EXTENDING THE TECHNOLOGY ACCEPTANCE MODEL IN E-LEARNING DISCUSSION FORUM ADOPTION: UNIVERSITY OF TECHNOLOGY STUDENTS' PERSPECTIVES

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Declaration

I, Jenny Louw, hereby declare that this work has not previously been 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 Masters in Information Technology at the Department of Information Technology, Central University of Technology. 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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Jenny Louw

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Dedication

This thesis is dedicated to my wonderful husband, Louis, whose abiding love and support has kept me motivated during the challenges of my Master's studies. I also dedicate this work to my parents, Nicolene and Pieter Aucamp and brother, Petri, who always believed in my abilities to achieve in whatever I aspire to become.

Abstract

The advancement of Information and Communication Technology and the Internet for educational purposes has been a staple discourse among researchers in recent years. However, preliminary investigations indicate that e-learning systems are underutilised due to the fact that some of their major features, like electronic discussion forums, remain inactive. Despite several scholars reporting on high levels of e-learning system implementation at Universities of Technology, it is unnerving that discussion forums within these platforms remain poorly utilised.

The purpose of this study is to establish constructs that may promote the adoption and use of discussion forums. The Technology Acceptance Model forms the theoretical framework for this study and is extended by including digital inclusion, attention and perceived enjoyment. The research design adopted in this study was a mixed-method approach, focusing on both quantitative and qualitative data analysis. The target population for qualitative data collection was 210, however, only 182 agreed to participate in the study. Qualitative data was collected from thirty participants who were purposefully selected from a third year Information Technology class and interviewed with regards to the different constructs which make up the Technology Acceptance Model.

Findings of this study suggest that perceived usefulness and ease, along with digital inclusion, may positively influence adoption and use of discussion forums at Universities of Technology. Both attention and perceived enjoyment were found to have a positive relationship on perceived usefulness and attitude. Furthermore, digital inclusion could be implemented to improve the perceived ease-of-use of the system, which ultimately leads to improved behavioural intention and usage. Improved usage of components within the Learning Management System leads to a healthy, functioning system used to its full potential, which benefits the learning experience for both student and academic. The study contributes to the board of knowledge by providing useful insights into the application of the Technology Acceptance Model. This is done by establishing additional constructs that may promote discussion forum usage.

Keywords

Blackboard™, Universities of Technology, Technology Acceptance Model, Learning Management System, South Africa, Central University of Technology, Information and Communication Technology, Discussion Forums, Digital Inclusion, Perceived Enjoyment, Attention.

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List of abbreviations

AGFI	- Adjusted goodness-of-fit
ATD	- Attitude
ATN	- Attention
AVE	- Average Variance Extracted
BB	- Blackboard™
BI	- Behavioural intention
CFI	- Comparative fit index
CoI	- Community of Inquiry
CoPS	- Communities of Practice
CR	- Composite reliability
CSCL	- Computer-Supported Collaborative Learning
CUT	- Central University of Technology
DF	- Discussion Forum
DI	- Digital Inclusion
DoI	- Diffusion of Innovation
EIS	- Executive Information System
GFI	- Goodness-of-fit
ICT	- Information and Communication Technology
IT	- Information Technology
LMSs	- Learning Management Systems
NFI	- Normalised fit index
PE	- Perceived enjoyment
PEU	- Perceived ease-of-use
PGFI	- Parsimonious goodness-of-fit
PNFI	- Parsimonious normed fit index
PU	- Perceived usefulness
RMSEA	- Root mean square error of approximation
RMSR	- Root mean square residual
SA	- South Africa

SA HEIs	- South African higher educational institutions
SAP ERP	- SAP Enterprise Resource Planning
SEM	- Structural Equation Modelling
SRMR	- Standardised root mean square residual
TAM	- Technology Acceptance Model
TRA	- Theory of Reasoned Action
U	- Usage
UoTs	- Universities of Technology
UTAUT	- Unified Theory of Acceptance and Use of Technology

CHAPTER 1: GENERAL INTRODUCTION

1.1 Introduction

The potential of information and communication technology (ICT) and the internet to enhance quality educational outcomes has been a staple discourse in the past 10 years (Sammelan, 2009; Sharma, 2011; Gesci, 2013). Several studies have reported on the value of social presence in online engagement (Rambe & Bere, 2012), and the importance of interaction for online teaching and learning, within a tertiary educational setting (Swan, 2002). These studies have demonstrated the capacity of educational technologies to unveil a world of potential within teaching and learning where academics and students can communicate on a level that will enhance the quality of the learning experience.

Among the most adopted educational technologies in the current South African higher education landscape are Learning Management Systems (LMSs). A recent study, conducted by Ng'ambi, Gachago, Ivala, Bozalek and Watters (2012), on 22 South African higher educational institutions (SA HEIs), suggests that LMSs remain the mainstay technologies used by educators for delivering educational resources. Similarly, Ivala (2011) documents some of the educational opportunities presented by LMSs, which include: Asynchronous and synchronous communication and collaboration tools that allow users to send and receive e-mails and instant messages via chats or blogs; Content development and delivery features, giving educators the tools to create learning object repositories which are easily accessible to students; Formative and summative assessments that can be used by instructors to set up multiple choice assessments for students, mark them and provide feedback to students; Class and user management tools that allow educators to enrol students for specific courses. In spite of tertiary institutions recognising the pedagogical potential that these LMSs can offer, many of their core features remain unused.

1.2 Finding the gap

E-learning is a process or philosophy of supporting teaching and learning by using a combination of educational technologies. LMSs form but one part of these technologies and support a particular delivery mode, known as the didactic mode. LMSs allow for

real-time access, which means that course material can be accessed anytime and anywhere. They are exceptionally important in facilitating learning and therefore should be fully utilised (EduTech, 2013). A particularly well-known LMS is Blackboard™ (BB), which is currently used by the Central University of Technology (CUT).

Blackboard Inc. developed the BB virtual learning environment which is currently used by a number of institutions. Abu Dhabi University (2013) adopted BB and found its content management system and easy file manipulation to be a huge advantage. In South Africa (SA), the utilisation of BB has become an established practice as numerous well-accomplished and newly-formed universities of technology (UoTs) make use of this platform; universities such as the University of the Free State, University of Pretoria, University of Johannesburg, Tswane University of Technology, and Durban University of Technology (Swart, 2015). Blackboard (2004: 2 of 4) posits that BB includes a number of features and capabilities that "enable instructors to efficiently manage courses, author content, create assignments, foster collaboration and manage online assessments".

Considering the phenomenal adoption of LMSs, such as BB, Moodle and SAKAI, within the South African higher educational landscape, it can be envisaged that numerous pedagogical strategies can be implemented to enhance effective teaching and learning via these different platforms. However, despite the phenomenal uptake of LMSs in SA HEIs for content delivery and course assessments, many of the collaborative tools on these platforms remain underutilised (Bosch, 2009; Ng'ambi *et al.*, 2012; Rambe & Bere, 2012). Discussion forums (DFs) are one of the least-adopted collaborative tools which have been seamlessly integrated into most LMSs.

The researcher hypothesises that underutilisation of the LMS's subcomponents leads to the entire LMS being underutilised. The BB LMS at CUT is currently being used mainly for announcements, assignment uploads and course information downloads. The reason for this is that many academics and students tend to lack the awareness and knowledge about the proper utilisation of its many features. Ivala's (2011) study corroborated the researcher's observations by arguing that most academics lack the skills of using LMSs, hence they utilise only basic aspects like grade administration, e-mail, and static content presentation.

The focal point of this study considers the collaborative feature, DFs, which is available in all LMSs. This study argues that the BB DF has the potential to boost effective teaching and learning in tertiary institutions. This fact is supported by a study that implemented an LMS in a first year introductory course, where improved academic accessibility to students and interaction between participants were established (Snowball & Mostert, 2010). Increasing student engagement by means of LMSs further impacts on social learning processes and outcomes (Yu, Tian, Vogel & Kwok, 2010). However, insufficient studies have been done to investigate factors that promote the adoption of DFs to enhance the educational experience of students, especially at a UoT.

1.3 Justification of the study

The potential of an LMS to enhance teaching and learning has been reported in previous studies. Studies include reports on support for student-centred learning (Sauers & Walker, 2004; Riad & El-Ghareeb, 2008; Jefferson & Arnold, 2009; Pollock, 2009), enhanced educator-centred learning (Motteram, 2006), and studies related to cooperative learning (Anagnostopoulos, Basmadjian & Mccrory, 2005; Fortune, Shifflett & Sibley, 2006). Concerted efforts have been employed to make e-learning initiatives a success in Africa. These strategies include:

- Growths in ICT policies and support systems in tertiary education sectors and at national level, which improve the conditions for the use of ICTs in tertiary education across Africa (Carr, 2013).
- Multiple undersea cable projects along the African coast (Song, 2011) that allows for cheaper and faster internet access (Osiakwan, 2012).
- Drastically improved access to mobile internet connections (Isaacs, 2014).
- Donor-funded projects, such as the Partnership for Higher Education in Africa's Educational Technology Initiative (OER Africa, 2013).

However, the increasing availability of ICTs in HEIs does not automatically transform educational practices. There is a growing amount of literature pointing to the underutilisation of LMSs. For instance, Unwin, Kleesen, Williams, Oloo, Alwala, Mutimucuio *et al*. (2010) highlights the limited use of LMSs due to the limited

understanding of their features and obstacles such as poor infrastructure and the lack of appropriate training needs for academics. Other studies stress that the tools for effective teaching and learning can be the best available, but without proper student motivation many valuable features or even the whole system might become underutilised (Moscinska & Rutkowski, 2011). Islam and Mäntymäki (2012) site that, even if academics and students often underutilise the system features, students claimed LMSs assist them in their studies, resulting in improved academic performance.

Unwin *et al.*'s (2010) findings are in line with the researcher's observation that academics and students underutilise the LMS, since they use the system mainly as a content management system. This study employs the systems philosophy approach which considers an e-learning system to be a set of features working together to achieve a specific goal (Schwalbe, 2010). E-learning DFs have been identified as one of the core features that contribute to the overall e-learning system functionality. The researcher is of the opinion that the effective utilisation of DFs have the potential to contribute significantly to the overall utilisation of the whole LMS, since DFs play a pivotal and powerful role in an inclusive learning environment (McLoughlin & Oliver, 2000). Poe and Stassen (2013) argue that DFs offer an exciting approach to learning where participants can collaborate with anyone, at anytime and anywhere. Some key factors that promote the use of DFs will now be discussed.

1.3.1 Affinity spaces

Considering the major affordances within an LMS, such as course organisation, assignments management, online tests, DFs, content management, self-study and announcements (Siekmann & Schullo, 2003; Daulton, 2006; Clark, 2007), the focus on DFs needs justification. DFs provide ideal interactive spaces which may be correlated to affinity spaces (Gee, 2004). Affinity spaces are places – physical or virtual - where groups of people interact because of a common endeavour or shared interest (Gee, 2004). DFs constitute affinity spaces to the extent that they allow for collaboration between people from all ages, ethnicities, education levels and cultures that share a common ground or motivation. Like instances of social media, DFs provide informal learning spaces that draw collaborators together to produce shared knowledge, cohesion of mutual interests, and collaboration (Rambe & Mawere, 2013).

1.3.2 User generated content

Conversational technologies, such as DFs, are central to the building of knowledge-based communities which combine both producer and consumer input (Rambe & Mawere, 2013). This is supported by Redecker, Ala-Mutka, Bacigalupo, Ferrari and Punie (2009) who suggest that DFs integrate learning into a wider community, reaching out in a virtual manner to meet people from other age groups and socio-cultural backgrounds. Redecker, Ala-Mutka and Punie (2010) summarise the four dimensions of learning offered by colloquial technologies, which includes DFs that are supported by LMSs and social media. Enhanced teaching and learning is achieved through: 1) Access to content for lifelong learning and professional development; 2) The creation of digital content by users and its publication online; 3) Knowledge construction through the connection of students to a community (peers, experts and academics), which allows them to tap into the tacit knowledge of their peers and highly specific, targeted knowledge in given fields of interests; and, 4) Improved academic and student collaboration on a given project or a joint topic of interest, pooling resources, sharing expertise and developing the potential of a group committed to a common objective.

1.3.3 Dissolution of the Ivory Tower

"Survival in a knowledge economy is dependent on knowledge sharing" (Buckley & Du Toit, 2010). The ivory tower system of knowledge construction dissolves when experts and novices unite in the effort of constructing individual opinions and sharing personal experiences and knowledge through DFs via non-hierarchal learning networks. Buckley and Du Toit (2010) report on the importance of academics to leave their ivory towers and form communities of practice (CoPs). CoPs are formed by people from a shared domain who engage in a process of collective learning. According to Buckley and Du Toit (2010), knowledge sharing at a tertiary institution is no different when compared to any other organisation, although by virtue of the fact that academics are "experts" in their fields, it might be perceived that such sharing is not necessary. Not only do CoPs create trust and understanding among people through the sharing of mistakes and accomplishments, they also form an important role in teaching, research, and community development. Lave and Wenger (1991) report on the positive impact that CoPs have on

student learning when communities (students, instructors, researchers and administrators) come together in an effort to share knowledge.

1.3.4 Community of Inquiry

In addition to the formation of CoPs, Rambe and Mawere (2013) acknowledge that web-based conversational technologies are also built around Community of Inquiry (CoI). The CoI is a concept that concerns the nature of knowledge formation within a social context. It also requires agreement among all involved in the process of inquiry, for legitimacy purposes (Peirce, 1877; Seixas, 1993; Shields, 2003; Pardales & Girod, 2006). As Redecker *et al.* (2010) comments, DFs provide students with opportunities to develop their competences to effectively and efficiently support competence building in a lifelong learning continuum through interaction with other students, academics, and experts.

1.3.5 Anonymous learning

Another valuable feature of DFs is that students have the option to post anonymously. Many LMSs have the functionality of anonymous posting and shy participants are more likely to contribute if they can remain anonymous. A learned scholar in mobile learning, Prof Dick Ng'ambi (2006), developed a mobile-based learning environment to support anonymous interaction among academics and students. Through this exercise, student participation greatly improved, resulting in an inclusive mobile learning environment. The reason for Ng'ambi initiating such a project was to allow students who did not have the confidence to speak in front of their peers to participate in class and group discussions anonymously (Ng'ambi, 2006) .

In conclusion, the five main factors that promote LMS DF utilisation, includes:

- Affinity spaces, allowing clusters to unite;
- User generated content, permitting people from different backgrounds and races to communicate on common ground;
- Dissolution of the ivory tower, allowing experts and amateurs to come together in knowledge building through the formation and building of CoPs;
- CoI, which means that students become competent in collaboration with their peers;

- Anonymous learning, allowing students to express their views without the fear of being judged.

1.3.6 Theories associated with technology adoption

Various models or theories may be used to establish factors that promote technology adoption. TAM is the preferred model to use in this study because of its predictive ability in studies involving students in technology adoption. The TAM has developed into a leading model in explaining and predicting system use. It has become so popular that it is cited by many researches who deal with user acceptance of technology (Lee, Kozar & Larsen, 2003). Its use will be substantiated in chapter 2.

1.4 Statement of the problem

Although literature suggest that effective utilisation of electronic DFs have the potential to boost students' academic performance, promote active academic engagement (Wentzel & Wigfield, 1998), and support virtual peer mentorship and seamless learning (Seow, Zhang, Chen & Looi, 2009), up to thus far these technologies have been suboptimally employed for student learning. Furthermore, there is growing evidence demonstrating the limited adoption of DFs available in an LMS, resulting in its overall underutilisation. The problem with underutilised DFs is that it has the potential to affect the overall efficient use of an LMS negatively, thus making no real contribution in enhancing the teaching and learning process.

1.5 Research question

What are the determinants of DF adoption that could influence the utilisation of the overall LMS at a UoT?

1.6 Research sub-questions

The research sub-questions for this study are as follows:

(i) How can existing technology adoption models be applied to help heighten e-learning DF adoption?

(ii) How can an improved adoption of DFs influence overall utilisation of an LMS?

(iii) To what extent does adoption of DFs contribute to improving students' instruction delivery?

1.7 Research objectives

The research objectives are as follows:

(i) To determine factors that may hinder students from fully utilising DFs for learning.

(ii) To determine factors which promote interest and motivation in maintaining discussions among students from previously disadvantaged communities.

(iii) To extend a technology acceptance model by establishing factors that may promote the adoption of e-learning DFs.

(iv) To provide best cases or examples of productive educational uses of DFs.

(v) To contribute to the utilisation of the overall e-learning system by making recommendations for the improvement of instructional delivery and pedagogy, using peer collaboration.

1.8 Research methodology and design

1.8.1 Research strategy

This study adopts a mixed-method approach, in which descriptive statistics, rather than inferential statistics, are employed. A mixed-method approach uses both quantitative and qualitative research methods. Quantitative research investigates social behaviour through statistics, mathematical or numerical data, or computational techniques (Given, 2008). Quantitative methods transform the data gathered from questionnaires into statistics and percentages which are then analysed to help the researcher verify which of the hypotheses are true. On the other hand, qualitative research is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research (Wyse, 2011). In this study questionnaires are used to obtain data from a large group of people (quantitative), whereas interviews are used to obtain detailed data (qualitative).

1.8.2 Research site

The CUT is a UoT in SA and serves as the research site for this study. The University was established in 1981 as "Technikon Free State" and later promoted to a UoT. UoTs are more practically orientated than traditional universities and focus on innovative problem solving.

1.8.3 Target population

The target population that is focused on is National Diploma and B-Tech students who are registered for IT (information technology) courses. First-year students are not included in this study as their unfamiliarity with BB and its features might influence the results.

1.8.4 Data collection and sampling methods

The primary data collection instrument is a questionnaire with closed-ended questions, resulting primarily in quantitative data. The basic objective of a questionnaire is to obtain facts and opinions about a phenomenon from people who are informed on the particular issue. Questionnaires are probably the instrument that is used most generally (De Vos, Delport, Fouché & Strydom, 2011). Convenience sampling is proposed as the IT students will be available in class, with the aim of gathering from the target population as many samples as possible.

Another data collection instrument, the interview, will also be used to clarify some of the answers obtained from the questionnaire. Interviews usually feature open-ended questions, resulting in qualitative data. Researchers may obtain information through direct interchange with an individual or group that knows or is expected to possess the knowledge they seek (DePoy & Gilson, 2008). The type of interview that will be used will be clarified in chapter 3.

1.8.5 Data analysis

Quantitative data from the questionnaires needs to be coded into MS Excel and uploaded into LISREL 9.1 where different statistical analyses can be done. This data may then be used to test the different hypotheses.

Qualitative data from the interviews needs to be recorded with a digital recorder and transcribed into Microsoft Word. The data may then be analysed by using thematic analysis and the results may be reported in the form of a narrative.

1.9 Research limitations

Descriptive statistics will be used as the results will only be interpreted with regard to the target population. Descriptive statistics are procedures that describe numerical data in that they assist in organising, summarising and interpreting sample data (Monette, Sullivan & DeJong, 2013). Descriptive statistics are most commonly used in quantitative research studies (De Vos *et al.*, 2011).

Due to the sheer number of them, not all departments at CUT are involved in this study. Only one feature in the LMS is to be investigated as there are many other different features, each with their own purpose and objectives, which, if considered, makes the scope of this study too big.

1.10 Expected outcomes

This study aims to enhance DF adoption at a UoT by identifying external variables capable of extending the TAM, thus contributing to a further understanding of the TAM. Funds spent on the system can be used more productively if all of the features are being utilised to their full potential. This study has the potential to raise awareness of the importance of DFs, which may in turn lead to improvements in academic- and student behaviour and attitudes towards the use of DFs. Student academic achievement may also increase as students engage more regularly with their peers and academics regarding the course content. Finally, this study has the potential to identify gaps in the usage of DFs in the current LMS. Possible recommendations to address these gaps may be of keen interest to CUT, system developers and other IT stakeholders.

1.11 Overview of the thesis

The research study is divided into six chapters, with chapter 1 being the introduction phase of the thesis and chapter 2 providing a whole literature review on e-learning, LMSs, BB and DFs. Chapter 3 describes the theoretical framework, the TAM, that

underpins the study, and focuses on the research methodology. Chapter 4 presents the research findings, analysis and interpretation of results from the data collection instrument that was used in the quantitative analysis. In chapter 5 the data analysis of the qualitative analysis will be discussed. Lastly, chapter 6 ends with a discussion, conclusion and recommendations. Figure 1.1 presents an overview of the research study with a summary of what is to be expected in each chapter.

