sampling demonstrates a range of different techniques based on the researcher's subjective judgement (Crowe, et al., 2011). Regarding non-probability sampling, the selection of elements is not made with the aim of being statistically descriptive of a population. Researchers use particular methods like personal experience, convenience and judgement. Non-probability sampling methods include convenience sampling, judgement sampling and quota sampling.

Probability sampling is used where the researcher needs to make inferences from the sample about the population to answer the research questions. Usually with probability sampling, sampling units are nominated randomly (Fricker, 2012). Probability sampling includes simple random sampling, which involves a random method, like computer generation or flipping a coin; systematic sampling (Espinosa & Bieski, 2012).

3.10.1 Justification for using non-probability

This study uses convenience sampling, which is a non-probability sampling that involves a particular sample of academics who can provide required information and were available to participate in the study. Academics from CUT were invited to attend an ERS workshop where its functionality and benefits were discussed. All who attended were invited to complete the online questionnaire. Around 295 academics work at CUT (Swart, 2018). 80 of these academics attended the workshop, but only 57 completed the online questionnaire. These academics were therefore conveniently on hand to be voluntary participants in this study.

Convenience sampling is affordable, easy and the subjects are readily available. An obvious disadvantage of convenience sampling is that it is likely to be biased. Convenience sampling should not be taken to be representative of the population. (Etikan, et al., 2016). However, the main aim of the study is to determine factors that may help to promote the adoption of an ERS. Therefore, academics who willingly attended an ERS workshop would be well suited to answer the online questionnaire as certain factors would have driven them to adopt this system.

The link to the questionnaire was sent to 80 academics at the University using Google forms. These are academics that have used an ERS before and some of them had attended an ERS workshop to understand the use of ERS. The sample of this study therefore consists of 80 academics who were given the questionnaire and only 57 (71% response) completed the online questionnaire from the four faculties at the Central University of Technology. 23 academics did not give feedback since some attended to meetings and some completed the questionnaire partially, and therefore those results could not be used in the analysis.

3.11 STATISTICAL ANALYSIS USED

The type of statistics used in this study includes the reliability and normality test, multi-collinearity, multiple regression analysis and correlation matrix. These statistics are discussed in detail in chapter 4 and they are briefly explained next. Reliability testing implies consistency and that the tests are valid and also reliable. A normality test is a statistical procedure used to determine if a data set is well modelled by a normal distribution and to compute how likely it is for a random variable underling the data set to be normally distributed (Zubry, 2018). It can be performed graphically or mathematically. The purpose of reliability and normality testing is mainly to check skewness and kurtosis of each measured variable in the graph (Ghasemi & Zahediasl, 2012). Multi-collinearity occurs when there is a high correlation between two or more predictor variables. For example, one predictor variable can be used to predict the other and this creates redundant information skewing the results in a regression model. The multi-collinearity helps to detect the correlation coefficients for all pairs of predictor variables. If the correlation coefficient, r is exactly +1 or -1, this is called a perfect multi-collinearity. Multiple regression analysis is a technique used to predict the unknown value of a variable from the known value of two or more variables, they are also called the predictors. A correlation matrix shows the coefficients between sets of variables. Each variable (Xi) in the table is correlated

with other values in the table (Xj). This then allows one to see which pairs have the highest correlation (Gajewski, et al., 2014).

3.12 ETHICAL CONSIDERATIONS

The study required no sensitive data and was completely voluntary. The research study at the Central University of Technology was approved by the Research and Innovation Committee of the Faculty of Engineering, Built Environment and Information Technology. Please refer to the annexure above for clarity.

3.13 SUMMARY

This chapter discussed the research methods, strategies and choices for the study. This study explained the reasons for using a case study to gather quantitative data. The research onion was discussed and it included the paradigms, the research strategies, the research choices, the time horizon, data collection, sampling techniques used in the study and the UTAUT model calculate the relationships between constructs. The next chapter presents the data and analyses of the results.

CHAPTER 4 DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

The previous chapter presented the research methodology used in the study, the research onion, research strategies and choices. This chapter presents various analysis of the data, including reliability analysis, correlation and assumption of multi-collinearity. Multiple linear-regression analysis conducted on IBM SPSS version 25 to test the constructs, is also included. The purpose of regression analysis is to evaluate if there is a statistically significant relationship among the variables specified in the conceptual model. The moderating role of age, gender and year of experience was also analysed. The moderation analysis was helpful to assess the 16 hypotheses. The title of each figure (given at the top) represents each construct. The horizontal axis of each figure represents the respective questions for each construct, whereas the vertical axis represents the frequency of responses as a percentage of all responses for each question. Five responses were available according to the Likert scale (1 = Strongly Agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly Disagree)

4.2 PILOT STUDY

The pilot study was done before the main questionnaire. It served as a guide to develop the questions for the main study. The purpose of the pilot study is to rectify any problems before the main questionnaire. It covered academics who voluntarily attended an ERS training workshop at CUT. 20 academics participated in the preliminary study and they responded after 2 weeks without any major questions to be rectified.

4.3 DEMOGRAPHIC PROFILE

The demographic profile was academics who voluntarily attended an ERS training workshop at CUT. The demographic profile gives background information about the participants of the study. It consists of age group, gender, position, experience and faculty of the academics. Table 4.1 illustrates this data. The profile indicates that the majority of academics are female (52.6%) with the largest number belonging to the age group of 20 to 39 years of age (42.1%). This suggests that the results will not be biased towards a specific gender or age group, as the sample is almost equally representative of both genders and the given number of age groups (except for above 50 years of age). In this case, the almost equal representation adds to the reliability

of the final results as gender and age bias are reduced. Bias of any sort should be avoided or at least limited as much as possible, so as to not compromise the study's conclusions and to make the results generalizable (Smith, 2010).

The results also show that many of the academics hold a senior lecturer position (42.1%) while 47.4% of the academics reported being in academia for 6-10 years. This indicates that there is a good spread between different levels of experience, which should also reduce bias with regard to the results when considering the influence of experience on the adoption of ERS. The most represented faculty is the Faculty of Engineering (31.6%), suggesting that more academics in that faculty are using ERS in their classrooms.

Table 4. 1 Demographic Profile of respondents

	Frequency	**Valid Percent**
Gender		
Male	27	47.4
Female	30	52.6
Total	57	100.0
Age group		
20-39 years old	24	42.1
40-49 years old	20	35.1
50 and above	13	22.8
Total	57	100.0
Position		
Assistant lecturer	1	1.8
Junior lecturer	13	22.8
Senior lecturer	24	42.1
Academic support	14	24.6
Professor	5	8.8
Total	57	100.0
Experience		
Less than 1 year	1	1.8
2-5 years	14	24.6
6-10 years	27	47.4
11-15 years	15	26.3
Total	57	100.0
Faculty		
Academic Support	6	10.5
Humanities	7	12.3
Health	17	29.8

Engineering	18	31.6
Management Sciences	9	15.8
Total	57	100.0

4.4 ASSESSING RELIABILITY AND NORMALITY

A reliability analysis was conducted on seven constructs, including their items to measure the internal consistency of each construct. The normality tests are used to regulate if a data set is well-modelled by a normal distribution and to calculate how likely it is for a random variable underlying the data set to be normally distributed. In reliability tests, internal consistency is used to measure the reliability of a summated scale where several items are summed to form a total score (Gliem & Gliem, 2003). Table 4.2 shows the reliability and normality test results. The standard deviation indicates a number used to tell how measurements are spread from the average (mean), or expected value. The highest standard deviation was 0.67 and lowest 0.49 that indicates that the majority of answers is around the mean. Results pertaining to Tables 4.2 through 4.4 were published in a full conference paper presented at EDUCON 2019 (Tsumake & Swart, 2019).

Table 4. 2 Reliability and Normality Test

					Non-Improved Cronbach Alpha		**Improved Cronbach Alpha**	
Constructs	**Mean**	**Standard Deviation**	**Skewness**	**Kurtosis**	**Cronbach's Alpha**	**No items**	**Cronbach's Alpha**	**No items**
Performance Expectancy	4.09	0.55	0.21	-0.47	0.843	4		
Effort Expectancy	4.02	0.52	0.38	-0.24	0.700	4		
Social Influence	3.73	0.59	-0.63	1.88	0.615	4		
Facilitating Conditions	3.91	0.49	-0.24	0.92	0.601	4		
Behavioural Intention	3.44	0.57	0.06	0.55	0.241	4	0.766	3
User Behaviour	3.24	0.67	-1.41	1.98	0.552	4	0.658	3
Digital Inclusion	3.21	0.64	0.61	0.19	0.323	4	No improvement attained	

The kurtosis indicates if a distribution is flatter than a normal curve with the same mean and standard deviation. It measures the amount of probability of the combined sizes of the two tails. The value is often compared to the kurtosis of the normal distribution, which is equal to 3 (Mukul, 2012). If the kurtosis is greater than 3, then the data set has heavier tails than a normal distribution. If the kurtosis is less than 3, then the data set has lighter tails than a normal distribution. In the results above, the kurtosis is less than 3 which means that the majority of responses is close to the mean value.