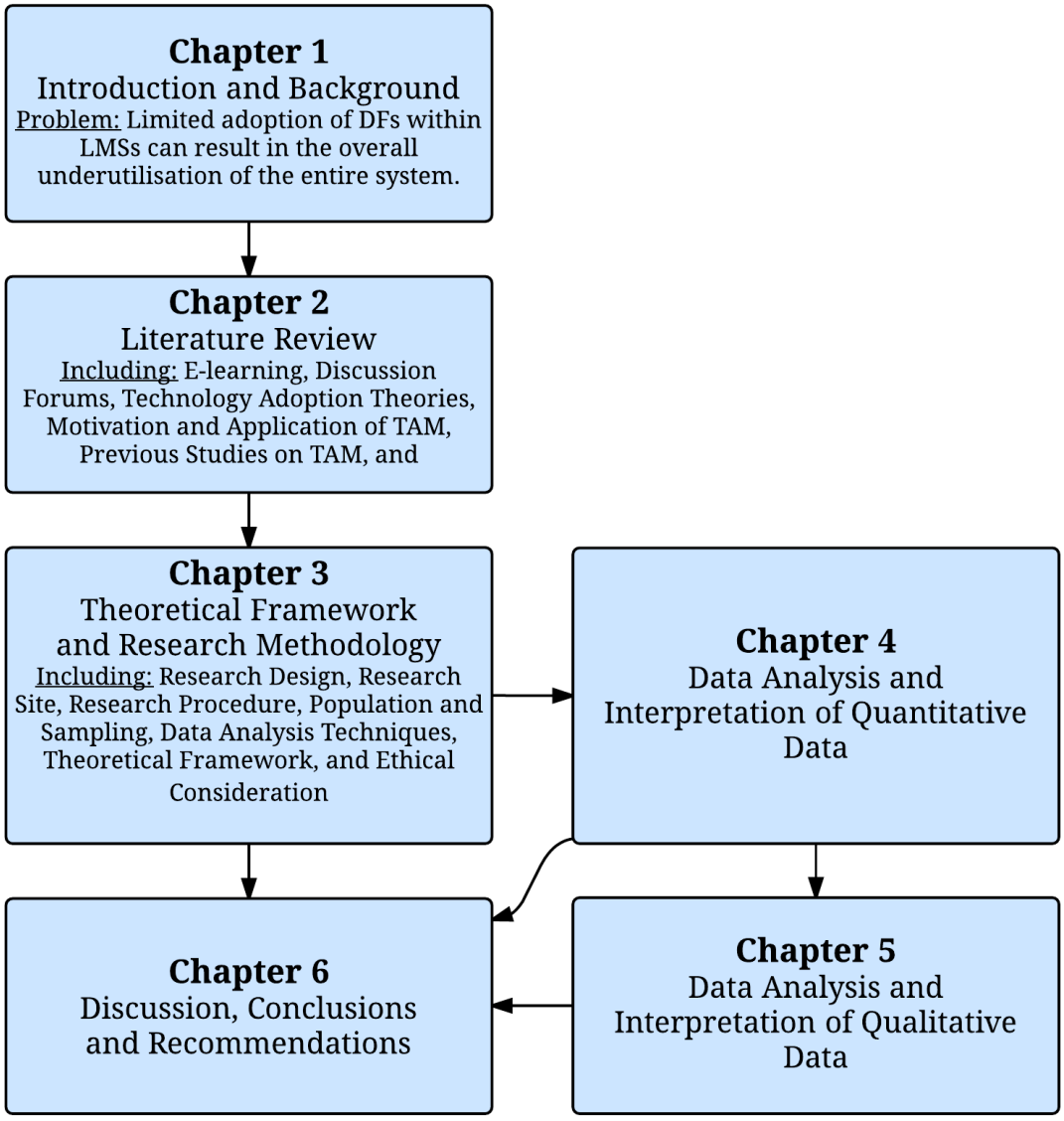

Figure 1.1: Overview of Thesis

1.12 Conclusion

In this chapter, the underutilisation of DFs within LMSs at UoTs in SA was highlighted. Limited adoption of these features result in the overall underutilisation of the system, which has the potential to affect the overall efficient use of an LMS negatively. In justifying the study, affinity spaces, user-generated content, the dissolution of the ivory tower, community of inquiry, anonymous learning and theories associated with technology adoption were discussed. The aims and objectives, followed by the research question and sub-questions were highlighted. Research limitations and expected outcomes were also discussed.

The next chapter presents the literature review which follows a funnel approach as it discusses e-learning adoption, starting from a global aspect and narrows down to a UoT. DFs are discussed in detail, followed by different technology adoption theories. Previous studies on the use of the TAM follow the same funnel approach. Lastly, the conclusion of the chapter is discussed.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Chapter 1 presented the research gap and problem that would form the focal area of discussion for this study. The reasoning behind the study was justified and expected outcomes were discussed. Chapter 2 covers the literature relevant to this study, firstly, by defining and discussing the concept of e-learning from a global to a South African perspective. Secondly, DFs within the e-learning systems are highlighted and their relevance in e-learning and ICTs is explained. Discussions relating to technology adoption theories follow, with specific emphasis on the TAM. Following this, the rationale for using the TAM is emphasised, along with its previous applications. The chapter is ended with the conclusion.

2.2 E-learning

A large number of institutions take great interest in e-learning (Bichsel, 2013), which means that e-learning is growing at a rapid pace. E-learning is now nearly ubiquitous in higher education, and offers a suite of technologies, tools, and processes that, when implemented and utilised skilfully, can have a positive effect on teaching and learning (Tufts University, 2008). E-learning refers to the use of any electronic media and is broadly inclusive of all forms of educational technology in teaching and learning.

E-learning systems are commonly utilised by a variety of users; ranging from small local businesses to large retailers, mining corporations, financial service providers and educational institutions across SA (Nicholas, 2013b). There may be other very different definitions of e-learning, but Clark and Mayer (2011) define e-learning as the instructional delivery that uses digital devices such as computers or mobile devices. Literature suggests that e-learning has become very popular as devices such as the computer, laptop, TV, tablet and smartphone can be found in nearly every household (Nicholas, 2013a). Shachar and Neumann (2003) claim that e-learning is ideal for distance learning where instructional delivery is done for students who are not physically present in a traditional setting such as a classroom.

Sangrà, Vlachopoulos and Cabrera (2012) did a study on building an inclusive definition of e-learning based on the participation of experts around the world. Based on the experts' contribution, the researchers composed a summary of four main points: 1. When defining e-learning, it is necessary to take into consideration the quick-changing nature of the various uses of technology for teaching and learning. 2. E-learning can be used for both collaborative and independent individual learning. 3. E-learning eases the management process of learning goal achievements. 4. E-learning is a new way to learn, or, a new training model. Based on these four points, the following definition for e-learning was created: "E-learning is an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction, and that facilitates the adoption of new ways of understanding and developing learning" (Sangrà *et al.*, 2012:152).

E-learning constitutes a number of different forms of learning, like blended learning, synchronous and asynchronous learning, web-based learning, academic-led or self-study. LMSs are one of the popular forms of e-learning. These systems are used to plan, manage, implement, and assess learning processes (Rouse, 2005). The most common examples of LMSs are BB, Moodle, SAKAI and ANGEL. Literature reports that LMSs utilise the internet to foster ubiquitous learning which is commonly known for supporting flexible learning (Isma, 2012).

E-learning can be delivered either synchronously or asynchronously. Synchronous e-learning provides a learning environment for students, with multiple ways to interact and share information at the same time. Synchronous e-learning systems include, but is not limited to, video conferencing, chat rooms, shared whiteboards, virtual classrooms, and scheduled online examinations (Er, 2009; Haslam, 2014). Robert and Dennis's (2005) cognitive model of media choice indicates that synchronous communication increases motivation. Synchronous e-learning platforms psychologically arouse students' desire to learn because the conversation closely resembles face-to-face communication. These claims correspond with Hrastinski's (2008) study where findings suggest that synchronous e-learning systems promote teamwork in learning. Furthermore, synchronous e-learning promotes instant feedback and critical thinking in a short space of

time while enjoying the flexibility to discuss learning material beyond stipulated course material. The study findings concluded that synchronous e-learning enhances students' motivation and arousal to participate in discussions. Synchronous e-learning can provide an environment for isolated students to become part of an online group and give them a feeling of belonging.

In asynchronous e-learning, participants have the flexibility of participating in an online activity anytime, anywhere, according to their own schedule (Hrastinski, 2008). People who have to balance family, work and other responsibilities find this type of e-learning very beneficial. It is thus a key component of flexible e-learning. Asynchronous e-learning is a great tool for students as they can log into an e-learning environment whenever they want to and can either collaborate with peers and academics through message boards and/or download course content. However, if a class is small, it might be difficult to get asynchronous discussions going (Palloff & Pratt, 1999). Striking a balance between these two types of e-learning and deciding when to use which one might be quite tricky.

Synchronous discussions spark motivation and desire among students to engage in discussions. Furthermore, literature suggests that a lack of student participation can be due to little motivation and desire among students (Xie, Debacker & Ferguson, 2006). Therefore, it can be argued that synchronous learning is the better option to use when trying to get students to participate in online collaborative groups. In asynchronous learning, more thought needs to be put into replies, whereas in synchronous learning the focus is often on quantity rather than quality – that is, trying to write something quickly before someone else replies to your thoughts. For e-learning initiatives to succeed, organisations and educational institutions must understand the benefits and limitations of different e-learning techniques and methods.

Higher education institutions in Palestine (Shraim, 2012), the UK (PricewaterhouseCoopers, 2004), Zimbabwe (Chitanana, Makaza & Madzima, 2008), SA (Mgutshini, 2013) and in many other parts of the world are increasingly moving towards incorporating e-learning as a teaching and learning tool. This vast trend is clearly motivated by the many benefits that e-learning offers. Students can access course content at any time that suits their schedules and from anywhere with an internet connection. This

flexibility offers many benefits to students who are unable to attend classes or to students who wish to extend their knowledge while working. Slow-learning students are often at a disadvantage in fast-paced classes where a certain amount of course content needs to be covered in a limited amount of time. Online training allows slow- and fast-learning students to work at their own pace and thus reduce stress and increase satisfaction (Kruse, 2002). Some students stay far from campus and travelling time and costs might be reduced if they have access to an internet connection from their homes. Virtual classrooms and communication between academics and students by means of DFs can result in educator fees and travelling and building costs being reduced (Posey, Burgess, Eason & Jones, 2010). Musawi (2011) claims that more and more courses will have reduced classroom meetings or seat time as this reduces the organisational, physical, and financial burdens and can simultaneously increase learning outcomes.

In tertiary institutions, some classes can be very large and for an academic to give each student the individual attention they require is nearly impossible. The use of online discussion groups gives students and academics the opportunity to interact with each other, whereas this opportunity does not always exist in large classrooms. Shy students who do not ask questions in class for fear of embarrassment are awarded the opportunity to voice their opinions in online discussions, where they have more confidence to ask questions and collaborate with the academic and other students. To help capture students' attention, e-learning can also accommodate different content modes, such as text, audio, video, images, TVs, CD-ROMs and computer-based learning (Lin & Gregor, 2006).

Rautenbach (2007) mentions another advantage, called better access control. All students receive the exact same material, delivered in the exact same way, which allows for consistency of content and quality of instruction to each student. E-leaning offers pedagogical advantages as it can successfully monitor and track student progress and test student knowledge.

There are also a few difficulties that might arise when using e-learning. Slow internet connections or old computers may frustrate accessing course materials. When a new online system is introduced, beginner students might find using the new system difficult and might not receive the benefits intended for students (ON24, 2012). Content that involves hands-on or laboratory work is difficult to simulate in a virtual classroom.

According to Kahiigi, Ekenberg and Hansson (2007), some issues associated with the implementation and use of e-learning within the higher education context is the limited implementation of technology as an instruction-delivery method, and the ineffective use of technology to support learning. Radović-Marković (2010) in his study on the advantages and disadvantages of e-learning in comparison to traditional forms of learning, claims that the majority of participants in his sample (68%) think that online learning is great as a new alternative for learning, but that it will not work for everyone and obviously not for every subject.

For e-learning to be utilised effectively and to ensure a successful transition to more flexible modes of delivery, it requires full, long-term commitment and support from senior management to support, foster, and monitor strategic change (Scottish Funding Council, 2007). Danner and Pessu (2010) in their study on the impact of e-learning adoption found that if e-learning was to be adopted successfully, more training was necessary for both academics and students. Furthermore, without awareness and the necessary ICT skills, technology cannot be used effectively to support e-learning (Haliso, 2011); thus it is a necessity for managers to put time and funds into training students and academics to enable them to use the system with confidence.

A study on the user acceptance of e-learning technologies found that concerns pertaining to institution strategy, time and training support are the three most critical barriers that hinder user adoption of e-learning technologies (Nanayakkara & Whiddett, 2005). ŞANCI (2005) indicates that a successful integration of ICT into education systems, and especially successful implementation of web-based distance-learning programmes, depend upon the acceptance, readiness, and active involvement of administrators, academics and students.

Academics need to put aside their traditional teaching styles, their reluctance to adopt change and their general perception of increased work load and be more open towards accepting e-learning as a complement to enhanced teaching and learning (Banning, 2005). With regards to methods of teaching, Garrison (2011:4) assert that “to realize the potential of e-learning as an open but cohesive system to support learning, it is essential that we rethink our pedagogy”.

Muilenburg and Berge (2005) point out that having confidence and comfort in using ICT reduces barriers to social interaction, administration, student motivation, and time. The structural changes in tertiary institutions over the past decade have mainly been caused by the introduction of technology initiatives (Singh, O'Donoghue & Worton, 2005). As a result of this, and the many benefits e-learning has to offer, many higher education institutions have adopted e-learning in their curricula. Table 2.1 summarises the advantages and disadvantages associated with e-learning and gives recommendations on how to improve user-adoption e-learning systems.

Table 2.1 Advantages, disadvantages and recommendations of e-learning adoption

Advantages	Disadvantages	Recommendations
• Anytime, anywhere access to course content. • Students can work at their own pace which may lead to reduced stress and increased satisfaction. • With access to course content from home, travel time and costs are reduced. • Virtual classrooms and online DFs may reduce educator fees, travelling costs and building costs. • Potential of increased learning outcomes and reduced organisational, physical and financial burdens due to reduced classroom meetings. • When dealing with large classes, academics can give more individual attention through DFs. • Shy students get a voice in DFs. • Different learning styles, like text, audio, video, etc. keep students' attention. • Improved monitoring of student progress is made possible.	• Slow internet connection or old computers could cause frustration. • Without proper training, freshman students might struggle with a new system. • Not all course content can be simulated in a virtual classroom. • Limited uptake and ineffective use of technology could influence e-learning effectiveness.	• Full, long-term commitment and support from senior management is needed. • Proper training for academics and students. • Confidence and comfort is important when using ICTs. • Institutional strategy, time and training support are needed for user adoption. • Usage depends upon acceptance, readiness, and active involvement of administrators, academics and students. • Academics should be more open to new pedagogical methods.

2.2.1 E-learning adoption in the world

Gyambrah (2007) compared the adoption of e-learning in the United Kingdom (UK), United States of America (USA), and Germany. He found that e-learning was adopted dissimilarly between these three countries. Germany, for instance, demonstrated slower adoption and application as compared to the UK and USA. He noticed a high level of private involvement in promoting the use of e-learning in the USA. It is evident from Gyambrah's (2007) study that these three countries are making efforts at adopting e-learning technologies. Having reviewed their state of affairs, it is also clear that higher educational institutions across the world can no longer ignore the inherent potential of e-learning.

A study done at Northumbria University in the UK measured the success in the utilisation of e-learning systems (Bell & Farrier, 2007). Results indicated that, as with many other similar institutions, problems may arise in ensuring that current systems and approaches keep pace with growing e-learning trends. In effect, the burgeoning growth of online materials and delivery can present quality assurance difficulties. An important factor recognised in their study is the need for academics to progress from using their online system not only as a document repository, but also to start using the technology for collaboration, communication and interaction within e-learning. According to student surveys from their study, 89% of the studied sample of students saw ICT as integral to their studies and 96% used ICT in their daily studies.

Baelo-Álvarez and Cantón-Mayo (2010) recorded that there are factors that influence the use-avoidance of ICT by professors in Castilla and Leon Universities in Spain. Interviews conducted at these universities showed that the reduced use of the available ICTs in their institutions is due to the lack of dedication and/or interest from the academics, and also their lack of training. Seventy-five percent of academics use ICT for basic concepts (multimedia presentations, software and basic applications) and only 25% employ it for a more advanced use (creation of material and content from ICT, development of virtual experiences).

A study was done in Texas to examine the factors that impact student satisfaction with a new e-learning system. From this study Green, Inan and Denton (2012) concludes that the usability of the system is important. Students should feel comfortable with a system so

that they can focus on learning the content. They should not spend their time navigating the system to figure out how it operates. Students should have access to technical support. Noted by Palmer and Holt (2009), Selwyn, Marriott and Marriott (2000), and Selim (2007), the availability and quality of technical assistance are contributors to student satisfaction. Students must be encouraged to use the system frequently. The more a student uses the system, the higher his or her level of satisfaction will be (Hoskins & Van Hooff, 2005; Hrastinski, 2008).

In a similar study done in Qatar, where student usage of an e-learning system was investigated, an interesting finding was recorded. Nasser, Cherif and Romanowski (2011) cite that students with basic ICT knowledge are less likely to use the e-learning system. Students who have used applications like Facebook or an LMS are familiar with the concepts and have mastered the technological language. They may not consider the e-learning system in Qatar to be very entertaining and thus are less likely to use it. The system is extremely easy to use and does not require a lot of skill and may leave students unchallenged by its usage. These findings show that even if the tools for effective teaching and learning are the best available, without proper student motivation, many valuable features or even the whole system might become underutilised (Moscinska & Rutkowski, 2011).

In Israel 8425 students participated in a survey where student satisfaction with e-learning systems was measured. Five critical success factors for increasing student satisfaction with e-learning systems were pointed out: content completeness, content currency, easy to navigate, easy to access, and course academics' responsiveness. The main contribution was in guiding institutions of higher education toward informed decision making regarding e-learning technology (Naveh, Tubin & Pliskin, 2012).

Hussein (2011) states that faculty members in Saudi universities have positive attitudes towards utilising an e-learning system that they use. Results of the study also indicate that they have sufficient awareness of the importance of e-learning and technology in teaching. These results are consistent with other studies that have indicated the effectiveness of using e-learning in developing the capabilities and skills of the students as well as enriching the environment within the learning communities (Sauers & Walker, 2004; Anagnostopoulos *et al.*, 2005; Joint, 2005; Fortune *et al.*, 2006; Motteram, 2006;

Boticario & Santos, 2007; Ozdamli, 2007; Riad & El-Ghareeb, 2008; Jefferson & Arnold, 2009; Pollock, 2009).

Physical, personal, and administrative constraints have been noted to strain activation of the system. These constraints include a lack of computer accessibility or internet connectivity and the high costs associated with connectivity compared to some other Arab countries. Personal constraints refer to unhealthy attitudes towards e-learning, considering it a sort of luxury or fun item and not necessary for learning; thus lacking knowledge and awareness of the true nature and importance of these systems. Lastly, some faculty members practice strong resistance for any change or development in the academic department, feeling threatened regarding their established positions for the benefit of others with good knowledge of technology. Table 2.2 summarises the challenges of using e-learning as previously discussed.

Table 2.2 Challenges of e-learning adoption in the world

Challenge	Description
Keeping pace	It can be problematic to ensure that current systems and approaches keep pace with growing e-learning trends. In effect, the burgeoning growth of online materials and delivery can present quality assurance difficulties.
Underutilisation	Online systems might only be used as a document repository rather than using the technology for collaboration, communication and interaction within e-learning.
Use-avoidance	Use-avoidance could be due to a lack of dedication and/or interest from the academics, as well as their lack of training.
Overly complex	Systems that are difficult to use and maintain could prove to be problematic.
Too simplistic	Some novice students might find the system too simplistic and boring. This is when proper motivation is required.
Physical constraints	This includes a lack of computer accessibility or internet connectivity and the high costs associated with connectivity.
Personal constraints	Refers to unhealthy attitudes towards e-learning caused by a lack of knowledge and awareness of the true nature and importance of these systems.
Administrative constraints	Some faculty members may demonstrate strong resistance to any change or development.

2.2.2 E-learning adoption in Africa

E-learning was implemented at a university in Tanzania and despite the achievements revealed in implementing ICT for teaching and learning, they still faced a lot of

challenges in undertaking such a process (Sife, Lwoga & Sanga, 2007). Table 2.3 presents a brief summary of some of these challenges.

Table 2.3 Challenges of e-learning in an African country described by Sife et al. (2007)

Challenge	Description
Lack of systemic approach	Many institutions embrace the ICT integration process without clear plans to guide the way.
Awareness and attitude	It is important to know the existing ICT facilities and services and their importance. However, according to Tusubira and Mulira (2004), there tends to be only vague knowledge about ICTs, some interpreting them as simply advanced technologies that require a lot of money and very advanced skills. Lack of awareness goes along with attitude.
Administrative support	Administrative support is critical to the successful integration of ICTs into the teaching and learning process. Administrators can provide the conditions that are needed, such as ICT policy, incentives and resources.
Technical support	This includes issues like installation, operation, maintenance, network administration and security. In most cases, technical support is not available, which implies that trainers and students require some basic troubleshooting skills to overcome technical problems when using ICTs. However, in most of the developing countries, including Tanzania, there are very few technical experts to implement and maintain ICTs (National Committee for WSIS Prepcom II, 2003; Bakari, Tarimo, Yngstrom & Magnusson, 2005)
Transforming higher education	Many institutions fail to integrate ICTs into teaching and learning because they are using ICTs to replicate their traditional practices, content and control. Their plans appear to be driven by ICTs and not by pedagogical rationale and focus (Ehrmann, 1995).
Staff development	Integration of ICT in teaching and learning does not only deal with the introduction of new hardware and software, but both academics and students have to adopt new roles and change their ICT habits and ways of teaching and learning.
Lack of ownership	It is critical that all stakeholders contribute to and own the policy and the plan. Institution-wide consultations are necessary in the identification of challenges, and in proposing areas for ICT application.

Table 2.3 Continued

Inadequate funds	Financial resources form a key factor to the successful implementation and integration of ICTs in education. It is obvious that countries with higher financial resource bases stand a better chance to reap the benefits offered by ICTs than those with limited resources.

Omwenga, Waema and Wagacha (2004) did a study in Nairobi, developing a model for introducing and implementing e-learning for the delivery of educational content within the African context. The potential benefits that the new technologies can bring to education, if implemented and used effectively, do not seem to be in question. However, fundamental issues relating to the possibilities and practicalities of integrating e-learning in a meaningful way into educational systems need to be considered. Table 2.4 lists some of these challenges.