The skewness is used to measure the asymmetry of the probability distribution of a real-valued random variable about its mean. The value of skewness can be positive or negative or undefined (Metter, 2016). If skewness is between -1 and -0.5 or between 0.5 and 1, the distribution is moderately skewed. If skewness is between -0.5 and 0.5, the distribution is approximately symmetric. Table 4.2 shows one result that is highly skewed, being User Behaviour (-1.41) and two moderately skewed results, being Digital Inclusion (0.61) and Social Influence (-0.63). Symmetrical results are observed for Behavioural Intention (0.06), Effort Expectancy (0.38), Facilitating Conditions (-0.24) and Performance Expectancy (0.21). This again suggests that the majority of responses were distributed around the mean value.

Four constructs (Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions) had a Cronbach's Alpha coefficient of more than 0.6. The Cronbach Alpha is used to measure the internal consistency; that is how closely related are a set of items in a group. It is also used to measure the scale of reliability (Goforth, 2015). The results demonstrate that some constructs (Behavioural Intention, User Behaviour and Digital Inclusion) are not internally consistent, as their Cronbach Alphas are below 0.6. This value should be above 0.6 to ensure internal consistency (Malhotra, 2012). It was attempted to improve those constructs by deleting items that had a poor contribution to the scale. This measure assisted to improve the construct Behavioural Intention and User Behaviour (see the right-hand column). No further improvement was possible for Digital Inclusion. Consequently, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behavioural Intention and User Behaviour were found internally consistent in their measurement. This is a typical measure based on the correlations between different items on the same test. It refers to the degree to which test items measure the same construct (Malhotra, 2012). This means that it measures several items on the table that propose to measure the same constructs and that it produced similar results.

4.5 ASSESSING MULTI-COLLINEARITY

Table 4.3 represents the multi-collinearity of the five independent constructs (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, and Digital Inclusion). These constructs are independent as they affect the results of the User Behaviour towards using ERS. They are therefore not dependant on other constructs. This multi-collinearity test was conducted to assess if there is a similar correlation between the independent constructs. Multi-collinearity was assessed by examining the Tolerance and Variance Inflation Factor (VIF). The value of the Tolerance should be above 0.1 and the value of VIF is expected to be below 10 (Schreiber-Gregory & Jackson, 2017). The results indicate that there is no multi-collinearity issue found in all presented constructs, as the value of the Tolerance for each one is above 0.1 and VIF is below 10. This means that all the independent constructs are distinct enough to be considered as different entities. A multiple linear regression test was conducted to evaluate the impacts of Performance Expectancy, Effort Expectancy, Social Influence, Digital Inclusion and Facilitating Conditions on Behavioural Intention and on User Behaviour. The results of this test is presented next.

Table 4. 3 Multi-collinearity

Constructs	**Collinearity Statistics**	
	Tolerance	**VIF**
Performance Expectancy	0.383	2.614
Effort Expectancy	0.416	2.402
Social Influence	0.765	1.308
Facilitating Conditions	0.676	1.479
Digital Inclusion	0.815	1.227

4.6 MULTIPLE REGRESSION ANALYSIS

The multiple linear regression test was conducted to evaluate the impacts of Performance Expectancy, Effort Expectancy, Social inclusion, Digital inclusion, and Facilitating Conditions, on Behavioural Intention and the impact of Behavioural Intention on User Behaviour. The model predicting Behavioural Intention to use an ERS is statistically significant ($F = 11.389$; $R^2 = 0.481$; $P < 0.001$). This indicates that these predictors or constructs (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Digital Inclusion) explain up to 48.1% of the variance of Behavioural Intention to use an ERS.

Table 4.4 presents the predictive effect of each predictor or construct. The results reveal that Performance Expectancy (β = 0.301; p<0.001; t = 1.935), Effort Expectancy (β = 0.471; p<0.001; t = 3.157) have a positive and significant effect on Behavioural Intention. Therefore, these hypotheses (H1, H2 and H6) are accepted. Behavioural Intention (β = 0.394; p<0.001; t = 3.181) have a positive and significant effect on User Behaviour. The results also show that the effect of Social Inclusion (β = 0.079; p>0.001; t = 0.722), Digital Inclusion (β = 0.049; p>0.001; t = 0.455), and Facilitating Conditions (β = -0.085; p>0.001; t = -0.722), on Behavioural Intention is not statistically significant. Therefore, H3, H4, and H5 are rejected. This result suggests that Behavioural Intention to use an ERS is not driven by Social Inclusion, Digital Inclusion, and Facilitating Conditions.

Table 4. 4 Multiple regression analysis

Predictor	**Unstandardized Coefficients**	**Std. Error**	**Standardized Coefficients**	**t-value**	**p-value**
Performance Expectancy	0.475	0.246	0.301	1.935	0.050
Effort Expectancy	0.784	0.248	0.471	3.157	0.003
Social Influence	0.117	0.162	0.079	0.722	0.474
Digital Inclusion	0.066	0.145	0.049	0.455	0.651
Facilitating Conditions	-0.150	0.208	-0.085	-0.722	0.473
Behavioural Intention	0.342	0.107	0.394	3.181	0.002

4.7 CORRELATION MATRIX FOR THE CONSTRUCTS

The multiple regression analysis was preceded by a correlation test to ascertain the relationships between the constructs. Table 4.5 shows the correlation values between the constructs. This is a simple table of correlations that indicates a Pearson value of 1 as a positive linear relationship (r =1). A key result indicates that there is a significant correlation between Performance

Expectancy and Behavioural Intention (p = 0.632) and between Effort Expectancy and Behavioural Intention (p = 0.700). Both these values are significant at the 0.01 level. This means that there is a 99% chance that these correlations exist. A correlation table is usually presented using a lower triangle that allows one to see which pairs of constructs have the highest correlation. Each random variable (or construct) in a table is correlated with all other values in the table (Gliem & Gliem, 2003). The correlation matrix in Table 4.5 shows correlation coefficients for a combination of 6 constructs, namely Behavioural Intention, Performance Expectancy, Effort Expectancy, Social Inclusion, Facilitating Conditions and Digital Inclusion. The diagonal of the table is always a set of ones, because the correlation between a variable and itself is always 1. No significant correlations were found to exist between Social Inclusion and Behavioural Intention, between Facilitating Conditions and Behavioural Intention and between Digital Inclusion and Behavioural Intention. The first column in this table is of key importance, .as the five bottom constructs impact on Behavioural Indentation as evident in the extended UTAUT model (see Figure 2.10).

Table 4. 5 Correlation matrix

Constructs	**Behavioural Intention**	**Performance Expectancy**	**Effort Expectancy**	**Social Inclusion**	**Facilitating Condition**	**Digital Inclusion**
Behavioural Intention	1.000					
Performance Expectancy	0.632***	1.000				
Effort Expectancy	0.700***	0.733	1.000			
Social Influence	0.098	-0.014	0.121	1.000		
Facilitating Conditions	0.183	0.374	0.242	0.387	1.000	
Digital Inclusion	0.321	0.370	0.385	-0.023	0.219	1.000

*** Correlation is significant at the 0.01 level

4.8 MODERATION ANALYSIS

Moderation analysis occurs when the relationship between two variables depends on a third variable. The third variable is usually referred to as moderator variable or moderator (Kenny, 2018). According to the UTAUT model, age, gender, and years of experience were specified as

moderators of the predictors of Behavioural Intention. These moderators have no statistically significant relationships to Behavioural Intention, as shown in Table 4.6. All the hypotheses are therefore rejected. This suggests that an academic's age, gender or years of experience is not related to the adoption of an ERS.