Table 2.4 Challenges of e-learning in an African country described by Omwenga et al. (2004)

Challenge	Description
Costs	The price of hardware and software, although constantly decreasing, remains considerably high for many educational institutions' budgets in most developing countries, Kenya not being an exception.
Poor infrastructure	Besides the high cost of using the technology and maintaining it, the existing infrastructure in developing countries is poor.
Professional competence	Teacher education is considered to be the single most important factor in ensuring the successful use of ICTs in education (Duguet, 1989; Walker, 1989). Its importance tends to be overlooked or underestimated in the development of initiatives for introducing these technologies into educational institutions. The result is that projects may fail from the outset or are never developed to their full potential.
Teacher attitudes	Teachers are likely to resist the introduction of ICTs into the classroom for a variety of reasons. Their unfamiliarity with the technologies, the additional time and effort needed to use them effectively, and perhaps the feeling that ICTs pose a threat to their professional role and image, are some of the reasons for this resistance.
Conflict with the curriculum	Problems may arise when educational software is imposed on academics without their being involved in its selection, development or evaluation. Educational software, such as the e-learning system developed at the University of Nairobi, are very costly and time-consuming to produce.

Table 2.4 continued

Lack of technical expertise	In some cases, Kenya, like most other developing countries, lack technical expertise at all levels in this domain. Their limited resources mean that the country usually has neither the local capacity to develop the necessary human resources in this field nor the means to attract highly-skilled and expensive experts from abroad.
Lack of information	A significant obstacle to the use of ICTs in education in Kenya is the lack of information that is available both to educational decision makers and practitioners.
Content development	Content is the driving engine of any information system. For educational purposes, it is not content that is lacking but the development of such content into appropriate modes for use in the new instructional technologies.

More recent studies also identified with challenges, similar to those listed in table 2.4, within ICTs in education in Africa (Isaacs & Hollow, 2012; Odunayo, Otito & Otito, 2013; Isaacs, 2014). It is therefore evident that challenges of e-learning in Africa have not changed much over the past 10 years.

2.2.3 E-learning adoption in SA

According to the e-learning Africa 2012 report (Isaacs & Hollow, 2012), there are more than 1.5 million students in SA that already have ICT access due to classroom labs that utilise Wyse cloud computing technology. Ssekakubo, Suleman and Marsden (2011) investigated the influence of e-learning in developing countries, such as SA. They concluded that e-learning, in the form of an LMS, was started as an attempt to improve the quality of learning and teaching, to ultimately reduce costs, and to improve access to learning material. However, in most cases this was not achieved. The system was thus rejected by most users for whom it was created.

In SA, a comparative study was done on students' experiences of an online and an on-campus class (Mgutshini, 2013). Out of 61 students, 34 were enrolled purely as online students, while the remaining 27 studied the same material entirely through the traditional classroom setting. Student satisfaction and achievements were measured. In terms of student satisfaction, online students reported more satisfaction with the learning experience than their campus-based counterparts. Both groups had comparable educational success though.

Some implications for effective e-learning for South African higher education students have been identified by Damoense (2003) and are presented in Table 2.5.

Table 2.5 Implications for effective e-learning in SA discussed by Damoense (2003)

Challenge	Description
Appropriate mechanisms	The challenge to academics at higher education institutions is to seek appropriate mechanisms to develop an online learning environment that will facilitate analytical and high level thinking skills, motivation, confidence, participation, and problem solving.
Obstacles in SA	In SA, there are large numbers of isolated students located away from the hub of higher education institutions. The use of computers in education should increasingly be viewed as an effective communication tool with vast opportunities for addressing the needs of these students, since geographical location and time do not matter in an asynchronous e-learning environment. However, infrastructure and access in remote regions are major obstacles for the SA Government, as socio-economic problems, such as the current HIV/AIDS pandemic (AIDS Foundation of South Africa, 2001), rising poverty and unemployment (Afrol.Com News, 2001) impose great demands upon the nation's financial resources.
Lack of technological skills	Academics at South African institutions are not adequately equipped with the necessary technological skills, particularly in using the internet as a tool in their teaching. Adopting these skills will enable them to extend the limitations of the boundaries associated with traditional classroom environments, and provide them with flexibility and opportunities to further advance their teaching strategies to meet the needs of the students.

These challenges faced in SA HEIs are still very relevant. According to the e-learning Africa Report of 2012 (Isaacs & Hollow, 2012), SA is the African country most likely to possess the following constraining factors: 1) Human resource capacity inadequacies, 2) lack of trained teachers, and 3) instability and lack of security. In the same report, many respondents expressed how the lack of change in attitude and awareness are the biggest missed opportunity of the last five years. A SA government employee noted that 'it is possibly the lack of leadership, skills and sustainability – not enough thought has gone into the planning and roll-out of many projects'.

2.2.4 E-learning adoption at UoTs in SA

The Durban UoT promotes and utilises an e-learning system. Although they believe that face-to-face education is important, academics who have an interest in e-learning are reported to attend e-learning training on a voluntary basis. Wired students who have an interest in the latest technology are keen to learn. One of their biggest limitations, though, as with many other institutions, is access to computer resources (DUT, 2013).

In another study done at a UoT in SA, findings confirm that the students' reaction to the introduction of an e-learning system was favourable and they seem to welcome its increased use by most of the academics. However, results show that academics use the system primarily for grade administration, e-mail, presenting static content and for the purpose of supplementing face-to-face instruction (Ivala, 2011), when the system is capable of so much more. Similar findings were found in other institutions (Gastfriend, 2009; Snowball & Mostert, 2010).

Oftentimes, e-learning systems are adopted by an institution because of student expectations or to keep up with the latest and greatest, without consideration on how to improve the learning experience for students. Teaching and learning styles should not be driven by technology, but technology should rather be seen as a tool for providing a better means to achieve the fundamental aim of education – better learning. In this study, e-learning refers to the utilisation of an institutional LMS that uses the BB platform, with DFs forming the main focus of attention.

Preliminary investigations corroborate the foregoing discussions by suggesting that adoption of e-learning DFs is limited due to the underutilisation of the overall e-learning system. This study will investigate factors that promote the adoption of e-learning DFs using the TAM as the theoretical lens.

2.3 Discussion forums

Online DF utilisation is increasing among universities as part of e-learning platforms (Adeyinka & Saka, 2012). A DF provides a public domain which is made up of individual discussion threads that can be organised around a particular subject. Students combine new opinions with their own and develop a solid foundation for learning. In support of this learning strategy, research indicates that as students become aware of the

variations in interpretation and construction of meaning among a range of people, they can construct their own meaning (Alexander, 1995). The review of literature suggests that DFs enhance the experience of students participating in e-learning. According to Bindé (2005), collaborative learning is a powerful tool in helping to develop skills and habits of mind, such as allowing students to think for themselves, weigh competing claims, argue their position with others, and work together to solve problems.

Social platforms like Facebook, twitter, mySpace, MixIt, and WhatsApp are popular among students because they give opportunities to share knowledge with their peers and friends in a fun, informal environment (Kabilan, Ahmad & Abidin, 2010). Green and Bailey (2010) argue in their study on the academic uses of Facebook that many study groups are using this platform mainly to discuss homework assignments and share answers. Yu *et al.* (2010) cite results from a survey and focus group discussions, which highlights the substantial impacts of online social networking engagement on student social learning processes and outcomes.

Despite the fact that these social platforms provide room for educational learning, their disadvantages prove to elaborate the advantages of LMS DF features. For instance, Wang, Woo, Quek, Yang and Liu (2012) reported on a study where a Facebook group was used as a collaborative platform for learning. One of the downfalls, stated by participants in this group, was that the discussions were not organised in a threaded structure, which makes it difficult to organise topics into specific categories. Students using Facebook also did not feel safe and comfortable as their privacy might be revealed. However, valuable features of LMS DF were noted here in that DFs are usually organised into easy-to-use and understandable topics, and that students have the option to post replies anonymously.

2.3.1 Advantages

DFs provide for edutainment. This means that students enjoy using them to interact with friends and peers, and in so doing engage more with the educational material. Issues discussed in class may be forgotten by students, but knowledge shared in a DF will remain for future reference (Cavanaugh, 2001). DFs also allow for much more informal discussion compared to formal lectures with hundreds of students. It caters for students

with different learning styles and provides a venue where they feel more comfortable to contribute to group discussions.

DFs are used in many areas of e-learning, such as LMSs, mobile devices and online forums on websites, to support collaboration. A study done on the effects of collaborative learning with mobile devices showed that learning performance and shared knowledge generation were enhanced when the participants were learning collaboratively with the mobile device (Bere, 2013).

Chou (2002) did a study on the perceptions of teachers using a content management system. Participants suggested embedding more communication tools, such as a forum, into the system. The fact that participants initiated collaboration and sharing within a community without prior instruction shows that there is a need for these tools as they can contribute to a better learning environment (Gabriel, 2004).

Garrison (1993) suggests that DFs have the potential to change the nature of distance education by providing an opportunity for the distance students to collaborate and create mutual understanding through building learning communities. Mason and Kaye (1990) describe computer conferencing as a medium that can provide opportunities for dialogue, debate and conversational learning, suggesting that students gain a sense of community by having access to other students' thoughts and ideas.

Results from an experimental study done by Wei and Chen (2006) showed a clear increase in the level of discussions. Most students indicated that they benefited considerably from collaborative mentor support in an e-book learning context through the provision of a ubiquitous DF. Collaboration was assessed in six groups at a Canadian university. A few beneficial factors in more collaborative groups and hindering factors in less collaborative groups were present (Jahng, Nielsen & Chan, 2010). A summary of recommended and discouraged practices for students are listed (See Tables 2.6 and 2.7).

Results from a study in Omen on the adoption of computer-supported collaborative learning (CSCL) showed that outcomes of implementing CSCL include enhanced knowledge of course content, increased confidence in applying the knowledge and skills gained, stronger collaboration skills, greater ability to create rather than simply consume knowledge, and improved leadership and public presentation skills. The study claims that traditional teaching methods in the Middle East have not prepared graduates for the work-

field in the 21st century (Porcaro, Al Musawi, Lindshield, Adhikari, Mauser, Sours *et al.*, 2011).

Table 2.6 Do's for students to ensure successful collaboration (Jahng et al. 2010)

Do's
• Use a lot of social statements to foster team spirit, • Start early to have enough time to build up friendships, • Have an overall understanding of the group task to go beyond a "divide-and-conquer" approach, • Use academics as resource people, • Express opinions explicitly for quick and clear decisions, and • Use appropriate communication and collaboration tools (e.g. MSN, Wiki).

Table 2.7 Don'ts for students to ensure successful collaboration (Jahng et al. 2010)

Don'ts
• Spend too much time getting to know the other users during the initial period, • Attempt diverse uses of different communication tools, • Use unclear expressions with an indecisive manner, • Struggle with technology and internet problems, • Display bossy, negative attitudes; impatience; and little understanding toward members, and • Live in different time zones.

2.3.2 Disadvantages

Despite an overwhelming amount of studies reporting on the advantageous use of DFs, there are also some challenges. Many students do not actively participate in DFs because of shyness, anxiety, poor writing skills, lack of confidence in the topic being discussed, lack of time, information overload, and poor motivation (Nonnecke & Preece, 2001). Vonderwell (2003) explored active participation in DFs and found that students commonly reported the lack of a "one-on-one relationship" with the academic to be a disadvantage of online learning; however, when students and academics interact with each other in a community metaphor they do not see this as an obstacle (Chou, 2002; Gabriel, 2004).

A study done by Takalani (2008) at a university in SA investigated the barriers of e-learning and found that students do not use e-learning as an effective communication tool, but restrict e-learning as an instructional tool. Students do not engage in discussions

or discuss their viewpoints with other students or academics on the blog, but rather use the system to access instructions from course academics.

Bezuidenhout (2009) evaluated the use of online DFs at a university in SA. Concerns were raised about the lack of training for students and tutors and that these DFs were being used for casual conversation rather than academic discussions. Additional findings included the following:

- 25% of students did not make any use of DFs,
- 58% only read the postings in the forums,
- 10% said that they had read the postings and contributed to one or more questions,
- 4% read the postings and responded to one or more questions, and
- 3% read the postings, contributed to questions and responded to others' questions.

Findings by Somogyi (2007) shows that only one of the academics interviewed reported that there were high levels of interactivity between the students on set topics in the DF. Most academics claim that the discussions occurring on their sites were administrative in nature. Surveys done on students resulted in clear indications that students want technology to be used in their classes, particularly the use of communication tools such as online DFs.

2.3.3 Recommendations

A table constructed by Northover (2002) outlines a few additional pros and cons of tutor-student and student-student communication in DFs (See Table 2.8). Many factors contributing to low participation levels can be reduced or eliminated by careful management. In order to utilise DFs successfully, a number of guidelines are recommended. A study by Chou (2002) cites active participants to be the most important factor influencing the success of online groups. Educators who use DFs successfully online estimate that their interaction with students can be three times as much when compared to interaction with face-to-face students, and that peer-to-peer interaction even exceeds that.

Table 2.8 Advantages and disadvantages of communication on DFs for tutor-student and student-student communication

Purpose	Pros of DFs	Cons of DFs
Tutor-Student communication	- Questions and answers are also available to others. - Ensures all information is equally shared. - Permanent record of all postings.	- Dependent on accessing the database to read postings. - Email tends to be more readily accessed.
Student-Student communication	- Group database gives a convenient place for collaborative work. - Students learn from each other. - Accessible at any time. - Threads of discussion are clear. - Contributions can be composed and well-considered before posting.	- As above. - Low language confidence can be a barrier that hampers willingness to contribute. - If an activity requires participation, it can be difficult to encourage poor- or no-participating students to participate.

Northover's (2002) study in New Zealand proves that the overall effectiveness of online discussion board activities are largely dependent on their planning and implementation. Academics responding frequently to or rewarding frequent student replies might boost motivation among students. Students may get more value from a discussion in proportion to their own input, but the academic can be more instrumental in the overall input and value for the class as a whole. Many LMSs have the function of anonymous posting and shy participants are more likely to contribute if they can remain anonymous.

Porcaro *et al.*'s (2011) study constructed considerations that need to be taken into account when introducing collaborative learning into the classroom. These considerations are classified as design, academic and technical considerations and are portrayed in Table 2.9.

Table 2.9 Considerations when introducing collaborative learning into the classroom

Design	- Explain the purpose and process of collaboration thoroughly before beginning projects. - Allow for ample early practice with CSCL tools before undertaking consequential tasks.
Academic	- Motivate and generate enthusiasm among students. - Academics should help students feel comfortable in expressing themselves freely and should give feedback and support in online discussions.
Technical	- Ensure that computer labs are available after hours for out-of-class collaboration and planning for those with low bandwidth or limited online access.

Additional ways to promote productive discussions and interactivity online are identified by Martyn (2005). In his study, he recommends incorporating these best practices into workshops and tutor training to improve the quality of online discussions:

- require student participation,
- grade student efforts,
- involve learning teams,
- structure discussions,
- require a deliverable, such as an assignment,
- pose questions and scenarios that require students to incorporate their own experiences, and
- relate discussions to the learning objectives of the subject.

The researcher has personally experienced the challenges of online collaborative learning and often lacked the motivation to participate in an online DF. Often, patience and adequate free time were needed to wait for replies in asynchronous discussion groups. Some people experience frustration and anxiety during small group collaboration. It is often the case that academics do not find the time to read hundreds of messages every day. In these situations, it would be useful for academics to obtain a general idea from the threads that students post, concerning areas in which they struggle and require further assistance. The solutions to these problems could then be discussed in a class lecture. It is important for an academic to know what the critical problems hindering collaboration are, and when to step in to provide the necessary support.

Drawing from studies discussed in this section (2.3), it is evident that DFs have the potential to enhance teaching and learning in higher education. Universities globally are experiencing low activity rates within DFs, although students have reported enjoying them and that they want to use them more often. Corich, Kinshuk and Hunt (2004:1) support this by saying that “e-learning offers many advantages but is often accused of being a faceless medium that does little to encourage social exchange, discussion or collaboration.” The importance of creating awareness and fostering technology adoption of DFs among academics and students must therefore be encouraged. A few technology

adoption theories used to test user adoption of technologies are discussed in the next section.

2.4 Technology adoption theories

The most popular theories used in testing technology adoption are the theory of reasoned action (TRA), the TAM, the unified theory of acceptance and use of technology (UTAUT), and the diffusion of innovation (DOI) model.

2.4.1 Theory of reasoned action

The TAM is an adaptation of the Theory of Reasoned Action (TRA) which was developed by Martin Fishbein and Icek Ajzen (1975, 1980). The TRA posits that an individual's behavioural intention depends on the individual's attitude towards the behaviour ("Would I normally act on this sort of thing?") and subjective norms ("Would others in the group do this?"). It suggests that perceived usefulness and perceived ease-of-use determine an individual's intention to accept and use a technology (Fishbein & Ajzen, 1975). The TRA is presented in Figure 2.1.

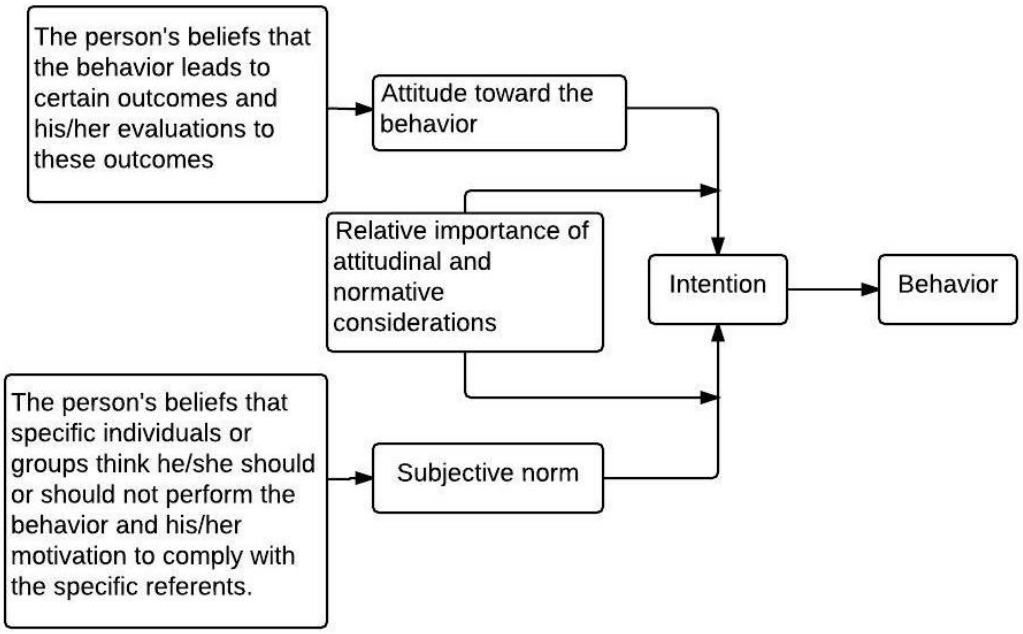

Figure 2.1 Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980).

Hale, Householder and Greene (2002) posit that the TRA has been tested in numerous studies across many fields, including dieting (Sejwacz, Ajzen & Fishbein, 1980), using

condoms (Greene, Hale & Rubin, 1997), consuming genetically engineered foods (Sparks, Shepherd & Frewer, 1995), and limiting sun exposure (Hoffman, 1999).

2.4.2 Technology acceptance model

The TAM was developed by Fred Davis in 1989 when it was first used to suggest that when users are presented with a new technology, numerous factors can influence their decision about how and when they will use it (Davis, 1989). The concept of the TAM is that, when the user has an intention to act, he/she will be free to act without limits. In practice, constraints such as limited ability and time, environmental or organisational limits, and unconscious habits will limit the freedom to act (Bagozzi, Davis & Warshaw, 1992). Perceived usefulness and perceived ease-of-use are two key factors that will influence users' intention to act. Perceived usefulness refers to the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). Perceived ease-of-use refers to the degree to which a person believes that using a particular system would be free from effort. Figure 2.2 presents the original version of the TAM (Davis, 1989).

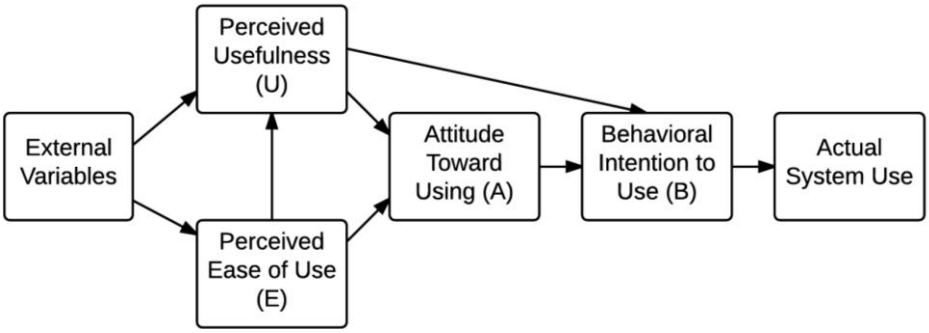

Figure 2.2 Original Technology Acceptance Model (TAM) (Davis, 1989).

2.4.3 Unified theory of acceptance and use of technology

The unified theory of acceptance and use of technology (UTAUT) model is a unified information technology acceptance and use model formulated by Venkatesh, Morris, Davis and Davis (2003). The model aims to explain user intention and behaviour in using a system and the resultant usage behaviour. The UTAUT model represents an integration of reviewed and mapped constructs from eight existing technology acceptance models, including TAM, TRA and Diffusion of innovation (DOI). Figure 2.3 represents the

UTAUT model which adopts four key constructs, namely 1) performance expectancy, 2) effort expectancy, 3) social influence, and 4) facilitating conditions. Gender, age, experience and voluntariness of use moderate the impact of the four key constructs. Researchers use the UTAUT model in testing innovations that range from commercial products to education technologies at large organisations to small businesses and educational institutions, in countries from Asia to Europe (Correia, 2012).

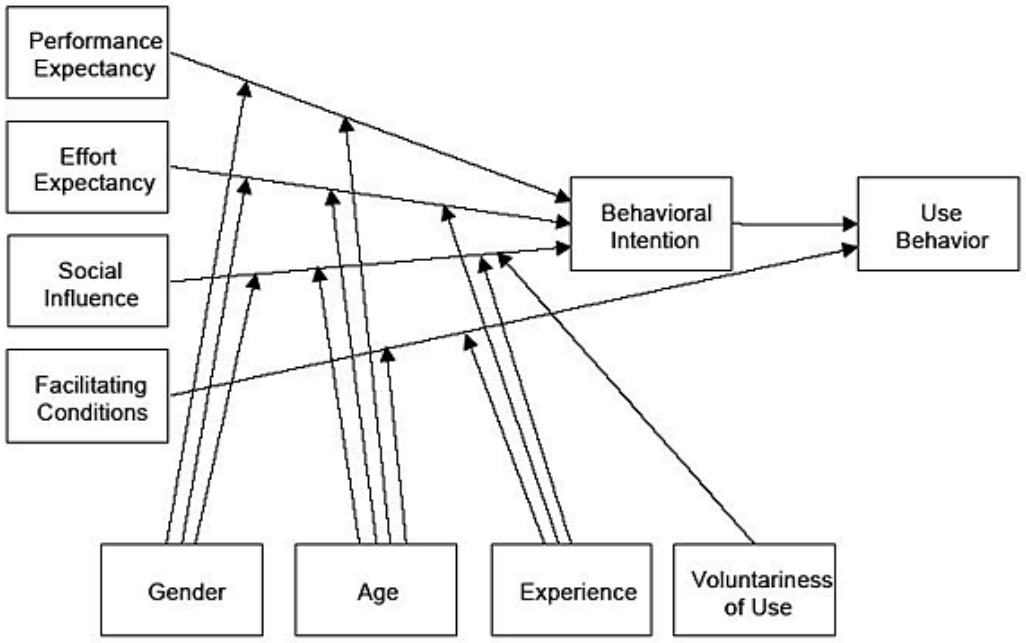

Figure 2.3 Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003).

2.4.4 Diffusion of innovation

In 1962, a professor of rural sociology, Rogers Everett, synthesised research from over 508 diffusion studies and published his seminal work: Diffusion of Innovations. The DOI model explains how, why, and at what rate new ideas and technology spread through cultures. Innovations are seen as technologies being communicated through certain channels over time and within a particular social system (Rogers Everett, 1995). Individuals are seen as having different degrees of willingness to adopt innovations; therefore it is generally observed that the portion of the population who adopt an innovation is normally approximately divided up over time. Dividing the normal dispersions into sections leads to the separatism of individuals into the following five

categories of individual innovativeness (from earliest to latest adopters): innovators, early adopters, early majority, late majority, laggards (Rogers Everett, 1995). The key elements in diffusion research are innovation, communication channels, time and social system. Figure 2.4 highlights the DOI model.

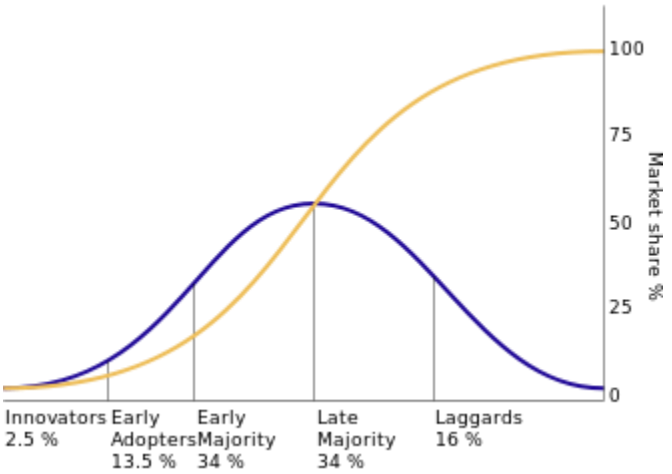

Figure 2.4 Diffusion of Innovation (DOI) (Rogers Everett, 1995).

With sequential groups of consumers adopting the new technology (shown in blue), its market share (yellow) will ultimately reach the saturation level. The DOI model gained wide popularity in the late 1980's as Prescott and Conger (1995) discovered in over 70 IT articles published between 1984 and 1994 that were related to it. The model has also been used in other fields of study, such as testing innovation among physicians (Coleman, Katz & Menzel, 1957), and new product growth models in marketing (Mahajan & Muller, 1979).

2.5 Motivation for the application of the TAM in this study

This study uses the TAM which is based on the TRA (Davis Jr, 1986), and deals with the prediction of the acceptability of an information system. Through the years, the TAM has evolved and been refined to include other variables and modified relationships based on Davis's original model. The TAM has developed into a leading model in explaining and predicting system use. It has become so popular that it is cited by many researches who deal with user acceptance of technology (Lee, Kozar & Larsen, 2003).

Weaknesses within other models provide enough motivation to use the TAM for this study. The first limitation of the TRA is that intention determinants are not limited to

attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991), and that there may in fact be other constructs influencing user behaviour. Kippax and Crawford (1993) state that some limitations of the TRA include the inability of the theory, due to its individualistic approach, to consider the role of environmental and structural issues and the linearity of the theory components. Individuals may first change their behaviour and then their attitudes about it.

Limitations of the DOI model are well documented (Botha & Atkins, 2005). Rogers Everett (1995) points out that the theory does not take into consideration that people will reject an innovation even if they fully understand it. Kole (2002) also posits that the DOI model: 1) does not account for the fact that diffusion and adoption may fail because it was not a good idea from the beginning; 2) relates the latest technologies with 'progress', thus ignoring alternatives; and 3) focuses on the individual user, therefore ignoring social structures. This last point is also called the 'individual blame bias'.

Bagozzi (2007a:245) criticises the UTAUT model and its subsequent extensions, saying that "UTAUT is a well-meaning and thoughtful presentation, but that it presents a model with 41 independent variables for predicting intentions and at least 8 independent variables for predicting behaviour". He posits that the model contributed to the study of technology adoption "reaching a stage of chaos." Instead, he proposes a unified theory which combines the "many splinters of knowledge" that can explain decision making.

Njenga (2011) conducted a study in Eastern and SA HEIs to test e-learning adoption. The findings indicate that a number of factors were identified that could affect e-learning adoption in higher education. Table 2.10 summarises conclusions made on factors affecting e-learning adoption in higher education for individuals, whereas Table 2.11 summarise the conclusions made on factors affecting e-learning adoption in higher education for institutions.

Many studies have shown that theories of behavioural intention have been useful in the prediction of technology usage and consumer behaviour (Chau & Hu, 2001; Chau & Hu, 2002a; Chau & Hu, 2002b; Chung & Kim, 2002; Gentry & Calantone, 2002; Chung, Shearman & Lee, 2003; Chung & Nam, 2007). Thus, the TAM has proven to be a valid model in predicting user behaviour in a variety of technologies.

Table 2.10 Summarised factors affecting e-learning adoption in higher education for individuals

Level	Factor	Effect
Individual	Perceived usefulness of e-learning	High perception of usefulness will lead to high adoption.
	Self-efficacy	A high level of self-efficacy will lead to high adoption.
	Perceived visibility of results	High perception of visibility of results will lead to high adoption.
	Perceived complexity	A high perception of complexity will lead to low adoption or non-adoption.
	Perceived compatibility	High perception of compatibility with the current way of doing things will lead to high adoption.
	Perceived ease-of-use	High perception of ease-of-use will lead to high adoption.
	Intrinsic motivation	Where intrinsic motivation is present, there is likely to be high adoption.
	Communication and collaboration	There will be high adoption of e-learning where there is easy communication, and encouraged collaboration.
	Extrinsic motivation	Where there are external rewards and recognition in using e-learning, there will be the likelihood of higher adoption.
	Subjective norm	If an individual thinks that the role of peers' influence in using e-learning is important, and the influence is positive, there will be high adoption.
	Personal innovativeness	A person's ability and willingness to experiment could lead to adoption of e-learning.

Table 2.11 Summarised factors affecting e-learning adoption in higher education for institutions

Level	Factor	Effect
Institution	Absorptive capacity	An organisation's ability and willingness to recognise the value of e-learning and applying it could lead to high adoption.
	Management support of e-learning	Explicit commitment and support from management for e-learning could lead to high adoption.
	Level of formalisation	High levels of command-chains could lead to rejection or non-adoption of e-learning.
	Organisational resilience to change	How an institution reacts to imminent change would have an effect on e-learning adoption. Where the reaction is in favour of the change there could be a high level of adoption.
	Communication behaviour	An environment that values quality and unrestricted flow of information as regards e-learning will foster e-learning adoption.
	Centralisation of decision making	Over-centralisation and a lack of involvement of all stakeholders in making decisions regarding e-learning could lead to non-adoption or rejection.

2.6 Previous studies on the TAM

The TAM has been used in a variety of different studies to test technology adoption in education. A few of those studies will briefly be discussed in the following sections.

2.6.1 Worldwide application of the TAM

A study done in Spain used the TAM to investigate motivational factors that influence the acceptance of an LMS called Moodle (Ngai, Poon & Chan, 2007). Data shows that technical support has a direct effect on perceived ease-of-use. Technical support also has a significant indirect effect on attitude. This underlines the importance of technical support both on a personal level and via the Web; users should also be trained to use Moodle effectively. Universities need to recruit academics that are trained in the use of distance learning systems in order to support other academics and students, and motivate them to use the LMS.

System usage is weakly influenced by perceived usefulness. This could be due to the fact that students are urged by their academics to use the system. Perceptions of use are therefore not entirely real, but influenced, having no direct stable relationship with system usage. The findings also illustrate that perceived ease-of-use is a key element that links the exogenous variable (technical support) to perceived usefulness, attitude and system usage. This stresses the importance of fostering user self-confidence so that users may perceive that the system is easy to use. Technological advances often require time for society to adapt to changes brought on by the arrival of new systems. Adults, more than young people, fear the unknown and are prone to urban myths and prejudice against new technology; these often have no base in reality. If users have difficulty using a system, they might believe that that system is too difficult to use and that the benefits they will gain from it are not worth the effort (Sánchez & Hueros, 2010).

A study was done in Jordan which explored student acceptance of e-learning using the TAM. The results demonstrated that perceived usefulness had no significant influence on students' attitude. On the other hand, perceived ease-of-use significantly influenced both attitude and perceived usefulness. Therefore, developers should ensure that e-learning interfaces are user-friendly through regular user engagement during development. Results from the study suggest that this engagement will encourage students to identify the

benefits of e-learning more readily and explore the opportunities it offers them to improve their performance. Consequently, this will motivate greater participation in e-learning, with a positive and creative attitude (Al-Adwan & Smedley, 2013).

2.6.2 African application of the TAM

Chitungo and Munongo (2013) investigated the applicability of the TAM in determining factors that influence Zimbabwean rural communities' intention to adopt mobile banking services. Questionnaires were distributed in Zaka, Chiredzi, Gutu and Chivi rural districts. The findings of this study indicate that the TAM can predict consumer intention to use mobile banking. Specifically, perceived usefulness, perceived ease-of-use, relative advantages, personal innovativeness, and social norms have a significant effect on users' attitudes, thus influencing their intention toward mobile banking. Perceived risks and perceived costs discouraged the adoption of the service.

Erasmus (2014) conducted a study on a real-time, fully integrated business system, called SAP Enterprise Resource Planning (ERP). His study was aimed at determining; 1) the congruence between the constructs of the TAM (perceived ease-of-use, perceived usefulness, attitude toward using, behavioural intention to use, and actual system usage), 2) psychological attachment (compliance, identification and internalisation), and 3) techno stress (negative computer thoughts), within an African SAP ERP user environment. Results confirmed that positive inter-construct relationships exist between all the TAM constructs, with the exception of techno stress. The researcher believes that this could be because participants were proficient in using SAP ERP and therefore experienced low levels of techno stress. Psychological attachment, however, played a significant role towards the sustained utilisation and exploitation of a management information system, such as SAP ERP.

2.6.3 SA application of the TAM

According to Averweg (2008), the TAM has been successfully applied and tested by several studies in North America. However, very few studies have been carried out outside this region. Literature suggests that not many studies on the use of the TAM to test user acceptance of a technology have been conducted in developing countries such as SA.

Averweg (2008), a researcher at a university in SA, conducted an investigation to test technology acceptance, using the TAM. Surveys were given to 31 organisations in Durban, KwaZulu-Natal, which implemented an Executive Information System (EIS). According to Lu and Gustafson (1994), people use computers because they believe that computers will increase their problem-solving performance (usefulness) and are relatively effortless to use (ease-of-use). Following suggestions made by Lu and Gustafson, Averweg chose perceived usefulness and perceived ease-of-use as the most important factors that could accurately determine computer usage in the EIS. The results of that study were not consistent with Davis's findings. However, the results partly support, 1) Venkatesh's (1999) and Brown's (2002) findings in that the perceived ease-of-use to use relationship can be a stronger catalyst over the perceived use to use relationship in fostering IT acceptance; and 2) indicate that there is no consistency in the frequency of usage of EIS. Brown (2002) reports that perceived ease-of-use becomes increasingly important as it influences both use and perceived usefulness.

Bere (2013) attempted to extend the TAM in testing students' perspectives regarding mobile learning adoption, using a special-purpose instant messaging service called WhatsApp. The study was conducted at a UoT in SA and the findings suggest that perceived convenience, perceived ease-of-use, perceived usefulness, behavioural intention, and system usage all have a positive influence on student desire to use WhatsApp mobile instant messaging for educational purposes.

2.7 Conclusion

This chapter covered e-learning, its advantages and disadvantages, and explained how it plays a vital role in the quality of student learning within the educational sector. This was followed by briefly discussing e-learning adoption studies from around the world. DFs were highlighted with a key benefit being the enhancement of the teaching and learning process. The background of various technology adoption theories were given with their main constructs and how they are applied. A motivation followed as to why the TAM is used for this study.

The next chapter covers the foundation of the proposed model, research methodology, which delves into more detail regarding the research design, site, procedures, population and sampling, data analysis, and ethical considerations.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In chapter 2 the foundation of the proposed model is highlighted. The concept of e-learning from a global to a South African perspective was discussed, followed by DFs and how they are relevant in e-learning. The motivation was given as to why the TAM is used for this study. Previous applications of the TAM were also highlighted. In this chapter (3) the research design, which starts with a review of the problem and research questions as stated in chapter 1, is covered. The research philosophy, target population, and sampling methods used for the data collection methods are presented. Research ethics are an important aspect of any study and are covered in detail in this chapter. The conclusion forms the last section of this chapter.

3.2 Foundation of the proposed model

Although the TAM is a well-used model, especially in measuring user acceptance of technology, some concerns have been raised regarding its usage. A great number of researchers found the need to extend the original TAM, especially in e-learning, with external variables (Mathieson, Peacock & Chin, 2001; Moghadam & Bairamzadeh, 2009; Yatigammana, Johar & Gunawardhana, 2013). Chuttur (2009) explains that the original TAM lacks the necessary rigor and relevance that would make it a well-established theory for the information system community. He claims that researchers have mixed opinions regarding its theoretical assumptions and practical effectiveness. Chuttur (2009) recognised the following limitations of the original TAM in terms of:

- Methodology used: Many studies on the original TAM employ self-reported use data instead of real actual use data, which is one of the main criticisms of studies using the TAM. Researchers argue that self-reported use data is a subjective measure, and is therefore unreliable in measuring actual use of a system (Legris, Ingham & Collerette, 2003; Yousafzai, Foxall & Pallister, 2007).
- Variables and relationships: Brown (2002) conducted a study to replicate the original TAM in the banking industry. They applied the TAM in a context where

system usage was mandatory. It was found that perceived ease-of-use may have a greater impact on system acceptance than perceived usefulness. These results differ from earlier studies where system usage was voluntary. It was then found that perceived usefulness had more influence than perceived ease-of-use on system acceptance (Davis Jr, 1986).

- Theoretical foundation: Bagozzi (2007b) was sceptical about the theoretical relationship among the different constructs formulated in the original TAM. He explains that intention may not be a true representation of actual use, as the time span between intention and adoption could hold uncertainties and other factors that might influence someone's decision to adopt a technology.

Subsequently, while the TAM has been used successfully in a great deal of studies on the measurement of technology adoption, some weaknesses exist. The researcher therefore chose three variables to extend the original TAM to fit the purpose of this study. These three variables are digital inclusion, attention and perceived enjoyment.

Digital inclusion is the "ability of individuals and groups to access and use information and communication technologies" (Becker, Crandall, Coward, Sears, Carlee, Hasbargen *et al.*, 2012:1). In this study digital inclusion refers to the extent to which users are made aware of and have the required access to technology. According to John Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) model, **attention** is defined as getting and holding a student's interest and attention (Niegemann, Domagk, Hessel, Hein, Hupfer & Zobel, 2008). The aim of extending the TAM with the construct, attention, is to investigate the different instructional approaches taken to capture students' attention. **Perceived enjoyment** is defined as the extent to which the activity or services offered by an LMS is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated (Van der Heijden, 2004). In this study, perceived enjoyment refers to the extent to which students enjoy using DFs.

Literature suggests that perceived enjoyment has been used in a number of studies to extend the existing TAM (Van der Heijden, 2004; Liao, Tsou & Shu, 2008; Çelik & Yilmaz, 2011). Although a limited number of studies report on the extension of TAM with digital inclusion and perceived attention, these variables have also enjoyed attention from researchers. For instance, studies on the topic of ICT usage in the digital divide

context have focused on examining demographic characteristics of users, such as gender, income, and level of education (Rice & Katz, 2003); analysing patterns of use (Akhter, 2003); and identifying benefits of use (Locke, 2005). This study, however, adds to existing research by identifying factors of digital inclusion that influence student use of DFs within the BB e-learning system. Furthermore, perceived attention is explored by Felder and Silverman (1988), who report on learning and teaching styles in Engineering Education, as well as Keller (1983), who reports on the usages of various instructional approaches to motivate student attention. Based on the effective use of perceived enjoyment in other studies (Çelik & Yilmaz, 2011), and the advantages of digital inclusion (Akhter, 2003; Rice & Katz, 2003; Locke, 2005) and perceived attention (Keller, 1983; Felder & Silverman, 1988), the researcher believes that these external variables will also be effective in accurately testing user adoption of e-learning DFs.

Van der Heijden (2004) extended the original TAM with perceived enjoyment and perceived attractiveness to address users' motivation toward the acceptance of websites. Venkatesh (2000:351) defines perceived enjoyment as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated". The findings suggest that the inclusion of perceived enjoyment and attractiveness with the original TAM constructs provided the right combination of measurements to accurately test user adoption of a web-based system.

3.2.1 Theoretical Framework

Preliminary investigations by the researcher identified the underutilisation of DFs at CUT as one of the main challenges confronting this higher educational institution today. It is therefore critical to understand the dynamics of adopting a collaborative tool that has the potential to enhance pedagogical delivery. For this purpose, this tool makes use of a scientifically accepted model, called TAM.

The TAM is an information systems theory that models how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors, such as perceived usefulness and perceived ease-of-use, influence their decision about how and when they will use it (Davis, 1989). Figure 3.1 presents the proposed extended TAM.

Drawing on TAM, this study explores latent variables that have the potential to stimulate positive attitudes toward the effective use and adoption of e-learning DFs in an LMS at UOTs among students. To get a better understanding of user behaviour and attitude towards online DFs, the TAM is extended to include digital inclusion, attention, and perceived enjoyment. Digital inclusion, attention and perceived enjoyment may contribute to technology adoption in that they have a positive effect on the perceived usefulness and attitude towards using DFs. However, perceived usefulness may also have a positive effect on attention and perceived enjoyment.

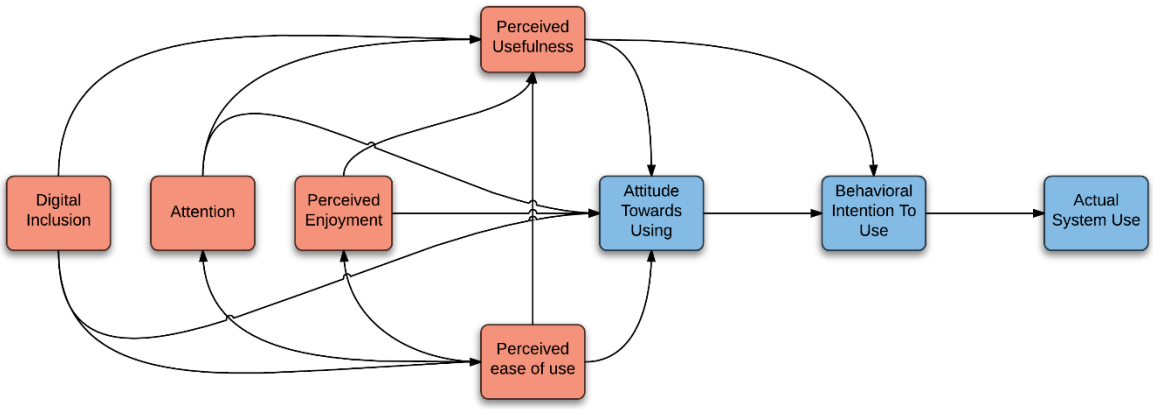

Figure 3.1 Proposed extended TAM (Davis, 1989).