Table 4. 6 Moderation analysis

Independent	Moderator	T Statistics	P Values	Description	Conclusion on Hypotheses
Performance Expectancy	Age	1.234	0.218	The p-value (0.218) of the interaction effect is not significant. Therefore, age does not moderate the relationship between Performance Expectancy and Behavioural Intention. Meaning: the relationship between Performance Expectancy and Behavioural Intention does not significantly differ across age groups.	**H1a Rejected**
	Gender	0.253	0.800	The p-value (0.800) of the interaction effect is not significant. Therefore, gender does not moderate the relationship between Performance Expectancy and Behavioural Intention. Meaning: the relationship between Performance Expectancy and Behavioural Intention does not significantly differ across gender.	**H1b Rejected**
	Years of experience	0.624	0.533	The p-value (0.533) of the interaction effect is not significant. Therefore, years of experience does not moderate the relationship between Performance Expectancy and Behavioural Intention. Meaning: the relationship between Performance Expectancy and Behavioural Intention does not significantly differ with years of experience in using an ERS.	**H1c Rejected**
Effort Expectancy	Age	1.275	0.203	The p-value (0.203) of the interaction effect is not significant. Therefore, age does not moderate the relationship between Effort Expectancy and Behavioural Intention. Meaning: the relationship between Effort Expectancy and Behavioural Intention does not significantly differ across age group.	**H2a Rejected**
	Gender	0.152	0.879	The p-value (0.218) of the interaction effect is not significant. Therefore, gender does not moderate the relationship between Effort Expectancy and Behavioural Intention. Meaning: the relationship between Effort Expectancy and Behavioural Intention does not significantly differ across gender.	**H2b Rejected**
	Years of experience	1.514	0.131	The p-value (0.131) of the interaction effect is not significant. Therefore, years of experience does not moderate the relationship between Effort Expectancy and Behavioural Intention. Meaning: the relationship between Effort Expectancy and Behavioural Intention does not significantly differ with years of experience in using an ERS.	**H2c Rejected**
Social Influence	Age	0.192	0.848	The p-value (0.848) of the interaction effect is not significant. Therefore, age does not moderate the relationship between Social Influence and Behavioural Intention. Meaning: the relationship between Social Influence and Behavioural Intention does not significantly differ across age.	**H3a Rejected**

	Gender	0.133	0.894	The p-value (0.894) of the interaction effect is not significant. Therefore, gender does not moderate the relationship between Social Influence and Behavioural Intention. Meaning: the relationship between Social Influence and Behavioural Intention does not significantly differ across gender.	**H3b Rejected**
	Years of experience	1.057	0.291	The p-value (0.291) of the interaction effect is not significant. Therefore, years of experience does not moderate the relationship between Social Influence and Behavioural Intention. Meaning: the relationship between Social Influence and Behavioural Intention does not significantly differ with years of experience in using an ERS.	**H3c Rejected**
Digital Inclusion	Age	0.192	0.848	The p-value (0.848) of the interaction effect is not significant. Therefore, age does not moderate the relationship between Digital Inclusion and Behavioural Intention. Meaning: the relationship between Digital Inclusion and Behavioural Intention does not significantly differ across age.	**H4a Rejected**
	Gender	0.133	0.894	The p-value (0.894) of the interaction effect is not significant. Therefore, gender does not moderate the relationship between Digital Inclusion and Behavioural Intention. Meaning: the relationship between Digital Inclusion and Behavioural Intention does not significantly differ across gender.	**H4b Rejected**
	Years of experience	1.057	0.291	The p-value (0.291) of the interaction effect is not significant. Therefore, years of experience does not moderate the relationship between Digital Inclusion and Behavioural Intention. Meaning: the relationship between Digital Inclusion and Behavioural Intention does not significantly differ with years of experience in using an ERS.	**H4c Rejected**
Facilitating Conditions	Age	0.403	0.687	The p-value (0.687) of the interaction effect is not significant. Therefore, age does not moderate the relationship between Facilitating Conditions and Behavioural Intention. Meaning: the relationship between Facilitating Conditions and Behavioural Intention does not significantly differ across age.	**H5a Rejected**
	Gender	0.708	0.480	The p-value (0.480) of the interaction effect is not significant. Therefore, gender does not moderate the relationship between Facilitating Conditions and Behavioural Intention. Meaning: the relationship between Facilitating Conditions and Behavioural Intention does not significantly differ across gender.	**H5b Rejected**
	Years of experience	0.846	0.398	The p-value (0.398) of the interaction effect is not significant. Therefore, years of experience does not moderate the relationship between Facilitating Conditions and Behavioural Intention. Meaning: the relationship between Facilitating Conditions and Behavioural Intention does not significantly differ with years of experience in using an ERS.	**H5c Rejected**

4.9 DESCRIPTIVE STATISTICS

Descriptive statistics is a brief descriptive coefficient that summarizes a given data set, which can be either a representation of the entire population or a sample of a population. The structure

of descriptive statistics is the foundation of fundamentally all quantitative analysis of data with straightforward graphic analysis (Kenton, 2018). Descriptive statistics is usually broken down into measures of central tendency and measures of variability. However, it can also be used to visualize raw data in graph form. In this section, the total number of responses for each question in the questionnaire are shown by means of a figure. The results of the actual responses to all the constructs are thus shown graphically. No reasons for the responses are provided as only the quantitative data is presented in this section. A further discussion of these quantitative results will be given in Chapter 5. The title of each figure (given at the top) represents each construct. The horizontal axis of each figure represents the respective questions for each construct, whereas the vertical axis represents the frequency of responses as a percentage of all responses for each question. Five responses were available according to the Likert scale (1 = Strongly Agree; 2 = Agree; 3 = Neutral; 4 = Disagree; 5 = Strongly Disagree).

4.9.1 Performance Expectancy

Figure 4.1 represents the results related to Performance Expectancy. The Performance Expectancy construct had four questions, as depicted in Figure 4.1. 89.1% of the participants (27.6% + 62.1%) agreed that they found an ERS that were provided as being useful in their classroom while 87.9% of the participants (22.4% + 65.5%) agreed that using an ERS provided by the University increases their productivity. The majority of participants 70% (31% + 39.7%) also agreed that the use of ERS increases student engagement in the classroom. However, 3.4% of participants disagreed with this statement, while 25.9% were neutral.

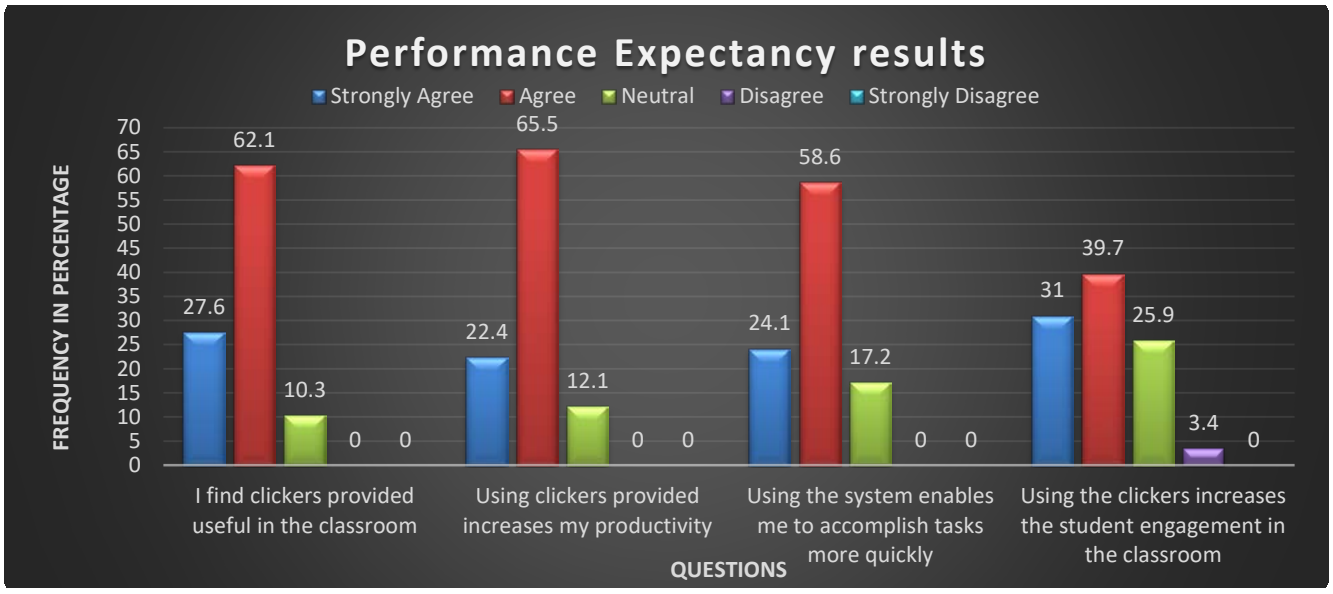

Figure 4. 1 Questions relating to Performance Expectancy

4.9.2 Effort Expectancy

Figure 4.2 represents the results related to Effort Expectancy that is the second construct in the UTAUT model to be addressed. The Effort Expectancy construct had four questions.

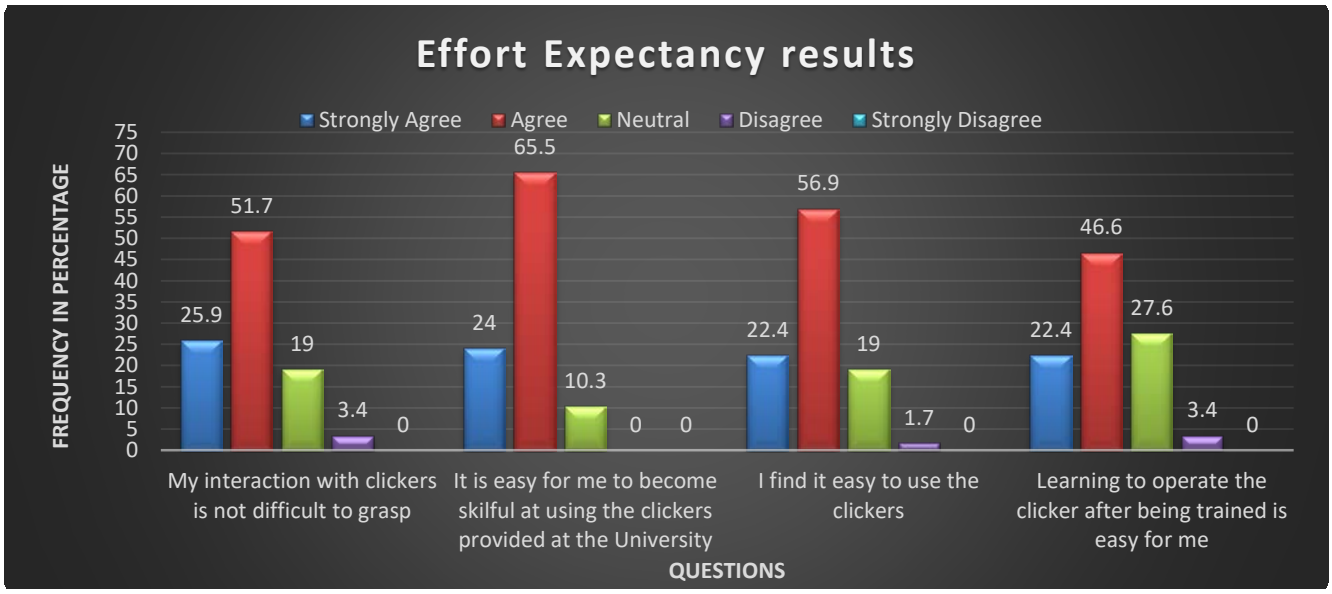

Figure 4. 2 Questions relating to Effort Expectancy

77.6% (25.9% + 51.7%) of the participants agreed that the interaction with ERS is not difficult to grasp while 89.5% of participants (24% + 65.5%) agreed that it is easy for an academic to become skilful at using an ERS provided at the University. 69% (22.4% + 46.6%) of participants indicated that learning to operate an ERS after being trained makes it easier to use them. However, 3.4% of the academics disagreed with this statement, with 27.6% being neutral.

4.9.3 Facilitating Conditions

Facilitating Conditions is the third construct in the UTAUT model to be addressed in Figure 4.3. The construct had four questions. 81.1% of participants (12.1% + 69%) agreed that they have the resources necessary to use an ERS. However, a small percentage of 6.9% of the participants disagreed (5.2% + 1.7%) with this statement. Only 8.6% of the participants agreed that ERS are similar to other learning tools while 44.8% where neutral in this regard. The majority of the respondents (43.1% + 48.3% = 91.4%) felt that the e-Learning Department at the University is available to deal with technical matters, relating to the use of ERS.

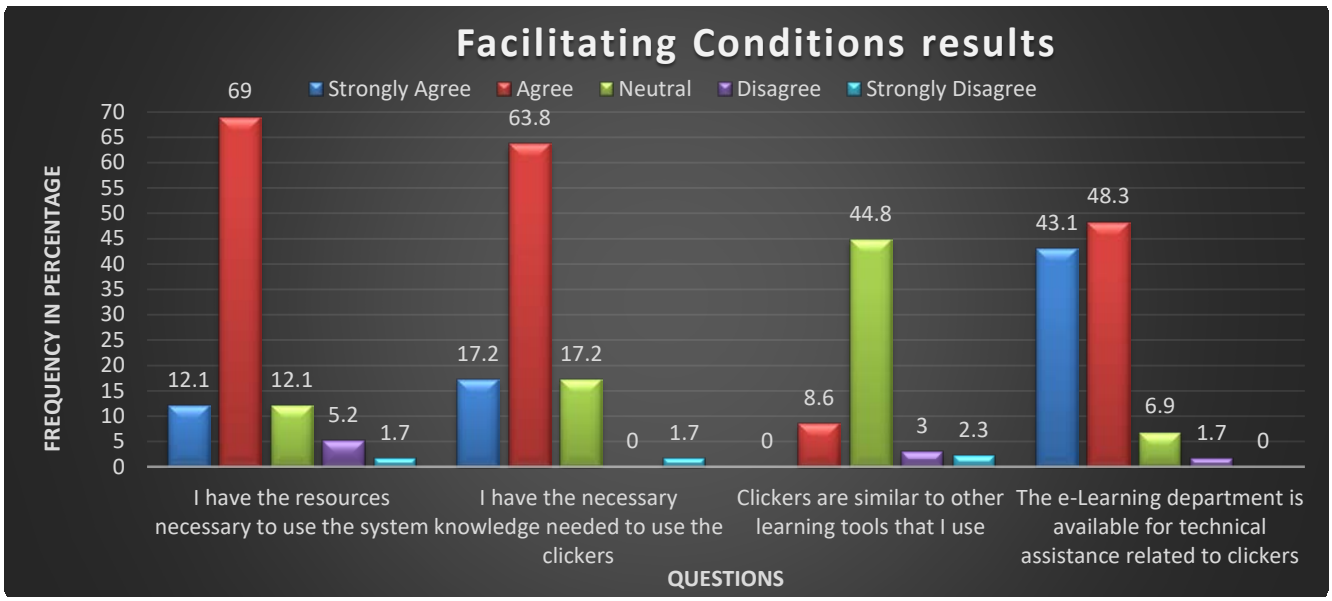

Figure 4. 3 Questions relating to Facilitating Conditions

4.9.4 Digital Inclusion

Digital Inclusion is the forth added construct to the UTAUT model to be addressed in Figure 4.4. This construct also had four questions.