The study has the potential to establish factors that may influence the adoption of DFs in an LMS at a UoT. The relationship between the TAM variables will be determined. Once TAM latent variables and their relationships to DF adoption are established, then recommendations are made regarding the most suitable techniques of implementing DFs in an effort to improve its adoption.

3.3 Research design

A research design occurs at the beginning of a research project and involves a plan or blueprint of how the research will be conducted by outlining how observations will be made and how the researcher will carry out the project (Mouton & Babbie, 2001; Monette *et al.*, 2013; Babbie, 2015). The research design used in this study incorporates a mixed-methods approach where both qualitative and quantitative data is analysed.

3.4 Research methodology

3.4.1 Research problem, questions, and objectives

Table 3.1 summarises the research problem, which was presented in chapter 1, and Table 3.2 addresses the main research question. The problem of underutilised DFs has the potential to affect the overall efficient use of an LMS negatively, thereby making no real contribution to enhancing the teaching and learning process.

Table 3.1 Research problem of the study

Research Problem
Although literature suggests that effective utilisation of electronic DFs have the potential to boost students' academic performance, active academic engagement (Wentzel & Wigfield, 1998), virtual peer mentorship and seamless learning (Seow *et al.*, 2009), these technologies have been suboptimally employed for student learning. On the other hand, there is growing evidence demonstrating the limited adoption of e-learning DFs among UoTs in SA, resulting in the underutilisation of the overall e-learning system. Mindful of the underresearched nature of the limited application of DFs, the research problem is the limited knowledge on the rationale of the poor utilisation of e-learning systems.

Table 3.2 Main research question of the study

Main Research Question
What are the determinants of DF adoption that could influence the adoption of the overall LMS at a UoT?

The study aims at identifying factors that influence adoption of e-learning DFs at UoTs. The following sub-questions will help focus the attention on how the TAM may be used to answer the main question. Table 3.3 introduces the research sub-questions and research methods and table 3.4 the research objectives.

Table 3.3 Research sub-questions and methods of the study

Research Sub-questions	Research Methods
How can existing technology adoption models be applied to help heighten e-learning DF adoption?	Questionnaire, interview, literature and document reviews.
How can an improved adoption of DFs influence overall utilisation of an LMS?	
To what extent does adoption of DFs contribute to improving students' instruction delivery?	

Table 3.4 Research objectives of the study

Objectives
To determine factors that may hinder students from fully utilising DFs for learning.
To determine factors which promote interest and motivation in maintaining discussions among students from previously disadvantaged communities.
To extend a technology acceptance model by establishing factors that may promote the adoption of e-learning DFs.
To provide best cases or examples of productive educational uses of DFs.
To contribute to the utilisation of the overall e-learning system by making recommendations for the improvement of instructional delivery and pedagogy, using peer collaboration.

3.4.2 Research hypotheses

Three constructs are used in this study to extend the TAM in an attempt to accurately test user adoption of DFs within an LMS at CUT. Figure 3.2 presents the extended TAM with the three additional constructs on the left. The letter H with its associated number refers to the different hypotheses which have been formulated for this study, and which are outlined below. The three additional constructs are:

1. Digital Inclusion: The extent to which people are made aware of technology.
2. Attention: The different instructional approaches taken to capture students' attention.
3. Perceived enjoyment: The extent to which people enjoy using technology.

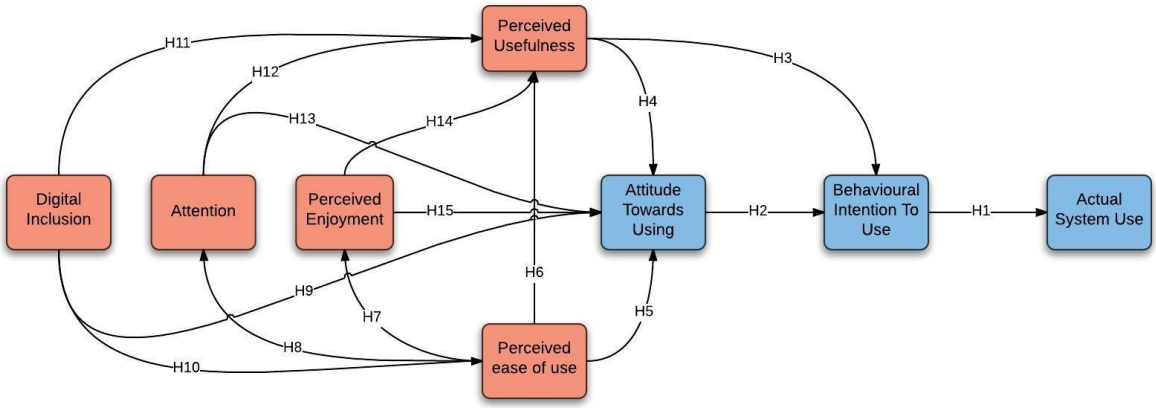

Figure 3.2 The extended TAM

The research hypotheses based on Figure 3.2 of this research's extended TAM model are as follows:

H1 A student's behavioural intention to use a DF is directly related to DF usage.

H2 A student's attitude towards DF adoption affects his or her behavioural intention to use the DF.

H3 The more a student perceives a DF as useful, the more positive the student's behaviour is to use DFs.

H4 A direct relationship exists between perceived DF usefulness and the student's attitude towards DF usage.

H5 A positive relationship exists between a students' perceived ease-of-use of the DF and the student's attitude towards DF usage.

H6 To students, perceived DF ease-of-use is directly proportional to perceived DF usefulness.

H7 Perceived ease-of-use directly influences a student's perceived enjoyment to use DFs.

H8 A positive relationship exists between perceived ease-of-use and attention.

H9 Digital inclusion directly influences attitudes towards using DFs.

H10 Students who are made aware of DFs will find them easy to use.

H11 Digital inclusion will have a positive effect on a student's perceived usefulness of DFs.

H12 Attention has a direct positive effect on perceived usefulness of DFs.

H13 Perceived attention gained by using technology during learning has positive effects on attitudes towards technology usage.

H14 The more the student enjoys using DFs, the more useful the student will find DFs.

H15 Perceived enjoyment is directly proportional to a student's attitude towards DF usage.

3.4.3 Research philosophy

Research philosophy can be defined as the development of the research background, research knowledge and the nature of that knowledge (Lewis, Thornhill & Saunders, 2007). A research paradigm helps to define the research philosophy and refers to a broad framework which comprises perception, beliefs, and understanding of several theories and practices that are used to conduct research (Cohen, Morrison & Morrison, 2007; Gliner, Morgan & Leech, 2011). Researchers' beliefs and values are influenced by

paradigm concepts (mental models, different perceptions, and beliefs towards reality), which help them construct valid arguments and terminology to provide reliable results.

Three different components of research paradigms exist (Easterby-Smith, Thorpe & Jackson, 2012): epistemology, ontology, and methodology. Epistemology refers to the general set of assumptions that are associated with the best way of investigating the nature of the real world. When considering research epistemology, one might ask what constitutes valid knowledge, and how it can be obtained.

Research ontology refers to the assumptions that we make to understand the real nature of society (Easterby-Smith *et al.*, 2012). It describes ways of constructing reality, "how things really are" and "how things really work". Ontological questions tend to relate to matters of real existence and action (Lincoln & Denzin, 1998). A valid question could be: What constitutes reality and how can we understand existence?

Methodology is the combination of different techniques used by researchers to investigate different situations. Methodological questions are those that tend to ask how an inquirer can go about discovering whatever he or she may want to believe or not (Lincoln & Denzin, 1998). An example of a question might be: What tools do we use to investigate these situations to know its reality? It is important for researchers to understand the philosophical side of research issues in order to understand the different combinations of research methods, called paradigms.

3.4.3.1 Paradigms

A paradigm can be defined as a model or framework for observation and understanding, which shapes both what we see and how we understand it (Babbie, 2013). Tashakkori and Teddlie (1998) list four different research paradigms, namely positivism, post-positivism, constructivism, and pragmatism.

The positivist paradigm underlies what is called quantitative methods, while the constructivist paradigm underlies qualitative methods (Lincoln & Guba, 1985; Howe, 1988; Guba & Lincoln, 1994). Positivism bases knowledge solely on observable facts and rejects speculation about "ultimate origins." When considering both qualitative and quantitative methodology, post-positivists typically prefer the experimental design due to their concern with causality and internal validity (Cook, Campbell & Day, 1979).

Similarly, constructivists prefer their own methods and dutifully distinguish the difference in methodological orientation. Pragmatists, on the other hand, believe that either method is useful, choosing to use the dazzling array of both qualitative and quantitative methods listed by Lincoln and Denzin (1998). Constructivists acknowledge multiple realities, working from the premise that knowledge is constructed through discourse in the context of individual histories and social interaction (Schwandt & Marquardt, 2000). Howe's (1988) concept of pragmatism is that quantitative and qualitative methods are compatible; thus, because the paradigm says that these methods are compatible, investigators could make use of both of them in their research.

The need for pragmatism has been highlighted by Bazeley (2013) who posits that pragmatism has influenced the development of many approaches to qualitative analysis, by emphasising:

- A focus on the transactional – action-based – nature of experience as this is affected by different conditions, and the consequences of action under those different conditions;
- A notion that one's ideas about self are built through interaction with others and hence are a reflection of the society of which one is part;
- A need to observe and interpret data from the point of view of the person providing them, as that is the basis for that person's thinking and consequent action.

Another very popular paradigm is the interpretive research approach, which is described by Mouton and Babbie (2001) as an approach that aims to understand people. This approach maintains that everyone is engaged in a process of making sense of their worlds and continuously interprets, creates, gives meaning, defines, justifies and rationalises daily actions (Mouton & Babbie, 2001). Understanding the different paradigms available in research enables one to easily select one for a given study. In this study, pragmatism is used as both qualitative and quantitative data will be triangulated in a mixed-methods approach.

3.4.3.2 Study uses mixed-methods research

Mixed-methods research might be defined as the type of research where a researcher or team of researchers combine elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration (Johnson, Onwuegbuzie & Turner, 2007). Quantitative research investigates social behaviour through statistics, mathematics or numerical data, or computational techniques (Given, 2008). It can also be defined as a formal, objective, systematic process in which numerical data is used to obtain information about the world. Quantitative research describes variables, examines relationships among variables, and determines cause-and-effect interactions between variables (Smith, 1987). It does not allow one to gain a very good understanding of the context or setting in which people talk. Participants' voices are not directly heard. Furthermore, quantitative researchers often do not discuss their personal biases and interpretations. Qualitative research fills these gaps.

Myers (1997) argues that qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena. The data is usually not in the form of numbers and calculations, but rather takes on an inductive approach. The objective of qualitative methods in research is to gain a greater comprehension of someone's experience. Royse (2007) describes qualitative research as being naturalistic so that researchers know what to ask and can alter their line of questioning depending on the participant's response. Data is gathered in a natural environment which in turn engages natural behaviour where participants freely express their thoughts.

Mixed-methods research provides strengths that dim the weaknesses of both quantitative and qualitative research. Mhlolo (2014) posits that mixed-methods provide corroboration in that they help to:

- Validate and explicate findings from a different approach and produce more comprehensive, internally consistent and valid findings.
- Provide more elaborated understanding and greater confidence in conclusions.
- Handle threats to validity and enable us to gain a fuller and deeper understanding.
- Provide richer, more meaningful, more useful answers to research questions.

By using mixed-methods research, the researcher wants to understand the reasoning behind students' limited adoption of emerging technologies. Furthermore, this study aims at reporting on the potential of DF adoption to support student learning and academic achievement. The potent combination of both qualitative and quantitative research is very useful in understanding first-hand experiences and getting base-line information from participants. Selecting which participants to include in the study could be achieved by investigating different population and sampling methods and choosing the best method for the study.

3.5 Target population and sampling

Population can be defined as a group of designated people, objects, or events that we want to draw conclusions from (O'Leary, 2004; Babbie, 2015). O'Leary (2004) says that to research any population, every element within it should be gathered, but for most studies, it is impossible to name and access all elements. Therefore, one can obtain information from a sample group of people and then apply the findings to a wider population. Babbie (2015) supports this by stating that it is difficult to study all the members of a population that one is interested in, and never being able to make every possible observation of them. In this case, one can select a suitable sample from the target population (in this study those being National Diploma and B-Tech students who are registered for Information Technology (IT)) and analyse it.

To understand a population, representativeness is often not a concern for researchers collecting qualitative data (O'Leary, 2004). Rather than focusing on many people, they focus on gaining a better understanding from only a few. On the other hand, some researchers wish to both gather qualitative data and represent a defined population, thereby requiring an appropriate sample size. Following size guidelines when working with qualitative data can allow researchers the option of quantitatively summarising some of their qualitative findings in order to make more mathematical generalisations about their population. Alternatively, when working with quantitative data, O'Leary (2004) suggests trying to find as large a sample as possible within time and budget constraints. The greater the sample, the more likely it will be representative and thus supply generalised data.

A sample can be described as a small portion of a population, or total set of objects, events or persons, considered for actual inclusion in the study; or it can be viewed as a subset of measurements drawn from a population in which one is interested (Barker, 2003; Unrau, Gabor & Grinnell, 2007). Sampling methods are divided into two main groups, namely probability sampling and non-probability sampling. According to De Vos *et al.* (2011), a quantitative study relies more on probability sampling techniques, whereas a qualitative study puts more focus on non-probability sampling techniques. Unrau *et al.* (2007) state that it all has to do with knowing or not knowing the population on which the intended study will be done.

Probability sampling allows researchers to calculate an accuracy estimate of the sample even before the study is completed. This can be done when each person in the population has the same known probability to be representatively selected (Unrau *et al.*, 2007; DePoy & Gilson, 2008). In non-probability sampling, the chance of selecting a specific individiaul is not known because the researcher does not know the population size or the members of the population (Salkind & Rainwater, 2003; Gravetter & Forzano, 2015).

The best-known kinds of probability sampling are simple random sampling, systematic sampling, stratified random sampling, and cluster sampling. Non-probability sampling methods include purposive/judgemental, consecutive, quota, and snowball sampling. Some of these non-probability sampling methods are more appropriate for quantitative than qualitative research, and vice versa.

The simple random sampling method is the easiest of the sampling methods, according to Marlow (2010), where theoretically, each case in the population has an equal chance of being selected for the sample (Jackson, 2015). A unique number has to be assigned to each participant in the population (Grinnell Jr & Unrau, 2005). In systematic sampling, only the first case is selected at random. The succeeding cases are then selected according to a particular interval; for example, every second or fourth case on a list of names, depending on the percentage sample needed (Babbie & Rubin, 1997). Babbie (2015) posits that systematic sampling has more value than simple random sampling, as far as convenience is concerned. Stratified random sampling is suitable for heterogeneous populations as the population can be divided into a number of sections which are mutually exclusive, and where participants are homogeneous with regard to some

characteristic like gender, level of education, computer skills, or age (Singleton Jr, Straits & Straits, 1993; Glicken, 2003; Mitchell & Jolley, 2012). Cluster sampling is often used where the population is too large for random sampling (Jackson, 2015). This method is advisable when a map of the relevant geographical area is available, but not with a sampling frame, like a list of names. Cluster sampling selects cases only from those clusters selected for the sample, unlike stratified sampling, which selects cases from each stratum. The next section explains some of the most popular non-probability sampling methods.

Purposive, also known as judgemental sampling is based on the judgement of the researcher. To best serve the purpose of the study, a sample is composed of elements that contain the most characteristic, representative, or typical attributes of the population. (Grinnell Jr & Unrau, 2005; Monette *et al.*, 2013). Consecutive sampling is very similar to convenience sampling. In convenience sampling, the samples are selected because they are accessible to the researcher or primarily because they were available at a convenient time or place. Consecutive sampling seeks to include all accessible subjects as part of the sample. All persons who are eligible should be included as they are readily available. This method is considered the best of all non-probability samples because it makes the sample a better representation of the entire population. The main purpose of quota sampling is to draw a sample that closely resembles a replica of the population and thus represents the population (Royse, 2007). Particular categories related to people, for instance gender, age or occupation, are sampled according to the distribution of these categories in the relevant population. The sample sizes are usually selected in proportion to the category sizes. Alston and Bowles (2003) explain that snowball sampling is used when one has little knowledge about the sampling frame and if there is limited access to appropriate participants for the study. It involves approaching one case that refers the researcher to another similar case, or, preferably, more than one (Grinnell Jr & Unrau, 2005; Royse, 2007). The sampling frame grows in this way until a sufficient number of cases have been included in the study.

The review of existing sampling techniques was helpful in identifying the sampling technique that should be used in this study. The decision was made that population sampling would be used for quantitative data collection. This is a type of purposive

sampling where you choose to examine a particular set of characteristics from an entire population. In purposive sampling the researcher purposefully chooses some participants to give questionnaires to, while ignoring others who took part in the study. Stratified purposive sampling would form the sampling technique for the qualitative data collection.

3.5.1 Sampling technique used to gather the quantitative data

In order to collect a sample representative of the target population, and to reduce the risk of missing potential insights from members who might have been excluded otherwise, the researcher used population sampling to gather the quantitative data. See page 74 for the sample. Using population sampling meant that it was possible to get deep insights into the topic of this study. Participants from 3rd- and 4th-year IT classes at the CUT were sampled. These participants would have more experience and exposure to DFs than 1st- and 2nd-year students who may still be relatively new to LMSs. Only participants who had been introduced to DFs previously were included in the sample. Participants were selected and asked to participate until the desired number of questionnaires was completed.

3.5.2 Sampling technique used to gather the qualitative data

For this study, the researcher combined stratified random sampling (probability sampling method) and purposive sampling (non-probability sampling method) to form a stratified purposive sample which was used to gather the qualitative data. Stratified sampling is used if the individuals in the population are not "equal" to begin with. This is true for this study as there would be more 3rd-year than 4th-year students enrolled for IT. It is important to ensure that the profile of the sample matches the profile of the population (Salkind & Rainwater, 2003). A group of 30 participants were selected from a population of 263 students by using stratified sampling calculations as shown in Table 3.5.

Table 3.5 indicates that 56% of 3rd-year IT students and 44% of 4th-year IT students were selected and included in the sample. Purposive sampling furthermore allowed the researcher to define specific criteria relevant to the research inquiry, which the participants had to meet:

- Registered 3rd- or 4th-year IT students of 2013.
- Students of any gender, marital status, colour, race or nationality.
- For comparability, 5 students who have never used a DF, and
- 25 students who have used DFs in the past.

Table 3.5 Stratified sampling calculations for qualitative data (Salkind & Rainwater, 2003)

	3rd-year students	4th-year students	TOTAL
Population number	147	116	263
Percentage	147 / 263 * 100 = 56%	116 / 263 * 100 = 44%	100%
Sample number	30 * 56% = 17	30 * 44% = 13	30

Once the appropriate sampling techniques for gathering quantitative and qualitative data were selected, data collection and analysis could commence. LeCompte and Schensul (1999) suggest that data analysis should already start when gathering data in the field. Data analysis is done to prove or disprove a theory and to help reduce large amounts of collected data in order to make sense of them. If this is not done, the data will remain a pile of unwieldy information. Without this crucial step in a study, the data gathered can become useless.

3.6 Data instrument design, collection and analysis

3.6.1 The questionnaire

Quantitative data was collected from 210 participants by using self-completion non-disguised questionnaires containing 5-item Likert scale questions. Self-completion questionnaires require no interviewer to be present. Non-disguised questionnaires require participants to be informed about the purpose of the questionnaire. This was done prior to handing out the questionnaires. According to Balaji (2007), this encourages students to complete the questionnaire as they know what its purpose is. These student responses tend to be less biased, with a higher response rate. The Likert scale is also the most widely used scale in research (De Vos *et al.*, 2011) and Neuman (2005) suggests that it is used when people need to express attitudes or other responses by means of ordinal-level categories (e.g. agree, disagree) that are ranked along a continuum. A 5-item Likert scale

with the following categories was used: 1 for Strongly disagree, 2 for Disagree, 3 for Neutral, 4 for Agree, and 5 for Strongly agree.

A pre-test of the questionnaire was completed by five students. A pre-test can be part of a pilot study and involves the 'trying out' of a particular research instrument (Baker & Risley, 1994). Pilot studies are a crucial element of a good study design (van Teijlingen & Hundley, 2001). The questionnaire used in the pre-test originally featured a 4-item Likert scale which excluded the 'neutral' option. Suggestions from these five students were to include the neutral option as they sometimes found it difficult to form a definite opinion about a specific question. Taking this feedback into consideration, it was decided to use the 5-item Likert scale, which did have some drawbacks.

The main drawback was that some participants did not offer any constructive feedback, as they marked all the questions as neutral. It may be that these students did not really read the questions or that they simply perceived the "neutral" option to be a "safe" answer. It may be that they hold neither positive nor negative opinions about the respective questions. Similar concerns were raised in other studies where researchers found that questions answered untruthfully could influence the results negatively (Johns, 2010).

Another drawback of the 5-item Likert scale is that each participant may have a different interpretation of the "neutral" option. In a recent study it was shown that possible interpretations of the mid-point can be: Do not know, Unsure, Do not care, No opinion, Neither, Neutral, Both equal parts of agree and disagree, Undecided, Not applicable, or Unwilling to answer. These responses suggest that the "neutral" option can be confusing to respondents, and may introduce measurement errors (survey questions being ambiguous or unclear) (Losby & Wetmore, 2012). Although these drawbacks are important to consider, there are also benefits of using the 5-item Likert scale.