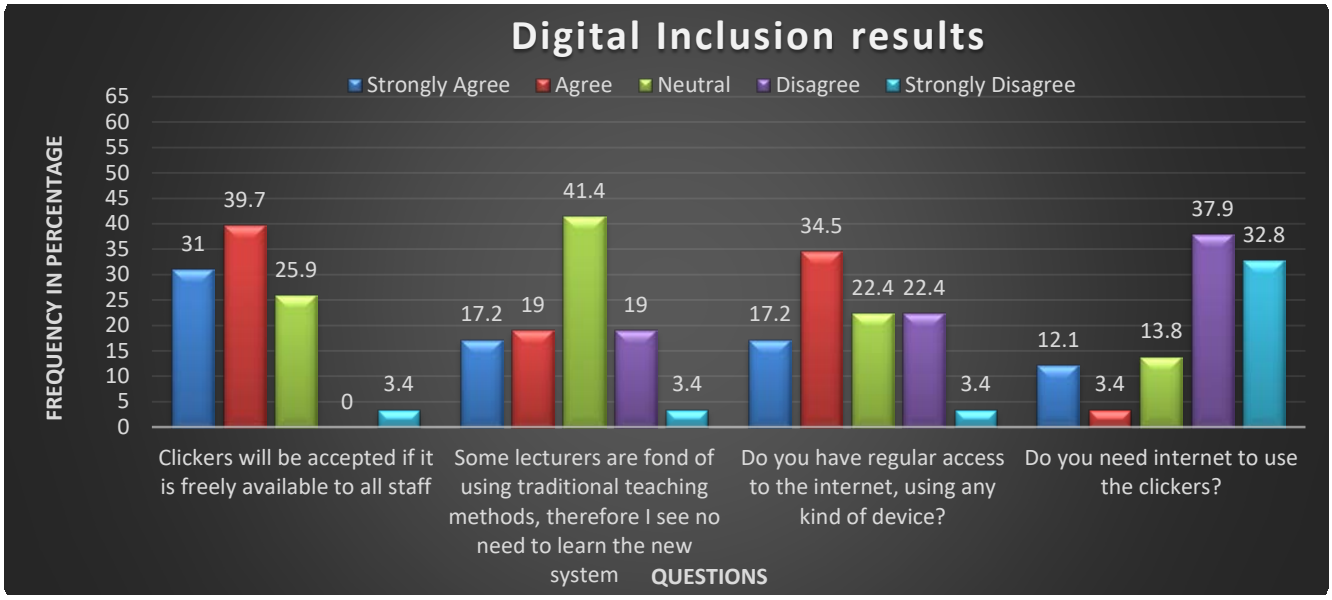

Figure 4. 4 Questions relating to Digital Inclusion

70.7% of participants (31% + 39.7%) agreed that ERS will be accepted if they are freely available to all the academics. 41.4% of the participants were neutral when asked if lecturers are fond of using traditional teaching methods and therefore see no need to learn about ERS. Only 36.2% (17.2% + 19%) agreed with this statement. The results also indicate that 15.5% of

the participants (12.1% + 3.4%) agreed that they need access to the internet to use an ERS, while 37.9% disagreed with this statement. It was found that this construct was not internally consistent, as its Cronbach Alpha was below 0.6 as shown in Table 4.2. It is therefore to be removed from the extended UTAUT model given in Chapter 2.

4.9.5 Social Influence

The Social Influence is the fifth construct in the UTAUT model to be addressed in Figure 4.5. This figure represents the results which had four questions. 67.5% of participants (8.6% + 58.6%) indicated that lecturers and other staff members have been helpful in assisting them to use an ERS. However, 8.6% disagreed with this statement. 55.2% of the participants (8.6% + 46.6%) agreed that people who influence their behaviour think that they should use the system while 36.2% were neutral in this regard.

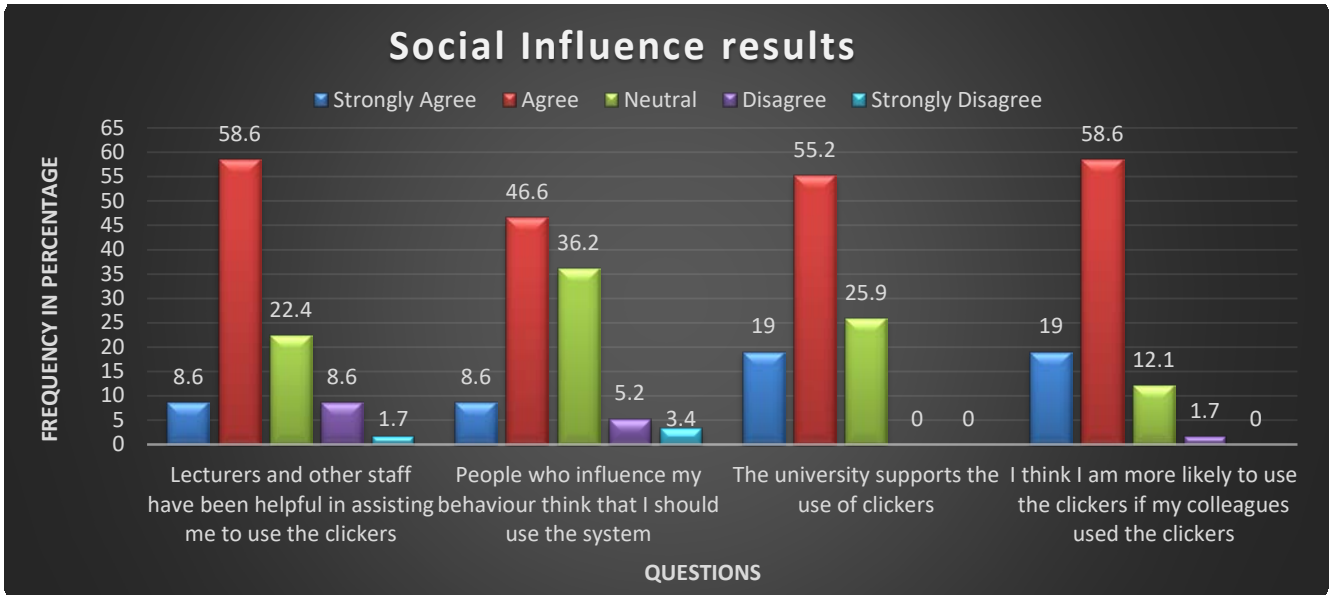

Figure 4. 5 Questions relating to Social Influence

77% of the participants (19% + 58%) believe they are more likely to use an ERS if their colleagues use them as well.

4.9.6 Behavioural Intentions

Figure 4.6 represents the results related to Behavioural Intentions in the UTAUT model. The Behavioural Intentions construct had four questions. 69% of the participants (29.3% + 39.7%) agreed to use an ERS throughout the year once they knew how to use them. 39.6% of the

participants (17.2% + 22.4%) agreed that they plan to use an ERS in the next semester. However, 39.6% (31% + 8.6%) disagreed to do this. The majority of participants (25.9% + 34.5% = 60.4%) agreed that they plan to use an ERS frequently in the future. Question 4 in this construct was removed to improve the internally consistency of this construct so that its Cronbach Alpha value finally equalled 0.766 (see Table 4.2).

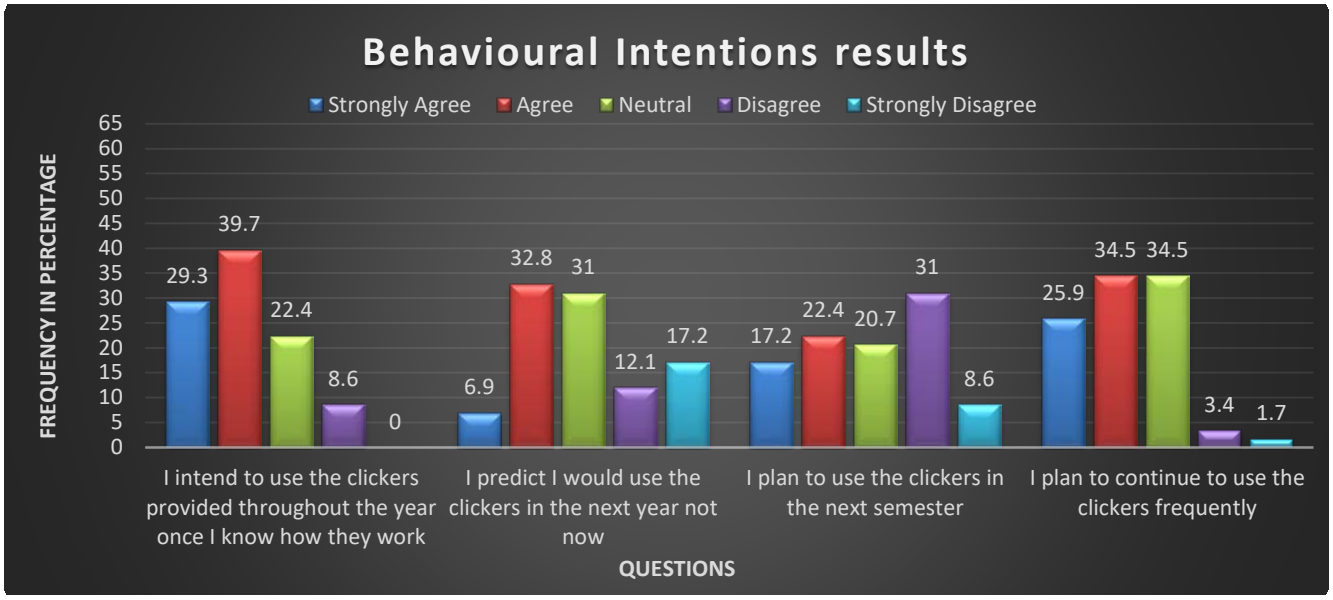

Figure 4. 6 Questions relating to Behavioural Intention

4.9.7 User Behaviour

Figure 4.7 represents the results related to User Behaviour in the UTAUT model. Four questions are depicted once again. 46.6% of participants (25.9% + 20.7%) agreed to use an ERS for personal use like conferences and workshops. The majority (27.6% + 10.3% = 37.9%) of the participants indicated that they do not regularly use ERS in their classrooms, while 36.2% were neutral in this regard. 72.4% of participants (56.9%+ 15.5%) indicated that they do not really want to use an ERS to perform their lecture duties.