A key benefit of using the 5-item Likert scale is providing participants with a wider range of options to choose from. Participants are not forced to choose a definite side, as the "neutral" option is included. The 5-item Likert scale has become the norm because it strikes a compromise between the conflicting goals that comes with offering enough choices (since only two or three options mean measuring only direction rather than also strength of opinion). The 5-item Likert scale further makes the questionnaire manageable

for respondents, since only a few people will have a clear understanding of the difference between points on a higher-item scale. Research confirms that data from Likert items (and those with similar rating scales) becomes significantly less accurate when the number of scale points drops below five or rises above seven (Johns, 2010).

Another method of ensuring valid responses is to reverse questions used in the questionnaire (Smith, 2013). This occurs when a question that was previously asked in the questionnaire is asked in reverse so that participants who strongly agreed with the earlier question will strongly disagree with this one. For example, a scale measuring user attitude towards DFs might include both the questions, "I dislike the idea of using BB DF" and "I like the idea of using BB DF". According to Altermatt (2006), using reverse questions 1) enables the researcher to detect acquiescence bias (the tendency to agree with all the questions), and 2) improves participants' understanding of the construct by forcing them to think about its opposite. In this study the completeness of the questionnaires collected from the whole sample group of participants was examined and invalid questionnaires were removed. The pre-test questionnaire further helped to ensure that there were no serious mistakes or unclear questions that could impede the students' ability to answer the questions truthfully. This ensured a measure of reliability and validity of the data collection instrument.

Reliability can be defined as yielding the same or compatible results in different experiments or statistical trials, describing the repeatability and consistency of a test (Shuttleworth, 2009). Pre-tests of the questionnaire were distributed to five participants of the sample. Reliability came to the fore as the questionnaires repeatedly provided the same data, with little variance. By analysing these pre-tests, the researcher also gained some insight into potential pitfalls where students might find some questions unclear or ambiguous. The necessary revisions were made to produce the completed questionnaire. Care was taken to develop the questionnaire in clear and unambiguous language, trying to eliminate jargon as far as possible. This enabled the participants to understand the questions being asked and to avoid any misunderstandings (De Vos *et al.*, 2011). De Vos *et al.* (2011) stress the importance of pre-tests on semi-final questionnaires before being utilised in the main investigation. By doing this, common errors of whatever nature can be spotted and fixed immediately at little to no cost. Pre-tests achieve two objectives:

they 1) improve the fact and content validity of the instrument, and 2) estimate how long it takes to complete the quesionnaire. Adequate space was left on the pre-tests for respondents to comment on any faults or difficulties they might have experienced during the completion of the questionnaire.

Construct validity involves determining the degree to which an instrument successfully measures a theoretical construct (De Vos *et al.*, 2011), which, in this study, was measured by means of convergent and discriminant validity. Convergent validity refers to the degree to which different measures of a construct yield similar results, or converge, whereas discriminant validity refers to the degree to which a construct can be empirically differentiated or discriminated from other constructs (Grinnell Jr & Unrau, 2005). Convergent validity was estimated by factor loading, average variance extracted (AVE), Cronbach's alpha and CR. The discriminant validity of the measurement model was examined by comparing the correlation coefficient between constructs and the square root of the AVE for each construct (Fornell & Larcker, 1981).

According to De Vos *et al.* (2011), criterion validity involves multiple measurements and is established by comparing scores on an instrument with an external criterion known to, or believed to, measure the concept, trait or behaviour being studied. In this study, criterion validity was achieved by introducing one group of sample participants to DFs before participating in the questionnaire and interview, whereas another group had no prior introduction to DFs. It is argued that if a correlation between a particular group and a scale score exists, the scale is regarded as having sufficient known group validity (Durrheim & Tredoux, 2004; Grinnell Jr & Unrau, 2010). Punch (2013) mentions that content validity focuses on whether the full content of a conceptual definition is represented in the measure. Content validity was ensured in this study by first obtaining a thorough understanding of prior TAM research and then using the TAM constructs as the main topics for the questionnaire- and interview guides.

The literature study served as the basis for constructing the data collection instruments. Formulating the questions for the questionnaire- and interview guides was vital as this would ensure proper data collection in order to support or reject the study's hypotheses. After gaining a greater understanding of the TAM and its relevance to this study, the knowledge obtained was used to frame the questionnaire guide (See Annexure A),

followed by the interview guide (See Annexure B). TAM constructs address fundamental aspects for collaborative e-learning and can be accurately used when testing user acceptance of a technology. Both questionnaire and interview instruments adopted the same basic structure, having the TAM latent variables as main points for the different sections of questions. These main points are aimed at testing user acceptance in all TAM constructs. The only difference was that the interview questions were formulated with the intention of gathering more detailed information from participants.

Eiselen, Uys and Potgieter (2005) posit that questions should be grouped in logical groups that relate to a particular topic, thus forming a specific logical order. Eiselen *et al.* (2005) also claim that general questions and biographical information should be placed at the beginning of a quesionnaire as they deal with factual information and are perceived as non-threatening. De Vos *et al.* (2011) argue that sentences should be well constructed and vocabulary and question style should be understandable and free of jargon, slang and abbreviations. It is also important to avoid double-barrelled questions to ensure that every question contains only one thought. These principles were kept in mind when developing the quesionnaire for this study.

The main approach to quantitative analysis includes univariate, bivariate and multivariate analysis. Univariate analysis is often seen as the first (Singleton Jr *et al.*, 1993) and simplest form of data analysis and is often used to analyse a single variable (De Vos *et al.*, 2011). Frequency distributions, averages, and measures of dispersion are examples of univariate analysis (Babbie, 2013). Babbie (2013:450) defines bivariate analysis as the "analysis of two variables simultaneously, for the purpose of determining the empirical relationship between them. The construction of a simple precentage table or the computation of a simple correlation coefficient are examples of bivariate analysis". Multivariate analysis is described by Babbie (2013:509) as "the analysis of the simultaneous relationships among several variables. Examining simultaneously the effects of age, gender, and social class or religiosity would be an example of multivariate analysis." As this study uses multiple different constructs in testing user adoption of DFs, it adopted the multivariate analysis approach.

After the questionnaires were received back from participants, they were coded into MS Excel and uploaded into LISREL 9.1, allowing the statistician to test factor loading and

reliability of each construct of the extended TAM model used in this study. This was achieved by calculating the mean, the standard deviation (for results validation), factor loading, Cronbach's alpha, composite reliability, average variance expectance, correlation coefficient, Pearson correlation, and t-value. Data from these calculations rendered important facts about the study. For instance, regression allows the researcher to determine whether the hypotheses will be supported or rejected by looking at the strength of the relationship between the dependent and independent variables. Furthermore, factor loading and variance helps to indicate if the data collection instrument is reliable. Demographic data retrieved from the questionnaires will be presented in chapter 4 by means of Pie charts.

3.6.2 The interview

Face-to-face semi-structured interviews were conducted with 30 students to gather more detailed information of their experiences and opinions of using DFs in an educational environment (Harrell & Bradley, 2009). The TAM constructs used in this study were also utilised in the construction of the interview questions. Questions were semi-structured and served as a guide to the interviewer, ensuring that all topics were covered in detail. Depending on the participants' feedback, follow-up questions were asked in order to draw definite conclusions. Griffee (2005) posits that a semi-structured interview involves pre-determined questions, but the interviewer is free to ask for clarification. The same questions were asked to all participants, but the sequence of questions would often change depending on the participants' responses. For clarification, some questions would be asked in a more confirmative tone if those questions have already been asked or answered in a previous question. Semi-structured questions allowed for a more conversational atmosphere, making the interviewee more comfortable, open and relaxed in sharing their experiences. This allowed the interviewer to explore the utilisation of e-learning technology for learning more deeply and to better understand the provided answers (Harrell & Bradley, 2009). In attempting to establish a collaborative and 'non-exploitative' environment, participants were able to choose a place and time suitable for them (Creswell, 1998). A polite and thankful tone was adopted by the interviewer at all times to ensure full co-operation from participants.

A drawback of semi-structured face-to-face interviews is the difficulty to accommodate the times set by participants and that each location has its own characteristics. These drawbacks can affect the mood or attitude towards the interview (Olson, 2007). For this study, a quiet location was used for most interviews. No incentives were offered to the participants as they willingly volunteered their time. The researcher's schedule was therefore adjusted to fit the participants' time preferences.

Using the same interview guide for all participants helped to improve the comparability of students' experiences with DFs in education. Using face-to face interviews made it possible to prompt participants for more information, thereby ensuring that all areas were covered and any uncertainties eliminated. Face-to-face interviews were inexpensive as they were conducted at the university and at the participants' convenience.

Prior to interviews, the interviewer explained the purpose of the interview to the participants and assured them that the interview was optional and confidential. Participants were given a quick overview of the format of the questions and were informed that the interview will take approximately 30 to 45 minutes to complete. The interviews were started by giving each participant the opportunity to ask any questions they might have. The researcher concluded by thanking the interviewee for their participation and asking for any last comments, opinions, or suggestions. Proper data collection techniques were incorporated to ensure accurate and complete data analysis of the qualitative data from the interviews.

Babbie (2013:403) defines qualitative data analysis as the "non-numerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationships." There are several data analysis approaches for qualitative analysis of which Merriam (1998) describes ethnographic, phenomenological, and constant comparative analysis. Ethnographic analysis involves identifying categories related to a culture's economy, demographics, human life, education, health care issues, and the environment. Phenomenological analysis includes an epochal approach which involves laying out one's assumptions about the phenomenon under study, bracketing, imaginative variation, and first and second order knowledge. Phenomenology is a school of thought that emphasises a focus on people's subjective experiences and interpretations of the world. The constant comparative method assigns codes that reflect the conceptual

relationships (Merriam, 1998). However, considering the different qualitative data analysis techniques available (ethnographic, phenomenological, constant comparative, etc.), the researcher concluded that a thematic analysis approach would best suit the purpose for this study.

Thematic analysis involves a process where specific themes are identified and reported in the form of a narrative. It is one of the most common forms of analysis in qualitative research (Guest, MacQueen & Namey, 2011) and emphasises pinpointing, examining, and recording themes within data (Braun & Clarke, 2006). Themes are patterns across data sets that are important to the description of a phenomenon and are associated with a specific research question (Daly, Kellehear & Gliksman, 1997). These themes become the categories for analysis (Fereday & Muir-Cochrane, 2008). Thematic analysis provides a "rich and detailed, yet complex, account of the data" (Braun & Clarke, 2006:5). Guided by Bazeley's (2013) suggestions on steps normally taken in thematic analysis, the following process was executed in order to analyse the qualitative data from the interviews:

1) All interviews were recorded with a recording device.
2) Each interview was transcribed word for word.
3) Every transcript was read through carefully to acquire a better sense of the whole.
4) Researcher comments and interpretations of the meaning of each statement were summarised and potential themes were identified and listed. Themes were identified by looking at repetitive or patterned relationships between identified elements in the data.
5) The researcher then looked for connections between themes and clustered them while keeping an eye on the original transcripts.
6) Data or themes that did not fit were worked into the final results.
7) Themes were expanded and changed as more transcripts were analysed. Ultimately, the researcher ended up with key themes that describe the essence of the study.

According to Braun and Clarke (2006), this process can be summarised into six phases to create established, meaningful patterns. These phases are: familiarisation with data,

generating initial codes, searching for themes among codes, reviewing themes, defining and naming themes, and producing the final report. This approach was followed by the researcher in determining 15 different themes from the qualitative data.

Before data could be collected and analysed, the ethical and legal aspects of conducting research on University participants had to be considered. This was necessary to ensure the safety of the student, researcher and university where the study was conducted.

3.7 Ethical considerations

The Code of Ethics of the National Association of Social Work (NASW) in the US (Williams, Tutty & Grinnell, 1995) provides some guidelines for social work research. These guidelines discuss the major ethical research issues which were carefully studied and considered during this study:

- The consequences for research participants should be carefully considered.
- It should be ascertained that the consent of participants is voluntary and informed, without any implied deprivation or penalty for refusal to participate, and with regard for participants' privacy and dignity.
- Participants should be protected from unwarranted physical or mental discomfort, distress, harm, danger or deprivation.
- As far as the discussion of evaluation of cases is concerned, it should only be done for professional purposes and only with people directly and professionally involved.
- All information obtained about participants should be treated confidentially.
- The researcher should take credit only for work actually done in direct connection with scholarly and research endeavours, and should give credit to the contributions made by others.

A consent letter (See Annexure C) was issued to the institution (CUT) where this study was conducted, and permission was granted to conduct surveys and interviews with the target population. The researcher also constructed a consent form that had to be signed by each participant (See Annexure D). The following conditions were set out by the institution:

- The survey will not interrupt any of the official activities at the institution;
- You will supply us with a copy of your report;
- The cost of all related activities will be covered by yourself;
- Recruitment of participants is the sole responsibility of yourself;
- Voluntary nature of the potential participant's decision to consent to participate should be strictly observed;
- You should not disclose a potential participant's decision to participate or otherwise to any other party;
- Permission does not compel, in any sense, participation of staff members or students in your survey.

Total confidentiality was enforced by ensuring participant privacy and anonymous treatment of participants' data as recordings were not distributed in any way and participants' names were not disclosed in any written material or discussion concerning the research project. Participant student numbers were not requested for the purpose of this study and were never recorded.

3.8 Conclusion

This chapter discussed the foundation of the proposed model, followed by a focus on the research design and methodology along with the research philosophy. The target population and appropriate sampling techniques were substantiated. The data collection instruments (questionnaire- and interview guides) and data analysis techniques were explained, followed by the ethical considerations taken during this study.

Chapter 4 presents the results of the quantitative data. These results are discussed in sections and divided according to the extended TAM constructs, namely digital inclusion, perceived enjoyment, attention, perceived ease-of-use, perceived usefulness, attitude towards using DFs, behavioural intention to use DFs, and DF usage.

CHAPTER 4: QUANTITATIVE DATA ANALYSIS

4.1 Introduction

Chapter 3 covered the research design and methodology. The research design used for this study is a mixed-methods approach, including both qualitative and quantitative data. Chapter 3 also focused on the population and sampling, data instrument design, data collection and analysis. Ethical considerations involved in conducting a successful research study were also provided. In this chapter different data analysis techniques are used to present the findings of the study's quantitative data. Data instrument validation is discussed and involves the testing of reliability, convergent validity and discriminant validity. A similar set of fit indices, used for the measurement model, are used to examine the structural model, allowing the researcher to report on whether the study's hypotheses may be supported or rejected.

4.2 Research site

This study was conducted at a UoT that was established in 1981 as "Technikon Free State" and later upgraded to a UoT in 2004 and named the Central University of Technology (CUT). UoTs are more practically orientated and focus on innovative problem solving. Admission criteria at these institutions are usually regarded as lower than those at traditional universities in SA. As a result, this phenomenon draws a variety of students with diverse levels of academic preparedness. Most of the institution's students originate from the Free State province, and especially from rural communities. These students' home language, or mother tongue, is predominantly Sesotho. It is often the case that high school teachers use code switching (when a speaker alternates between two or more languages, e.g. English and Sesotho) in the classroom and this makes it difficult for these learners to properly read, write and converse in English. Unfortunately for these learners, who are mostly English second or third language speakers, English is the instructional medium at CUT. A large proportion of these students study part-time due to work or family responsibilities, and are therefore in their mid-twenties.

4.3 Research procedure

The research for this study included 3rd- and 4th-year IT students who were enrolled for the Information Systems III and Internet Programming IV modules, respectively. The study was limited to one department because the researcher wanted to maintain a manageable population. It was also limited to senior students who had previous experience with LMSs. In an effort to extend the teaching and learning of these students, whose pedagogy was predominantly based on traditional lecturing, the researcher introduced electronic DFs to extend the classroom environment.

Since an LMS is a complex phenomenon, the researcher applied the system theory in breaking the LMS into smaller, more manageable components to explain its purpose. However, this study was limited to only one subsystem of the LMS, called the DF. Its ability to promote effective teaching and learning through academic collaborations led to its selection as a unit of study in this research. Given that the aim of the study was to identify factors that promote DF adoption, Information Systems III and Internet Programming IV, which are technology-based modules, served as the perfect contexts for such an investigation.

The participants were divided into clusters of at most 10 in a cohort, excluding the facilitator. Each group was assigned a facilitator whose role was to guide the participants and moderate academic discussions within the LMS DF platform. The use of small clusters helped the facilitator to manage the academic collaborations in this cyber platform. Participants were allowed to post questions on any section of the syllabus that they required assistance on. Participants were encouraged to post questions at any time of the day as the discussions were open 24 hours a day. Available participants or the facilitator would engage with the discussions until they found a satisfactory solution for the person who raised the question.

The study's initial academic discussion using the LMS DF platform took place a few weeks before one of CUT's major assessments. These discussions were aimed at preparing participants for the assessment. The facilitators guided participants in their groups with assessment questions regarding techniques, knowledge creation and critical thinking. Additionally, participants assisted each other in the learning process (peer learning). Active participation was encouraged. Participants had the option of posting

anonymously, giving them the freedom to participate and interact with their peers without the fear of being ridiculed. The facilitators used their real names for easy identification by participants. For weeks thereafter, participants were still posting questions and discussing them among themselves. The facilitators used their clusters as a platform to identify questions and syllabus sections that needed further explanation. The lecturer was then notified of issues to elaborate on in class for the benefit of all the students. The facilitators also identified at-risk participants and notified the lecturer for further intervention.

4.4 Quantitative analysis

According to and Babbie and Rubin (2005), quantitative data analysis can be described as the techniques through which researchers convert data to a numerical form and subject it to statistical analysis. The purpose of analysis is thus to reduce data to an intelligible and interpretable form so that the relations of research problems can be studied and tested, and conclusions drawn. Quantitative data can be analysed manually or by computer, but is most often calculated via a computer, using a number of different statistical software programs, such as Statistical Package for the Social Science (SPSS) (Field, 2009). VanderStoep and Johnson (2008) posit that the primary advantages of quantitative research is that they allow for large sample sizes, increased statistical validity, and can accurately reflect the population. Ledgerwood and White (2006) support this by saying that quantitative research is conclusive and the results can be inferred to the rest of the population.

It is generally stated that the larger the population, the smaller the sample percentage of that population needs to be, and vice versa (Neuman, 2003). It is also a practice that the greater the probability of sample error, the larger the sample should be (Grinnell Jr & Unrau, 2005; Welman, Kruger & Mitchell, 2005). Different opinions exist with regard to the minimum sample size for a study. Grinnell and Williams (1990) contend that 30 is sufficient to perform basic statistical procedures, while others feel that a minimum of 100 is enough. Stoker (1985) suggests that a population of 200 participants should amount to a sample size of approximately 64. Considering the relevant literature, this study's sample size of 182 out of a population of 263 students for the questionnaire is well within

the acceptable number of participants to accurately generalise the sample to the population and thus extract reliable meaning from the research.

The study adopted a two-step process for quantitative data analysis, as recommended by Anderson and Gerbing (1988). The first step involves an examination of the measurement model (TAM) and includes testing of the construct reliability and validity. The second step involves the structural equation modelling (SEM).

According to Chang, Yan and Tseng (2012), SEM is a statistical method that utilises both the factor analysis and path analysis. The SEM approach provides theory construction and analysis relationships among variables (Chin, 1998; Chang *et al.*, 2012). Consequently, SEM was used in this study to examine the research model and hypotheses. LISREL (Linear Structural Relations) 9.1 is one of the covariance analysing software packages employed for the provision of SEM analysis. Even though LISREL was used to examine parameters among latent variables and relationships between variables and latent variables simultaneously, the model analysis and the explanation of LISREL must engage in both the measurement model and structural model analyses (Hulland, 1999; Haffer & Kristensen, 2008). This helps one to analyse relationships among variables and predictability of the model more precisely (Haffer & Kristensen, 2008). Based on this argument the researcher chose to apply the two-step process for quantitative data analysis mentioned above. Following this two-step process, the researcher performed the measurement model analysis for evaluating reliability and validity of latent variables first. The SEM analysis for examining the research hypotheses and the explanatory power of the model followed.

4.4.1 Measurement development

An initial questionnaire was created with 42 questions. A pilot study was conducted with 5 participants who were randomly selected from the study population. De Vos *et al.* (2011) stress the importance of a pilot study on semi-final questionnaires, before being utilised in the main investigation. The pilot study helped to identify vaguely defined and ambiguous questions. The questionnaire used in the pilot study originally featured a 4-item Likert scale which included options for Strongly disagree, Disagree, Agree, and Strongly agree. The pilot study suggested an amendment of the Likert scale from 4 items to 5 items, with the option for Neutral added. A further revision that was made to the

questionnaire was to rephrase unclear and ambiguous questions. Additionally, some questions were swopped with others to improve the flow and logic of the questionnaire. Three questions were eliminated due to duplication or not being totally relevant to the construct being tested. This elimination left a total of 39 questions that were included in the final questionnaire (See Annexure E). All the questions were developed from previous studies and tailor adapted to meet the objectives of this study.

4.4.2 Questionnaire sample for quantitative data

The target population consisted of 176 third-year and 34 fourth-year registered IT students at the research site, of which 153 and 29, respectively, agreed to participate in the study. Population sampling was used in this study for doing the questionnaire sampling. According to Lund Research (2012), population sampling is a type of purposive sampling technique that involves examining the entire population that have a certain set of characteristics. With this type of sampling, it is possible to get deep insights into the phenomenon you are interested in. With such wide coverage of the population of interest, there is also a reduced risk of missing potential insights from members that are not included. A self-completion questionnaire was administered to the target population of 210, however, only 182 agreed to participate in the study. A total of 146 questionnaires were returned, resulting in an overall response rate of approximately 80%. One study reports on response rates from distributing paper-based questionnaires. An average of 56% was obtained from 9 different studies (Nulty, 2008).