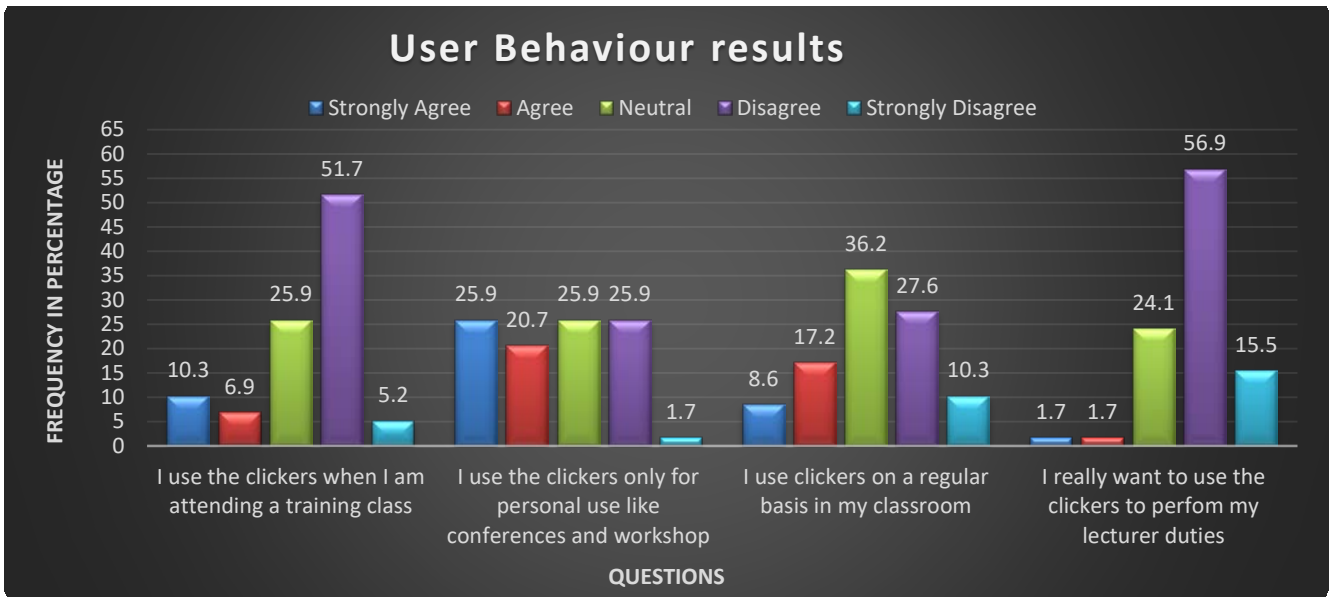

Figure 4. 7 Questions relating to User Behaviour

Question 3 in this construct was removed to improve the internally consistency of this construct so that its Cronbach Alpha value finally equalled 0.658 (see Table 4.2).

4.10 SUMMARY

In this chapter, a detailed description of the data analysis and results were given, as retrieved and interpreted from the questionnaire. Firstly, the demographics of the 57 participants who volunteered to participate in this study were given that indicates that the majority of academics are female (52.6%), with the largest number belonging to the age group of 20 to 39 years of age (42.1%). The demographic profile also shows that many of the academics hold a senior lecturer position (42.1%), while 47.4% of the academics reported being in academia for 6-10 years. This was followed by a presentation of the data analysis. This included a reliability analysis, correlation and assumption of multi-collinearity and a multiple linear-regression test. The main result indicates that the five independent constructs (Performance Expectancy, Effort Expectancy, Social Inclusion, Facilitating Conditions and Digital Inclusion) explain up to 48.1% of the variance of Behavioural Intention to use an ERS. Digital Inclusion should not be included as a construct as it was not internally consistent. It is therefore removed from the extended UTAUT model as proposed in Chapter 2. Another key result indicates that there exists a statistically significant correlation between Performance Expectancy and Behavioural Intention ($p = 0.632$) and between Effort Expectancy and Behavioural Intention ($p = 0.700$).

The next chapter entails a discussion of the results as given in this chapter. Appropriate recommendations will also be given based on the acceptance or rejection of the hypotheses.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapter covered the results of the study. The results of this current study are quantitative and were analysed using descriptive statistics. The chapter also presented participant demographics, instrument reliability and validation, the multiple regression analysis and descriptive statistics for each construct in the UTAUT model. In this chapter, the findings depicted in the previous chapter, are discussed. This chapter also includes an overview of the chapters, research questions resolved, hypothesis reviewed, final extended UTAUT model and recommendations.

5.2 OVERVIEW OF THE CHAPTERS

In this section, an overview of the previous four chapters is repeated (as reflected in Chapter 1), as follows:

Chapter 1: This chapter presented the introduction by outlining the background of emerging technologies in higher education and the advantages of using them. One such technology is an Electronic Response System (called an ERS in this research), used to engage students in a classroom in higher education. The chapter further introduced technology adoption models, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) model. This last one was selected for the study and used to assess the adoption of an ERS by academics in higher education. The UTAUT model is selected from various theoretical models as a result of its ability to adapt to diverse studies, being capable of helping to understand complex technologies, such as an ERS. The problem statement in the study highlighted the unsatisfactory level of adopting an ERS at a university amongst academics, which needed to be addressed. Six research questions were posed and one of them stated: “what are the factors that may influence the adoption of an ERS at a University of Technology”. These questions are answered in Chapter 5. Three research objectives were posed and one of the objectives was to determine the factors associated with the adoption and usage of ERS by academics using variables in the UTAUT model. The chapter also covered important definitions, the value of the research section, a brief methodology section and delimitations. One of the limitations in the study stated that certain departments at the University would be excluded due to the fact that a limited number of ERS exist.

Chapter 2: This chapter presented the literature review of technology in higher education and the importance of technology to digital natives and digital immigrants. A few important sectors in the world where technology is important were noted, that included the Health system and the Education system. The Education system was further discussed with different methods to deliver education and some advantages of using technology in education. One of the advantages mentioned were to improve learning skills in higher education and to build online skills. Although technology may have advantages in higher education, there are some disadvantages that included access to inappropriate content, which meant students can always be exposed to access even bad and violent information quickly, like pornography and violence. The chapter explained in more detail the various technology adoption models, with special emphasis on the UTAUT model. The UTAUT model is selected as the model for this study to help determine the cause of underutilization of an ERS in higher education and to assess the behavioural intention of using it. The chapter further discussed background information about ERS as it was developed in the mid 1980's. Research from different writers in assessing ERS's effectiveness was discussed with the advantages and disadvantages contrasted. A detailed explanation of using an ERS during classroom time was discussed. The chapter concluded with the UTAUT model and its constructs, demonstrating how it will be used with some hypothesis questions and how it will be used to assess the user behaviour with an ERS.

Chapter 3: This chapter presented the methodology and data collection techniques, demonstrating a summary of the statistics, which are to be used in the analysis. This study explained the reasons for using an exploratory case study to gather quantitative data. The research onion was discussed and explained in detail with a diagram including the paradigms, the research approach, the research strategies, the research choices, the time horizon, the techniques and procedures and the data collection. The link to the questionnaire was sent to 80 academics at the University using Google forms. Sampling techniques were discussed where convenience sampling was selected. Statistical analysis methods were briefly mentioned, that included the Reliability and Normality test, Multi-collinearity, Multiple Regression analysis and finally the Correlation Matrix. The Ethical consideration section stated that no sensitive data would be collected and that participation and was completely voluntary. The study was approved by the Research and Innovation Committee of the Faculty of Engineering, Built Environment and Information Technology.

Chapter 4: This chapter focused on the findings of the study along with appropriate discussions. It covered a detailed description of the data as retrieved and interpreted from the questionnaire. Firstly, the profile of the 57 participants who volunteered to participate in this study were given that indicates that the majority where female (52.6%), with the largest number belonging to the age group of 20 to 39 years of age (42.1%). The demographic profile also showed that many of the academics hold a senior lecturer position (42.1%), while 47.4% of the academics reported being in academia for 6-10 years.

The results also included a Reliability and Normality test where the reliability analysis was conducted on seven constructs to measure the internal consistency of each construct and the normality analysis determined whether the data has a normal distribution or not. The Cronbach Alpha was used to measure the internal consistency; that is how closely related are a set of items in a group. Four of the seven constructs had a Cronbach Alpha coefficient of more than 0.6, which is acceptable. A question relating to Behavioural Intention and User Behaviour had to be removed to enable a value of more than 0.6 for those two constructs. The construct Digital Inclusion could not be improved, and can therefore not be included in the proposed model. The kurtosis values were less than 3, which means that the majority of responses were close to the mean value.

A Multiple Regression Analysis test was also conducted that is used to inform the relationship between one or more explanatory variables. The results indicated that five constructs (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Digital Inclusion) explain up to 48.1% of the variance of Behavioural Intention to use an ERS.

The Correlation Matrix for the constructs were presented that indicated that there is a significant correlation between Performance Expectancy and Behavioural Intention ($p = 0.632$) and between Effort Expectancy and Behavioural Intention ($p = 0.700$). Both these values are significant at the 0.01 level. The Moderation Analysis results showed that the moderators have no statistically significant relationships to Behavioural Intention. All the hypotheses were therefore rejected. This suggested that an academic's age, gender or years of experience is not related to the adoption of an ERS. Descriptive statistics were also presented showing the actual responses of the participants to the questionnaire.

5.3 RESEARCH QUESTIONS RESOLVED

In this section, the research questions are repeated (as reflected in Chapter 1), followed by a direct answer.

i) What are the factors that may influence the adoption of an ERS at a University of Technology?

According to the statistics indicated in Chapter 4 (see Table 4.4), the results reveal that Performance Expectancy ($\beta = 0.301$; $p<0.001$; $t = 1.935$) and Effort Expectancy ($\beta = 0.471$; $p<0.001$; $t = 3.157$) have a positive and significant effect on Behavioural Intention. Therefore, these hypotheses (H1, H2 and H6) are accepted. Behavioural Intention ($\beta = 0.394$; $p<0.001$; $t = 3.181$) also has a positive and significant effect on User Behaviour. The results also show that the effect of Social Inclusion ($\beta = 0.079$; $p>0.001$; $t = 0.722$), Digital Inclusion ($\beta = 0.049$; $p>0.001$; $t = 0.455$), and Facilitating Conditions ($\beta = -0.085$; $p>0.001$; $t = -0.722$), on Behavioural Intention is not statistically significant. Therefore, these constructs were rejected. This result suggests that Behavioural Intention to use an ERS is not driven by Social Inclusion, Digital Inclusion, and Facilitating Conditions but by Performance Expectancy and Effort Expectancy.

ii) What is the degree to which academics believe that using an ERS will improve their job performance?

According to Figure 4.1, the Performance Expectancy construct had four questions attached to it. 89.1% of the participants agreed that they find an ERS as being useful in their classroom, while 87.9% of the participants agreed that using it will increase their productivity. This shows that the majority of academics believe that an ERS will provide benefits to their job performance. The statistics did show that there was a statistical significant relationship between Performance Expectancy and Behavioural Intention.

iii) What factors influence academics to perceive an ERS as difficult to use?

According to Figure 4.2, the Effort Expectancy construct had four questions. 77.6% of the participants agreed that the interaction with an ERS is not difficult to grasp while 89.5% of them agreed that it is easy for an academic to become skilful at using it. These results show that

some academics justified to say that an ERS is too difficult to use, therefore they cannot adapt to use ERS. These justifications were not adequate enough for academics not to adapt to an ERS. The results did show that there was a statistical significant relationship between Effort Expectancy and Behavioural Intention.

iv) To what extend does Social Influence affect academics use of an ERS?

According to Figure 4.5, the Social Influence construct had four questions. 67.5% of participants indicated that lecturers and other staff members had been helpful in assisting them to use an ERS while 77% believed they are more likely to use it if their colleagues use them as well. The results demonstrate that academics are mostly influenced by their colleagues to use an ERS. The results did show that there was no statistical significant relationship between Social Influence and Behavioural Intention.

v) To what extent do academics feel that they have enough support to use an ERS?

According to Figure 4.3, the Facilitating Conditions construct that had four questions. 81.1% of the participants agreed that they had the resources necessary to use an ERS, while 91.4% felt that the e-Learning Department at the University is available to deal with technical matters relating to the use of it. These results indicate that the majority of the academics feel that there are sufficient resources and support to use an ERS. The results did show that there was no statistical significant relationship between Facilitating Conditions and Behavioural Intention

vi) Are academics at a University of Technology behaviourally inclined to use an ERS?

According to Figure 4.3, the Behavioural Intentions construct had four questions. 69% of the participants agreed to use an ERS throughout the year, once they knew how to use it. The majority of participants (60.4%) agreed that they plan to use an ERS frequently in the future. This indicates that almost two-thirds of the participants would be behaviourally inclined to use an ERS in the future. The results did show that there was a statistical significant relationship between Behavioural Intention and User Behaviour.

5.4 HYPOTHESES REVIEWED

In this section, the hypotheses are clarified that were presented in Chapter 2. There are 16 hypotheses for this study that were formulated as follows:

H1a: Performance Expectancy influences behavioural intention positively more for younger instructors than for older academics.
H1b: Performance Expectancy influences positively towards the behavioural intention of an ERS for experienced users.
H1c: Performance Expectancy influences positively towards the behavioural intention more of female than male users.
H2a: Effort Expectancy has a positive effect on behavioural intention towards ERS more for younger academics than older academics.
H2b: Effort Expectancy has a positive effect on behavioural intention towards an ERS for academics with more educational technology experience.
H2c: Effort Expectancy has a greater positive effect on female than on male academics regarding their behavioural intention.
H3a: Social Influence has a greater positive effect on the use of an ERS by younger academics than for older ones.
H3b: Social Influence has a greater positive effect for experienced users of an ERS than experience technology experience.
H3c: Social Influence has a greater positive effect on the use of an ERS by males than for females.
H4a: Digital Inclusion has a greater positive effect on the use of an ERS by younger academics than for older ones.
H4b: Digital Inclusion will have a greater positive influence on the behavioural intention of academics with more educational technology experience.
H4c: Digital Inclusion will have a greater positive influence towards males than towards females in terms of their Behavioural Intentions.
H5a: Facilitating Conditions has a positive effect towards the Behavioural Intention for younger academics than older academics.
H5b: Facilitating Conditions has a greater positive effect for experienced users of an ERS than less experience technology users.
H5c: Facilitating Conditions has a greater positive effect for male users than female users on the support given regarding the use of an ERS.

H6: Users Behavioural Intentions to use ERS positively affect the users' use behaviour of actually using ERS.

The results suggest that Behavioural Intention to use an ERS is not really driven by Social Influence, Digital Inclusion, and Facilitating Conditions. However, adoption of an ERS seems to be driven by Performance Expectancy and Effort Expectancy. The results also indicate that age, experience or gender play no significant role in the adoption of such a system

5.5 FINAL EXTENDED UTAUT MODEL

In this study, the model was extended by adding Digital Inclusion, which was rejected since it had no statistical significance toward the Behavioural Intentions of individuals to adopt ERS's. Its internal consistency was also not established, which may suggest that the questions used in the questionnaire need to be reviewed. The final results do indicate that the constructs explain up to 48.1% of the variance of Behavioural Intention to use an ERS. Figure 5.1 presents the constructs with their statistical results.