Thus, it is a clear indication that the response rate of 80% achieved for this study is well above the average of 56% obtained from these 9 studies. Therefore, a response rate of 80% is very good. Third-year students returned 120 questionnaires, resulting in an approximately 78% response rate while 4th-year students had an approximately 90% response rate. Forty-one questionnaires were discarded due to incompleteness or discrepancies in answering. This left one hundred and five questionnaires to be considered for analysis.

Cochran (1977) and Krejcie and Morgan (1970) prepared tables which present the sample size in line with a certain degree of reliability and population size. Based on these tables, another researcher, Ross (2004), suggests that if parametric tests are to be employed, between 30 and 500 samples would be required. This study provides a final sample size

of 105, which falls within the acceptable range, thereby validating its usage in statistical software programs.

Socio-demographic features of the 105 participants who answered the measurement device are given in Table 4.1. The sample consisted of a majority of female participants (63%) as opposed to 37% male participants. Fifty-one per cent of participants claimed that they have internet access at home. The results from this question provided valuable information regarding the availability of DFs to the study's participants off and on campus. Half of the participants do not have access to the internet from home, which might be an indication towards the possible underutilisation of DFs. Participants consisted of 93 third- and 12 forth-year students with 90% of all the participants aged between 20 and 25. Eighty-three participants prefer a combination of face-to-face and online learning, whereas 20 prefer only face-to-face learning and the remaining 2 prefer only online learning.

Table 4.1 Socio-demographic profile of sample

Variables	Variable Category	Frequency	Percentage
Gender	Female	67	63%
	Male	38	37%
Internet Access	Yes	54	51%
	No	51	49%
Level of Study	3rd Year	93	89%
	4th Year	12	11%
Age	< 20	3	3%
	20-25	94	90%
	26-30	7	6%
	> 30	1	1%
Learning Preferences	Face-to-face only	20	19%
	Face-to-face and online	83	79%
	Online only	2	2%

4.4.3 Descriptive statistics

The means and standard deviations for all constructs in this study were determined and are displayed in Table 4.2. To determine the mean, the average of the numbers is calculated. Then, for each number, the mean is subtracted and the result squared (the squared difference). Then the average of those squared differences equals the standard deviation.

Table 4.2 Descriptive statistics of the proposed model

Variable	Mean	Standard Deviation
Digital Inclusion (DI)	3.672	0.981
Perceived Enjoyment (PE)	4.064	1.121
Attention (ATN)	3.411	0.721
Perceived ease-of-use (PEU)	3.672	0.890
Perceived Usefulness (PU)	4.104	0.762
Attitude (ATD)	2.123	0.654
Behavioural Intention (BI)	2.755	0.904
Usage (U)	3.972	1.112

With the exception of two items, the descriptive statistics indicates that participants held generally positive perceptions (mean scores greater than three) towards DFs in learning. The mean scores ranged from 2.123 to 4.104 with the highest score belonging to the perceived usefulness construct, and the lowest score to attitude. The standard deviation ranges from 0.654 to 1.121, indicating that participants' responses were not extremely different, but rather very similar.

4.4.4 Instrument validation

A confirmatory factor analysis (CFA) to test the proposed model and associated hypothesis was conducted using LISREL 9.1. Unlike normal regression models, LISREL estimates parameters by using simultaneous equations. It is therefore possible to estimate many parameters in complex structures of interaction. One major advantage is that one can distinguish between latent variables and observed variables. This concept is based on the acknowledgement of the inevitability of measurement error (Ganzeboom, 2015). The measurement model's goodness-of-fit (χ^2/df, GFI, AGFI, PGFI, NFI, CFI, PNFI, RMSR, RMSEA, SRMR) was estimated using ten common indices provided by LISREL (see Table 4.3).

Table 4.3 shows that all the model-fit indices exceed their respective recommended values, as suggested by Gefen, Straub and Boudreau (2000). This indicates a good fit between the model and data. The ratio of χ^2 to degrees-of-freedom (df) was 2.278, which, according to Carmines and McIver (1981), is within the recommended value of 3.

Table 4.3 Fit indices for measurement and structural models

Goodness-of-fit Measures	Recommended value	Measurement Model	Structural Model
χ^2/df	≤ 3	2.278	2.278
Goodness-of-fit (GFI)	≥ 0.8	0.955	0.955
Adjusted goodness-of-fit (AGFI)	≥ 0.8	0.929	0.929
Parsimonious goodness-of-fit (PGFI)	≥ 0.5	0.732	0.732
Normalised fit index (NFI)	≥ 0.9	0.993	0.993
Comparative fit index (CFI)	≥ 0.9	0.936	0.936
Parsimonious normed fit index (PNFI)	≥ 0.5	0.797	0.797
Root mean square residual (RMSR)	≤ 0.05	0.032	0.032
Root mean square error of approximation (RMSEA)	≤ 0.08	0.067	0.067
Standardised root mean square residual (SRMR)	≤ 0.08	0.039	0.039

Diamantopoulos and Siguaw (2000) argue that the goodness-of-fit (GFI) is an indicator of the relevant amount of variances and covariance accounted for by the model and shows how close the model comes to perfectly reproducing the observed covariance matrix. According to Moutinho and Hutcheson (2011), the adjusted goodness-of-fit (AGFI) refers to the GFI adjusted for the degrees of freedom in the model, while the parsimonious goodness-of-fit index (PGFI) makes a different type of adjustment to take into account model complexity. The GFI and AGFI of the study is 0.955 and 0.929, respectively, indicating acceptable levels. This is confirmed by Diamantopoulos and Siguaw (2000) who state that acceptable fits should range between 0 and 1. In this study, values for the PGFI are much lower than those typically considered acceptable for other indices of fit. However, Mulaik, James, Van Alstine, Bennett, Lind and Stilwell (1989), indicate that PGFI values equal to or greater than 0.5 are considered acceptable. Notice a PGFI value of 0.732, which indicates a very good model fit.

The normalised fit index (NFI), comparative fit index (CFI) and parsimonious normed fit index (PNFI) are three other indices of fit. NFI and CFI typically range from 0 to 1, with values greater than 0.9 representing reasonable model fit (Hong, Thong & Wai-Man Wong, 2002). The measurement model yields values of 0.993 and 0.936 for NFI and CFI, respectively, indicating a good model fit. The PNFI value is 0.797, indicating acceptable levels, as the recommended value should exceed 0.5 (Mulaik *et al.*, 1989). The root mean square residual (RMSR) gives an indication of the proportion of the variance not

explained by the model, whereas root mean square error of approximation (RMSEA) describes the discrepancy between the proposed model and the population covariance matrix. The standardised root mean square residual (SRMR) is an absolute measure of fit and is defined as the standardised difference between the observed correlation and the predicted correlation (Kenny, 2012). Values were 0.032, 0.067 and 0.039 for RMSR, RMSEA and SRMR, respectively, which was within the recommended cut-off values of no more than 0.05 (RMSR) and 0.08 (RMSEA and SRMR) for good fit (Hu & Bentler, 1999).

After the values of fit were determined, the psychometric properties of the instrument could be evaluated in terms of reliability, convergent validity, and discriminant validity. Table 4.4 presents the fit indices for measurement and structural models obtained from LISREL. The measurement model involves the mapping of measures onto theoretical constructs and is used to test adequate reliability, convergent validity, and discriminant validity. The structural model shows the causal and correlational links between theoretical variables and is used to test the GFI of the proposed research model.

Several other assessment criteria were considered in addition to the global measures of fit. Strong evidence of measurement reliability was provided by Cronbach's alpha and composite reliability (CR) values (see Table 4.5) (Fornell & Larcker, 1981; Bernstein & Nunnally, 1994). Note that all Cronbach's alpha and CR values presented in Tables 4.4 and 4.5 are above 0.7, which, according to Nunally (1978) and Hair, Anderson, Tatham and William (1998) is necessary to establish scale reliability.

Hair *et al.* (1998) posit that internal consistency of reliability reflects the stability of individual measurement items across replications from the same source of information. It can therefore also be said that Cronbach's alpha and CR measurements demonstrate a reasonable level of internal consistency among the items.

Convergent validity was estimated by factor loading, average variance extracted (AVE), Cronbach's alpha and CR as shown in Table 4.5. It was already established that Cronbach's alpha and CR for all constructs were above the 0.70 threshold. The AVE for all constructs were above 0.6, indicating good convergent validities (Bagozzi & Yi, 1988). Finally, all factor loadings exceeded 0.5 on their own constructs, with values

ranging from 0.722 to 0.926. These indicators suggest the adequate convergent validity (Bagozzi & Yi, 1988).

Table 4.4 Factor loading and reliability of original TAM constructs

Variable	Question	Factor loading	Cronbach's Alpha	Composite reliability	AVE
Perceived ease-of-use (PEU)	PEU1	0.823	0.836	0.854	0.823
	PEU2	0.874			
	PEU3	0.829			
	PEU4	0.844			
	PEU5	0.835			
	PEU6	0.833			
	PEU7	0.792			
Perceived usefulness (PU)	PU1	0.884	0.869	0.932	0.923
	PU2	0.891			
	PU3	0.881			
	PU4	0.889			
Attitude (ATD)	ATD1	0.793	0.754	0.864	0.895
	ATD2	0.762			
	ATD3	0.722			
	ATD4	0.892			
Behavioural Intention (BI)	BI1	0.812	0.801	0.795	0.732
	BI2	0.789			
	BI3	0.794			
	BI4	0.802			
Usage (U)	U1	0.779	0.788	0.832	0.777
	U2	0.842			
	U3	0.822			

Note: A five-point Likert scale was used (1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly agree).

The discriminant validity of the measurement model was examined by comparing the correlation coefficient between constructs and the square root of the AVE for each construct (Fornell & Larcker, 1981). As shown in Table 4.6, the correlation of each construct is lower than the square root of AVE, suggesting good discriminant validity. In summary, the fit indices demonstrate a good overall fit between the measurement model and the data. The statistical results indicate that the measurement model has high reliability, convergent validity, and discriminant validity. Table 4.6 presents the square root of AVE for the study model constructs.

Table 4.5 Factor loading and reliability of TAM extended constructs

Variable	Item	Factor loading	Cronbach's Alpha	Composite reliability	AVE
Digital Inclusion (DI)	DI1	0.862	0.766	0.892	0.689
	DI2	0.926			
	DI3	0.886			
	DI4	0.852			
Perceived Enjoyment (PE)	PE1	0.884	0.794	0.798	0.762
	PE2	0.8721			
	PE3	0.792			
	PE4	0.812			
Attention (ATN)	ATN1	0.836	0.817	0.782	0.658
	ATN2	0.823			
	ATN3	0.818			
	ATN4	0.832			

Note: A five-point Likert scale was used (1-Strongly disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly agree).

Table 4.6 The square root of average variance extracted (AVE) for the study model constructs

Variables	DI	PE	ATN	PEU	PU	ATD	BI	U
DI	**0.739**							
PE	0.685	**0.762**						
ATN	0.663	0.735	**0.708**					
PEU	0.688	0.712	0.612	**0.823**				
PU	0.688	0.755	0.631	0.819	**0.923**			
ATD	0.678	0.682	0.611	0.789	0.911	**0.895**		
BI	0.636	0.665	0.642	0.612	0.812	0.723	**0.732**	
U	0.646	0.643	0.620	0.678	0.852	0.689	0.700	**0.777**

*Note: Digital Inclusion (DI); Perceived Enjoyment (PE); Attention (ATN); Perceived ease-of-use (PEU); Perceived usefulness (PU); Attitude (ATD); Behavioural Intention (BI); Usage (U).
*Note: Bold numbers in diagonal lines represent square root of AVE for each latent variable; numbers in non-diagonal lines represent the correlation coefficient between the latent variable and the other latent variables.

4.4.5 Structural model

The causal structure of the proposed research model was tested using SEM. Teo and Khine (2009) describe SEM as a common statistical tool for modelling relationships between variables which cannot be observed directly, but only with measurement error. The relationships between these unobservable, latent variables are formulated in structural equations, and they are measured with error by indicator variables in a measurement model. There are numerous reasons why structural modelling is important,

of which Schumacker and Lomax (2004) explain four major ones. Firstly, structural modelling permits complex phenomena to be statistically modelled and tested, whereas basic statistical methods only provide a limited number of variables, which provides limited understanding of complex phenomena. Secondly, greater recognition is given to the validity and reliability of observed scores from measurement instruments. This is because SEM techniques, for instance, take statistical analysis as well as measurement error into account when statistically analysing data. The third reason why structural modelling is important is that due to a well-matured SEM, it has provided many researchers with an increased capability to analyse sophisticated theoretical models of complex phenomena, thus requiring less reliance on basic statistical methods. Lastly, SEM software programs have become increasingly user-friendly in that they have become Windows based and contain features similar to other Windows-based software packages. A similar set of fit indices used on the measurement model was used to examine the structural model (see Table 4.3). All the fit measures of the structural model are the same as those of the measurement model, indicating a good model fit. As a result, the path coefficients of the structural model could be examined. Path coefficients and *t*-values for each equation in the hypothesised model are presented in Tables 4.7 and 4.8, along with the variance for each construct.

Results from the structural model as represented in table 4.7 can be interpreted as follows:

- **H1**: Supported with (β=0.327; *t*=4.231) - students' BI to use DFs affects DF usage
- **H2**: Supported with (β=0.296; *t*=3.922) - a student's ATD towards DF adoption affects his or her BI to use DFs
- **H3**: Supported with (β=0.412; *t*=6.274) - the more a student perceived a DF as useful, the more positive the student's behaviour is to use the DF
- **H4**: Supported with (β=0.462; *t*=6.532) - a direct relationship exists between PU and student's ATD towards DF usage
- **H5**: Supported with (β=0.231; *t*=3.142) - a positive relationship exists between a student's PEU of DF and the student's ATD towards DF usage

- **H6**: Supported with (β=0.324; t=4.532) - PEU is directly proportional to PU of participants
- **H7**: Rejected with (β=0.052; t=0.561) - PEU directly influences a student's PE
- **H8**: Rejected with (β=0.035; t=0.411) - PEU directly influences a student's ATD

Table 4.7 LISREL results for structural model including original TAM constructs (H1 – H8)

Hypothesis	Path	(β) Path coefficient	*t*-value	Status
H1	Behavioural intention: Usage	0.327	4.231***	Supported
H2	Attitude towards usage: Behavioural intention	0.296	3.922**	Supported
H3	Perceived usefulness: Behavioural intention	0.412	6.274***	Supported
H4	Perceived usefulness: Attitude towards usage	0.462	6.532***	Supported
H5	Perceived ease-of-use: Attitude towards usage	0.231	3.142**	Supported
H6	Perceived ease-of-use: Perceived usefulness	0.324	4.532***	Supported
H7	Perceived ease-of-use: Perceived enjoyment	0.052	0.561	Rejected
H8	Perceived ease-of-use: Attention	0.035	0.411	Rejected

*Note: *p < 0.05; **p < 0.01; ***p < 0.001*

Results from the structural model as represented in table 4.8 can be interpreted as follows:

- **H9**: Rejected with (β=0.0324; t=0.431) - DI directly influences ATD towards using DFs
- **H10**: Supported with (β=0.223; t=3.042) - DI has an impact on PEU
- **H11**: Rejected with (β=0.042; t=0.421) - DI has a positive effect on PU of DF
- **H12**: Supported with (β=0.289; t=3.658) - ATN has a positive influence on PU
- **H13**: Supported with (β=0.481; t=6.632) - ATN has a positive influence on ATD
- **H14**: Supported with (β=0.442; t=6.312) - PE has a positive impact on PU
- **H15**: Supported with (β=0.333; t=4.772) - PE is directly proportional to a student's ATD towards DF usage

Table 4.8 LISREL results for structural model including extended TAM constructs (H9 – H15)

Hypothesis	Path	(β) Path coefficient	*t*-value	Status
H9	Digital inclusion: Attitude towards usage	0.0324	0.431	Rejected
H10	Digital inclusion: Perceived ease-of-use	0.223	3.042**	Supported
H11	Digital inclusion: Perceived usefulness	0.042	0.421	Rejected
H12	Attention: Perceived usefulness	0.289	3.658**	Supported
H13	Attention: Attitude towards usage	0.481	6.632***	Supported
H14	Perceived enjoyment: Perceived usefulness	0.442	6.312***	Supported
H15	Perceived enjoyment: Attitude towards usage	0.333	4.772***	Supported

*Note: *p < 0.05; **p < 0.01; ***p < 0.001*

Hulland (1999) points out that LISREL and other covariance structure analyses software programs examine the structure model based on the overall model fit, whereas SEM examines the model's goodness-of-fit based on R^2 values of exogenous variables. As shown in Table 4.9, R^2 for the seven exogenous variables in the present model, including U, BI, ATD, PU, PEU, PE and ATN were, respectively, 0.53, 0.68, 0.57, 0.64, 0.49, 0.41 and 0.51. In other words: (Refer to Figure 4.1 for the visual representation.)

- BI explains about 53% of the total variance in U of DF.
- PU and ATD explain about 68% of the total variance in BI to use DF.
- PU, DI, ATN, PE and PEU explain about 57% of the ATD towards DF.
- DI, ATN and PEU explain 64% of total variance in PU.
- PEU explains about 51% of the total variance of ATN.
- PEU explains 41% of the total variance of PE.
- DI explains about 49% of total variance in PEU.

Based on the results from the model, BI was the most important determinant of intention to use DFs. Since the research model explains more than 50% of the total variance in

attitude towards using, BI to use, and usage, the research model holds a good predictability and explanatory power for the acceptance of DFs within LMSs.

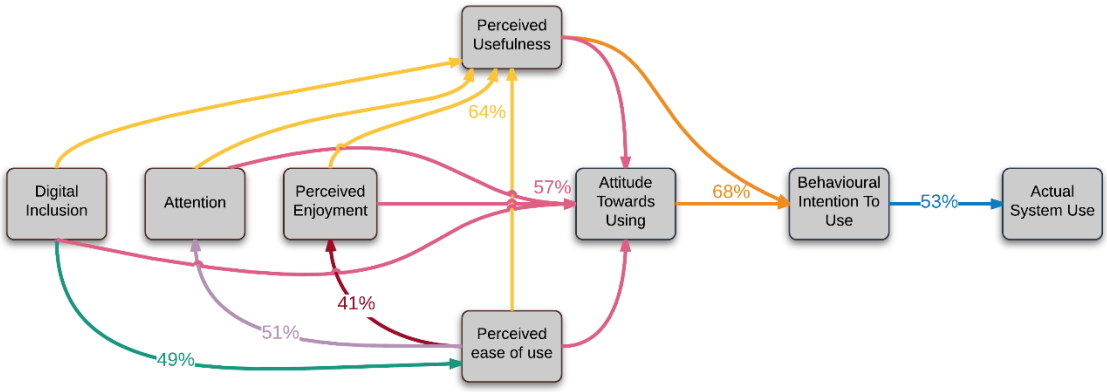

Figure 4.1 The extended TAM with R^2 values

Table 4.9 Percentages of total variance explained of exogenous variable

Exogenous variable	*R^2 Values
Usage (U)	0.53
Behavioural Intention (BI)	0.68
Attitude towards using (ATD)	0.57
Perceived usefulness (PU)	0.64
Perceived ease-of-use (PEU)	0.49
Perceived enjoyment (PE)	0.41
Attention (ATN)	0.51
Digital inclusion (DI)	0.49

*Note: *R^2 is the percentage of total variance explained of exogenous variable*

4.5 Conclusion

Chapter 4 presented the statistical analysis of the quantitative data by using LISREL 9.1. Quantitative data analysis involved looking at the questionnaire sample, followed by reporting on the instrumental validation and structural model. Out of the 15 hypotheses, 11 were supported and 4 were rejected. Chapter 5 will present the analysis of the qualitative data for this study by looking into the different TAM constructs which make up the hypotheses for this study.

CHAPTER 5: QUALITATIVE DATA ANALYSIS

5.1 Introduction

Chapter 4 presented the results of the quantitative data of the study. The statistical analysis for chapter 4 included the presentation of the reliability, convergent validity, and discriminant validity. Structural model analysis was used to establish the nature of the hypotheses of the study model by indicating whether they should be supported or not. Chapter 5 involves the presentation of qualitative data. Narrative analysis of interview data is employed in this chapter to validate quantitative data findings. All the interviews were conducted in November 2013. Narrative themes were developed based on the study model's constructs, which includes collaborative e-learning, digital inclusion, attention, perceived enjoyment, perceived ease-of-use, perceived usefulness, attitude, behavioural intention, and usage. An additional construct was identified during the study, being collaborative e-learning. Qualitative data results were established to triangulate quantitative data results.

5.2 Qualitative data analysis

Considering that the main focus of this study is on students' views and experiences as to the use and effectiveness of DFs, a narrative analytic approach is followed to analyse the study's qualitative data. Bamberg and Cooper (2012) define a narrative analysis approach as a story-telling methodology. Narrators place characters in space and time and, in a broad sense, arrange things orderly to make sense of what really happens with a phenomenon. They (Bamberg & Cooper, (2012)) further argue that narratives provide a portal into the realm of experience, where speakers explain how they as individuals experience events and convey their subjective meaning from these experiences. Using thematic analysis in the form of a narrative, themes were identified from the interviews conducted with participants and summarised in conjunction with the study model's constructs. For confidentiality purposes, participants' details or any information that can lead to their identification should be kept anonymous (Corti, Day & Backhouse, 2000). To ensure this criterion, participants were assigned pseudonyms. Participants' pseudonyms used in this study are: James, Andy, Coreen, Nadia, Puleng, Thabang, Drew,

Leonard, David, Mary, Dennis, Louis, Tsidi, Petri, Nicole, Tumi, George, Sandy, Dave, Greg, Nathan, Jacques, Chloe, Mickey, Wearne, Gerald, Lara, Kobus, Pieter, and Ria.