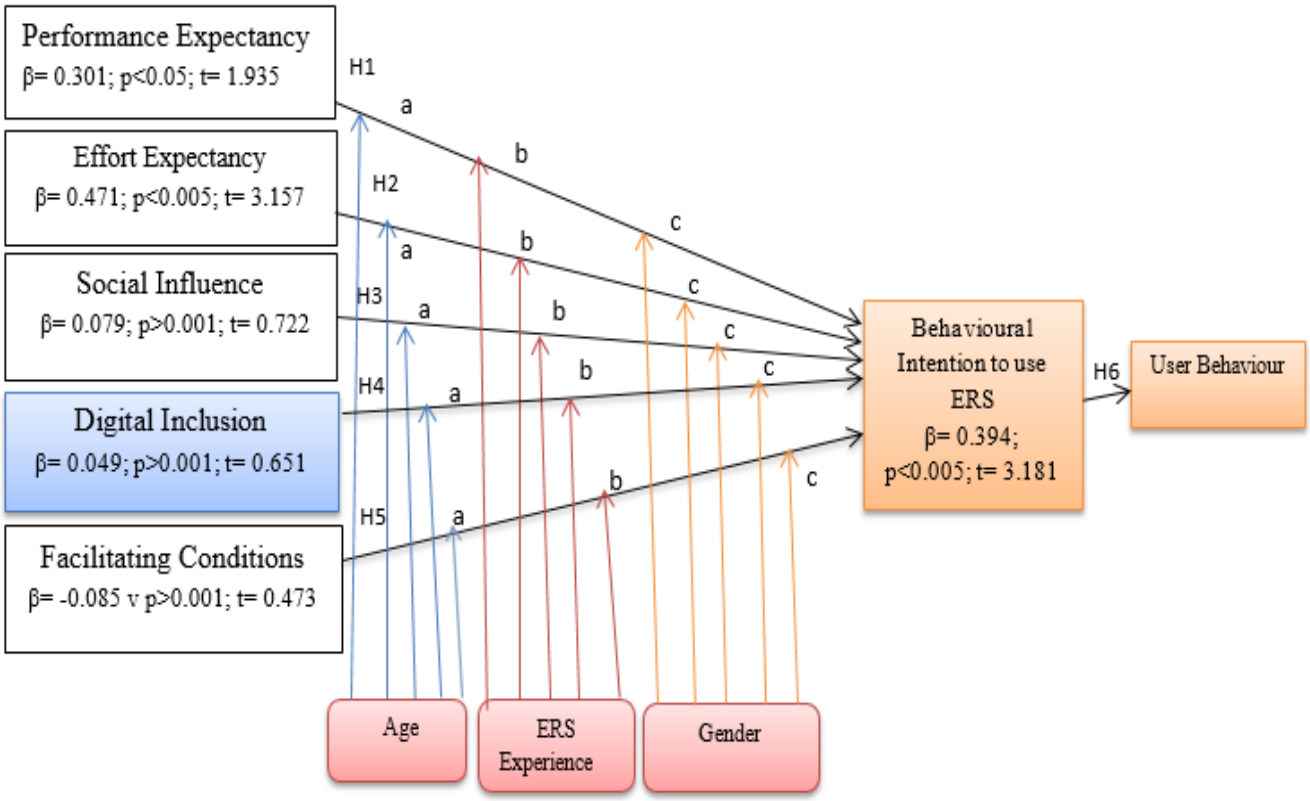

Figure 5. 1 Original UTAUT model with the additional construct that has been rejected

Performance Expectancy (β= 0.301; p<0.05; t= 1.935) and Effort Expectancy (β= 0.471; p<0.005; t= 3.157) have a positive and significant effect on Behavioural Intention. Social Influence (β= 0.079; p>0.001; t= 0.722), Digital Inclusion (β= 0.049; p>0.001; t= 0.651) and Facilitating Conditions (β= -0.085 v p>0.001; t= 0.473), have no significant effect on Behavioural Intention. Behavioural Intention (β= 0.394; p<0.005; t= 3.181) had a positive significant effect on User Behaviour.

5.6 RECOMMENDATIONS

The UTAUT model was used to assess the adoption of an ERS. A new construct was added to the original model, being Digital Inclusion. No internal consistency was established for this construct; neither was it found to be statistically significant towards Behavioural Intention. It is recommended that the questions regarding this construct be reviewed. Its effect could also be determined with regard to other technological devices, such as smartphones and tablets.

According to the UTAUT model, age, gender, and years of experience were specified as moderators of the predictors of Behavioural Intention. These moderators have no statistically significant relationships to Behavioural Intention. It is therefore recommended to market an ERS to all academics, irrespective of age, gender and year of experience. This shows that an ERS can be used by anyone whether male or female, young or old or with more work experience or less experience.

Two constructs that were statistically significant towards Behavioural Intention to use an ERS, were Performance Expectancy and Effort Expectancy. This shows that academics value an ERS's to perform well in their job and makes to it easy to use an ERS. Therefore, an ERS's ability must be marketed to academics to make their job easy and to perform well in their work.

The study also had a limitation. The questionnaire was not distributed to all academics in the University, but only to a few departments. This was a limitation because the University brought a few ERS systems to be used by academics. It is therefore recommended that the University invest in more such ERS, so as to make it more available to all academics.

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Annexure A: Main Study Questionnaire

Assessing Technology Adoption at a University of Technology: A Case Study of Electronic Response Systems

Initials& Surname: Onalenna Pearl Tsumake

Department: Centre for E-learning Technology

Telephone: 0515073186

QUESTIONNAIRE FORM

Purpose of this research

This is a questionnaire for all academics at the University that have attended the Electronic Responsive System (ERS or "clickers") training seminar/workshop offered by the Central University of Technology at the Centre for E-learning Technology. The aim of this research is to investigate how academics are adapting to the new ERS ("clickers") and how adequate it is being utilised by academics during classroom and workshop sessions. This research forms part of my MTech research study in the field of Information Technology.

The questionnaire

The purpose of this questionnaire is to gather academics' perceptions about adopting and using an ERS "clickers" in their respective modules. The questionnaire has three sections and is completely anonymous, having no impact on any work related duties or rewards. Please read the instructions provided for each section. This questionnaire should take no more than 25 minutes to complete.

SECTION A: Biographical Details

Instructions: Please put an **X** in the most appropriate **Block.**

Gender

Male	1
Female	2

Age group

20-39 years old	1
40-49 years old	2
50 and above	3

Position

Assistant lecturer	1
Junior lecturer	2
Senior lecturer	3
Academic support	4
Professor	5

Your years of experience of teaching at University level

Less than 1 year	1
2-5 years	2
6-10 years	3
11-15 years	4

Which Faculty

Academic Support	1
Humanities	2
Health	3
Engineering	4
Management Sciences	5

SECTION B: Performance Expectancy Questions

Instruction: Please put an **X** in the most appropriate Block.

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
I find clickers provided by the University useful to the teaching in classroom					
Using the clickers provided in the University increase my productivity.					
Using the system enables me to accomplish tasks more quickly.					
Using the clickers provided in the University increases the student engagement in the classroom					

SECTION C: Effort Expectancy Questions

Instruction: Please put an **X** in the most appropriate **Block**

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
My interaction with the clickers available to the University, is clear and understandable.					
It is easy for me to become skilful at using the clickers provided in the University.					
I find it easy to use clickers provided by the University.					
Learning to operate the clickers after being trained is easy for me					

SECTION D: Social Influence Questions

Instruction: Please put an **X** in the most appropriate **Block**

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
The lecturers and other staff in my institution have been helpful in using the clickers and knowing how to operate them.					
People who influence my behaviour think that I should use the system.					
In general, the University supports the use of clickers.					
I think I am more likely to use the clickers if my colleagues used the clickers.					

SECTION E: Facilitating Conditions Questions

Instruction: Please put an **X** in the most appropriate **Block**

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
I have the resources necessary to use the clicker system.					
I have necessary knowledge needed to use the clickers					
Clickers are similar to other learning tools that I use.					
A specific group(E-learning) is available for assistance with the clickers usage difficulties					

SECTION F: Behavioural Intentions Questions

Instruction: Please put an **X** in the most appropriate **Block**

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
I intend to use the clickers provided throughout the year once I know how they work.					
I predict I would use the clickers in the next year not now.					
I plan to use the clickers provided in the next semester.					
I plan to continue to use the clickers frequently.					

SECTION G: User Behaviour Questions

Instruction: Please put an **X** in the most appropriate **Block**

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
I use the clickers when I am attending a training class.					
I use the clickers only for personal use like conferences, workshop not necessarily for classroom.					
I use clickers on a regular basis in my classroom.					
I really want to use the clickers to perform my lecture duties.					

SECTION H: Digital Inclusion Questions

Instruction: Please put an **X** in the most appropriate Block

Statement	**1 Strongly disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly agree**
Clicker will be accepted if it is freely available to all staff members.					
Some lecturers are fond of using traditional teaching methods and therefore see no need to learn about this new technology, even if it is freely available.					
Do you have regular access to the internet, using any kind of device (eg clickers)?					
Do you need internet to use the clickers?					

Thank you very much for completing this questionnaire

Annexure B: Ethical Clearance

A letter was submitted to the Faculty Research and Innovation Committee (FRIC) for ethical clearance. The letter was approved in the meeting which was held (see snapshot).

8.13 OP Tsumake (M.Tech: Information Technology)

Request for ethical clearance

Request **FRIC2016/05/8.13**

Resolution: FRIC2016/05/8.13

FRIC approved the request for ethical clearance for Ms OP Tsumake for the use of the questionnaire which in NO way requires any sensitive or private information.