5.2.1 Participants

Stratified purposive sampling was used to interview thirty participants until data saturation was reached; because of this, the researcher had to stop further recruitment of interview participants. Patton (2002) describes stratified purposive sampling as samples within samples and suggests that purposive samples can be stratified or nested by selecting particular units or cases that vary according to a key dimension. According to Cohen *et al.* (2007), this approach can lend credibility to a research study. This method is useful when enough information is available in order to recognise characteristics that may influence resulting data. The sample groups (3rd- and 4th-year students) don't have equal numbers to begin with, thus justifying the use of this sampling technique. By using stratified sampling calculations (Salkind & Rainwater, 2003), the ratio of 3rd- and 4th-year students is 56% and 44%, respectively. This relates to 17 out of 147 third-year students and 13 out of 116 fourth-year students. Table 3.5 in chapter 3 demonstrates these calculations. Among the interviewed participants 23 were African, four White and three Coloured. The sample group of students comprised 18 male and 12 female participants with ages ranging from 22 to 30. Five of the 30 participants had never used a DF before, whereas the other 25 were familiar with DFs and have used, or are still using them during their studies.

The rest of the data analysis provides further narratives based on collected data guided by the study model. The main themes of the data analysis is: collaborative e-learning, which is facilitated by digital inclusion; perceived enjoyment; attention; perceived ease-of-use; perceived usefulness; attitude; behavioural intention; and usage. An additional construct was identified, being collaborative e-learning and will therefore be discussed.

5.2.2 Collaborative e-learning

Although this theme is not among the model constructs, it has been added here, seeing that the central theme of DFs involves interactions of both learner-to-learner and learner-to-facilitator. Therefore, collaborative e-learning has been identified as an important theme for the study. Collaboration involves working with one or more people towards

achieving a common goal (Dillenbourg & Schneider, 1995). Collaborative e-learning is an approach to learning that involves student groups working together to either complete a task or solve a problem. Collaborative e-learning methods have become well-known worldwide, primarily due to our enhanced understanding of how people learn, resulting in best teaching practices being adopted to help students acquire the necessary graduate attributes.

One of the greatest advantages identified by the participants regarding collaborative e-learning was the opportunity to gain insight into the minds of their peers. Comments included:

> I really enjoyed the interaction with my peers when the lecturer was not available. It was fun sharing my knowledge and to get to know other students (Tsidi).
>
> DFs not only reminded me of what I've been taught in class, but also gave me a platform to see what I understood and how much I understood. I also got new ideas and insights from my peers (Nadia).
>
> DFs provides a comfortable environment for students to interact with their lecturers and peers (Lara).

When compared to traditional methods like lecturing, collaborative e-learning averages a 25% increase in retention of information and its application to the assignment (Fletcher, 1991). Stimulating one's mind and keeping it actively focused on a specific topic by means of discussions, helps one to remember the work for longer. Nicole agreed with this statement:

> The continued use of DFs helped me recall information gained from discussions on topics we had to learn for tests and exams (Nicole).

Due to active participation in discussions, Petri discovered that he remembered work so much better when he was corrected by his peers:

> You need to be corrected in order to remember the answer longer (Petri).

Hall (1997) found that by applying collaborative e-learning through using various pedagogies and teaching methods, learning times are reduced by an average of 40% to 60%. This means that students spend less time for the same benefits and have more time for other subjects, revision etc. Due to the flexibility that collaborative e-learning offers, students can manage their time much more efficiently:

> Time is not an issue on DFs. If you want to post something at 3 am in the morning, nobody will be bothered. DFs can be used anywhere, 24 hours a day (Coreen).
>
> DFs helps me manage my time more efficiently because I can work from home (Gerald).
>
> Using DFs can save one a lot of time. I've had an instance where I was struggling with a problem and upon visiting the DF, discovered that my peers already found a solution (Louis).

Collaborative e-learning is an essential part of e-learning that provides multiple benefits to both educators and students. If used correctly, it has the potential to positively impact the way students learn and retain information. Participants also reported on the fun environment that DFs offer where they can get to know and collaborate with their peers. Considering the advantageous uses that collaborative e-learning offer both lecturers and students, this construct must be considered in this study.

5.2.3 Digital inclusion

According to Washington State University (2015), digital inclusion refers to individuals and disadvantaged groups having access to ICTs, and possessing the necessary skills required to use them. It enables them to take part in and draw valuable information and resources from the institution's growing cognitive and information society. Although the definition of digital inclusion can be multi-faceted (Seale, 2009), in this study it refers to the extent to which people are made aware of technology, have access to it, and are able to use the technologies they have access to.

Selwyn and Facer (2007) posit that digital inclusion occurs when all members of a society are able to access the affordances offered by technology. Fortunately, according to participants in this study, access to computer facilities at CUT has drastically improved over the last few years. Where they could previously only make use of the library's computer labs after hours, there are now new computer lab facilities in additional buildings. One student, however, experienced difficulties during his first year with gaining access to computers at the facilities where internet access was made available:

> In the beginning I had a problem with gaining access to a computer. The labs available to me for use were always full. It was only when I bought myself a laptop that I could communicate on DFs anytime and anywhere (Dennis).

As UoTs tend to put emphasis on trying to provide their students with as much practical experience as possible, additional facilities have been provided at CUT and other UoTs where students can access and use computers for learning. However, it is different for students who work or have families to support at home. For them it could be difficult to physically be at the institution, and they might want to access DFs from home. The only solution for them might be to own a desktop computer, laptop, or mobile device with an internet connection.

The majority of participants claimed that they were aware of DFs, but have never received any sort of training regarding their use. This could either mean that no training was required because of the user-friendliness of the system, or that there were no staff members available whom the lecturer could refer students to for training. Although a percentage of participants liked the idea of receiving training, the majority said they would not attend the training:

> I don't think training is necessary for DFs. For me a five-minute introduction in class was enough (David).

Mary's views supported Kobus's argument:

> I did not struggle, but I think it would be a good idea for the university to appoint someone who would be responsible for providing additional help to students who struggle with the system (Kobus).

An interesting discovery was to see by whom discussions was initiated in DFs that had a high activity rate. In all cases, the lecturer was the one who initiated the discussions. Both James and Kobus shared Ria's and Louis's opinions:

> The lecturer informed us about a post on the DFs. It is then when I became interested. I posted some of the topics myself and received replies from both lecturer and other students. The lecturer was involved in all of my subjects where DFs was used (Ria).

> It all starts with the lecturer. They should introduce students to DFs and start the threads and then keep on reminding the students to visit and participate in them (Louis).

Many suggestions were given by participants as to how the university can improve awareness of BB DFs. The following comments were made in this regard:

> I believe the university should inform more students about DFs as it really helped me and I am sure have helped countless other students (Dennis).
>
> The use of smartphones for learning are so widespread nowadays; students can use their mobile phones to go onto the university's LMS and access DFs from anywhere and at any time. This fact will make competitions on DFs a really good idea. Within no time all students will know about the competition and what they could win and thus will everyone know about, and utilise DFs (Sandy).
>
> The institution should conduct a workshop twice a year. It will be particularly helpful to students not doing IT courses and do not have the skills to quickly figure out how the system works (Petri).

The combination of readily available facilities and proper training could motivate students more to use DFs for educational purposes. Studies on the topic of ICT usage in the digital divide context have focused on examining the demographic characteristics of users, such as gender, income, and level of education (Rice & Katz, 2003); analysing patterns of use (Akhter, 2003); and identifying benefits of use (Locke, 2005). Considering the interview data for this study, students can become more aware of technology through on-campus IT courses, competitions involving digital media devices, and motivated lecturers offering in-class training. This study, however, adds to existing research by identifying the construct of digital inclusion that influences student usage of DFs within the BB e-learning system.

5.2.4 Attention

According to John Keller's ARCS (Attention, Relevance, Confidence, and Satisfaction) model, attention can be gained in two ways: perceptual arousal and inquiry arousal (Keller, 1983). Perceptual arousal comes from using surprise or uncertainty to gain someone's interest, whereas inquiry arousal stimulates curiosity by posing challenging questions or problems to be solved. During the interviews for this study and their

analysis, the aim was to gain insight into whether content modes are used to capture students' attention, and if so, which.

Most participants claimed that they were not aware of the different content modes (e.g. audio, video, graphics, etc.) within BB DFs and only used text to communicate with their peers. All participants said that they would be more motivated to learn if they had been made aware of these different content modes:

> I realised that oftentimes students only go to DFs when they are desperate for more information, for example, just before a test, and different content modes would definitely motivate us to go back more often even if discussions are not of an educational nature and you get an opportunity to get to know your peers, which would be great in a class of 200 students, as it is difficult to get to know each other (Andy).
>
> Things like pictures make it easier and captures one's attention. We also would not be limited to using only text (Pieter).

A few, however, struggled to think of a scenario where they could be useful. Here are Puleng's thoughts:

> I would make use of these content modes if the opportunity presents itself. Currently, I can't think of a subject where it would be useful to utilise these content modes. I never really had the necessity to use any other feature than text (Puleng).

All participants thought that it would be a good method of motivation if a small percentage of marks were allocated for participation. Coreen said the following:

> Marks can be allocated for participation, but there should be some rules. A small percentage should be allocated for posts that are productive and relevant to the topic. There should also be no time limit, but be monitored, for example, over the span of a year or semester. Students should also have the option of posting anonymously. I think that it might happen that someone visit DFs with a negative attitude only to obtain marks, but realise afterwards that it has really been beneficial not only for marks, but also by actually learning something from them; and this will cause them to use DFs more actively (Coreen).

In response to the question of whether participants found questions posted on DFs challenging enough, all students agreed that questions were tricky and that they had to think hard in order to answer them. This motivated them to revisit those discussions:

> They were definitely challenging enough and very interesting and this motivated me to search for more information on the topic or related topics (David).
>
> I struggled with some of the questions and had to do some research on the topic; but that's how I prefer it (Nathan).
>
> Sometimes I had to check the book or Google in order to answer the questions. One gets very open minded and your knowledge base expands a lot (Mary).

A follow-up question prompted participants to explain whether they would go back to discussions where they found the questions to be easy. Dennis and Drew differed from each other:

> I would go back hoping to find more challenging questions (Dennis).
>
> I don't think I would go back. If I did, it would be to help others, because I know how it feels to be frustrated with a question you don't have an answer to. As I am working and have a lot of things going on, I might not have the time to visit them often if they are not challenging enough (Drew).

The researcher infers that the visual appeal and auditory affordances of online DFs may draw the attention of learners and motivate them to use DFs for educational purposes. In support of this statement, Felder and Silverman (1988) posit that although there are numerous styles through which students learn, it would be sufficient for an instructor to include a relatively small number of techniques to meet the needs of many students in any class. The participants' claims about perceived attention are consistent with Keller's (1983) findings that the use of various content modes motivate students to engage in academically productive activities. Keller (1983) elaborates by saying that students who perform well through the use of the same tried and trusted method of instructional approach will benefit from variation. As such, the variations of modes of information within DFs have the potential to capture and retain the attention of students, each with their own learning style. Thus, attention should be retained as a construct in this study.

5.2.5 Perceived enjoyment

Perceived enjoyment refers to the extent to which the activity itself of using computers is perceived to be enjoyable, aside from any academic consequences that may be expected (Davis, 1993). Sun and Zhang (2006) claim that perceived enjoyment plays a vital part in user technology acceptance and has great significance, especially for hedonic systems.

Participants had different reasons for finding DFs pleasant as can be seen by the following five responses:

> I find DFs very pleasant to use because every day when someone posts something, I will do research about it and find it challenging and exciting trying to solve the problem (Chloe).
>
> I enjoy using DFs, but then threads should not go too long unanswered (Kobus).
>
> I like it when everyone comes up with their own ideas and opinions about something. It is very interesting to see what others think and how their thoughts differ from your own (Dave).
>
> At first I thought it would be a waste of time, but soon I came to realise that I liked using them and that I was actually learning something (Petri).
>
> DFs creates that 'extra class feel', but in a fun way. I enjoyed the fact that I could learn so much from my peers and in turn contribute by sharing my knowledge with others. I also enjoyed the idea of not having to study alone but knowing that there are others whom I could ask for help should I struggle (Tumi).

Tsidi, Andy and Thabang did not necessarily find DFs enjoyable, but rather a place where they could go and learn. When asked whether DFs offer playful learning, David, Petri, Thabang and Tsidi all said that they did not experience any playfulness using DFs. David said:

> It was more of a learning experience for me. Sites like Facebook and WhatsApp offer me more of a playful experience (David).

The majority of participants, however, said that they enjoyed using DFs:

> I enjoyed receiving replies for my posts and to see what other students agree and disagree with, and ultimately receiving the correct answer. This exercise made me realise what my mistakes were and learn from my peers' mistakes as well (Mickey).

Louis agreed with Andy in that it is fun learning from your mistakes, since you get to understand the work better. Nadia said the following:

> To me it was like a game. It gave me a boost of confidence when I answered questions correctly where others have failed. This also made me more motivated to participate (Nadia).

All participants agreed on the matter that playfulness in DFs does not inhibit their learning. Here are some of their thoughts:

> Sometimes students post jokes or dwell on a topic. But even then it doesn't really bother me as I can always visit DFs in my free time and catch up on discussions. DFs are also not the only medium of teaching we are exposed to; we still have our books and classes to attend, so DFs offer something more (Andy).

Suggestions were made by participants on how to make DFs more pleasant for students. David shared Dennis's suggestion of introducing a competition:

> Competitions or promotions would be the most effective for me and it would also motivate students to use DFs (Dennis).

Here are a few of the other participants' views:

> It would be more pleasant if lecturers and students made use of the content modes available in DFs, like picture or video uploads (Kobus).
>
> It might be a good idea to redesign the interface to make it more appealing and student-like. Alerts and reminders on the dashboard could also be a good way of reminding students to visit DFs often (Leonard).

Van der Heijden (2004) extended the TAM with perceived enjoyment and perceived attractiveness in order to address users' motivation toward the acceptance of websites. In that study, perceived enjoyment refers to "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated", as defined by Venkatesh (2000:351). These findings suggest that the inclusion of perceived enjoyment and attractiveness with the original TAM constructs provided the right combination of measurements to accurately test user adoption of a web-based system. The incorporation of short threads, different content modes, and promotions within the DFs may lead to an improved adoption of this e-learning system.

5.2.6 Perceived ease-of-use

Drawing from the TAM, Davis's (1989:320) perceived ease-of-use construct refers to "the degree to which a person believes that using a particular system would be free from effort". According to participants, the system was very user-friendly, enabling students to become proficient with the functionality of the DFs within 5 to 10 minutes, without any additional help from educators or peers. On the contrary, students in other faculties who are not exposed to computers on a regular basis might find the system difficult to use and might require further assistance. The following two participants expressed their views:

> At first it was a bit difficult just to get to know the system, but it was user-friendly enough for me to figure it out by myself without any training required (Jacques).
>
> Within a few minutes I became comfortable with the system and as an IT student I found it easy to use (Louis).

Being separated into smaller groups was appealing to participants like Andy and Drew:

> I really like being separated into groups. If a lot of students in a large class all participate, the screen can become cluttered and one can easily miss a post that might contain useful information. Groups make it easier to keep up with what everyone in your group is saying and reply to their posts. More students get the required attention this way as well (Andy).
>
> You get to know the people in your group and you are not bombarded with too much information. It is much more manageable for both student and lecturer (Drew).

Mary, however, wanted to see the whole class's comments:

> I would like to see the whole class's comments to get an even better understanding of what everyone is thinking and get a broader understanding of the topic being discussed (Mary).

What can be concluded from the participants' feedback is that they did not receive any training on BB or DFs, but were only given a quick introduction to DFs by their lecturer. No participant experienced any challenges using the system and agreed that a quick introduction in class was sufficient to start using the system. Participants' experiences with the ease-of-use of DFs indicate that this construct influenced their willingness to adopt DFs for learning. These findings agree with previous findings from technology

adoption studies, which show that perceived ease-of-use influences technology adoption (Al-Adwan & Smedley, 2013). However, in this study, findings regarding the ease-of-use are contradictory to the findings of Danner and Pessu (2010) and Nanayakkara and Whiddett (2005) who state that user training, which improves ease-of-use, causes underutilisation of educational systems. A possible reason for this contradiction can be that the technology considered in this study (being DFs) is only a component of the entire LMS in which participants are proficient in.

5.2.7 Perceived usefulness

Perceived usefulness was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989:320). Based on the responses of the participants, DFs were very useful in their learning and definitely enhanced their performance:

> You learn more about the subject you are currently studying. Any technology-related topics help us, especially when becoming more familiar with the terms and this helps you converse with other students. It helps you understand the lecturer better and makes classes more exciting. One participates better in class, wanting to know more and also encourages the lecturer to know his students are passionate about his/her subject (David).
>
> They help eliminate things that do not work so we can concentrate on things that will work in programming. It's like a place to log your errors. You learn from others' mistakes (James).
>
> Topics discussed were really helpful because in the end we came up with new things and stimulated our minds to think outside the scope of the work (Tsidi).

All participants mentioned that their grades improved as a result of participating in DFs and said that DFs helped them to prepare for tests and exams. Tsidi enjoyed the benefits she got from DFs, while others made the following comments:

> If the forums are used actively, it would benefit anyone. If lecturers could only devote a few minutes per day in replying to posts or giving some knowledge into a topic discussed, it would also help a lot (Coreen).
>
> Since I started using them, my progress marks improved a lot. Work discussed on the DFs were relevant to my subjects and sometimes to tests and exams. DFs

> enabled me to think outside the box, especially where broader topics were discussed. It also made me understand the scope of the work better (Mary).
>
> I wish more lecturers could introduce DFs in their courses, because it would help other students improve their grades too (Kobus).

James expressed his views on why he thinks DFs are being underutilised, when they are clearly very useful to students:

> I don't think these students have an idea of what DFs are or what its purpose is. I believe that it all starts with the lecturer; they must introduce it to the students and explain its purpose in order for them to realise its importance and thus make use of them (James).

Previous studies reported that perceived usefulness positively influences technology adoption (Al-Adwan & Smedley, 2013). The authors' findings from these studies have been corroborated with the participants' perspectives in this study. This further affirms the findings of Aboelmaged and Gebba (2013) on the significant impact of perceived usefulness on attitudes towards using mobile banking. In this study, all participants agreed that DFs were useful to their learning. This can be derived from their comments on enhanced performance, improved grades, and DFs being a good aid in helping them prepare for tests and exams. Many participants also highlighted the importance of the lecturers' responsibility to introduce DFs to their students. Furthermore, lecturers are the motors behind successful forums and need to communicate with students on a regular basis, for example, supplying the correct answers to questions, posting knowledgeable facts, or posing new and challenging questions. This construct is thus important for testing user adoption and should be retained.

5.2.8 Attitude towards using DFs

Attitude refers to an individual's positive or negative feeling towards performing the target behaviour, for example, using a particular system or technology. It also involves an individual's judgement of whether performing a certain behaviour is good or bad and gives a general evaluation of whether an individual is inclined or disinclined to perform that behaviour (Ajzen & Fishbein, 1980). Participants generally had a very positive attitude towards using DFs and enjoyed using them:

I have a very good attitude towards DFs as I feel that they can only help students. Previously, I studied at another institution where I did not benefit from their DFs at all. The system was not very user-friendly and I had no idea of what was going on there. It was very confusing to keep track of posts made and many questions were left unanswered. Even lecturers started discussions without posting any conclusion or answer to the discussion. I immediately got a negative attitude seeing these types of things. I am positive about discussions that are active (Gerald).

A friend told me the other day that DFs are only there for marks. I disagreed with him and told him that they are there to help students think for themselves and broaden their views on something (Dennis).

I like DFs because of the fact that I can work from home and manage my time more efficiently (Petri).

Participants acknowledged that it would be advisable for educators and students to use DFs for their learning:

That would be very useful. We can discuss the problems we have in class (Pieter).

Everything is computer based nowadays and this wonderful tool should definitely be used more. It offers another way of learning (Drew).

It could be a great help for all of my subjects. It creates a relaxed environment and you learn your peers' strengths and weaknesses (Tsidi).

Nadia also felt that she definitely benefited from the discussions:

They really helped improve my marks and better my understanding of the course (Nadia).

Some participants felt that they would have benefited less if they had not participated in the discussions:

Yes and no. Yes, because if you try something for yourself and receive the correct answer afterwards, you can see your mistakes and work on them to do better in the future. No, depending on the content being posted and how interested I was in what was being discussed. It's like reading a magazine; you get to remember things you read in the magazine that captured your attention longer than things you have to study (Andy).

> If I did not participate in group discussions I don't think I would have benefited as much as I have from them. When you do something practically and also make an effort to try and answer, you will learn something and retain the answer better and longer (Louis).

Unlike the uptake of emerging technologies (mobile phones) by the elderly, where the intention to use the technology is influenced primarily by external factors, such as objectification (which includes filial affection, safety, and security) (van Biljon & Renaud, 2008), students' attitude towards the use of DFs were generally positive. The relevance of DFs to student learning is expressed in the students' belief that DFs helped to improve their academic performance. Therefore, this construct should be retained to determine DF adoption. Similar findings show that ease-of-use has little influence on elderly users accepting and using emerging technologies (e.g. mobile devices), leading to their deriving sub-optimal value from its usage (van Biljon & Renaud, 2008). Furthermore, wholehearted adoption can only occur if the adopter fully accepts the technology. If not, he or she is unlikely to progress fully and therefore remains a reluctant user of the technology. A reason for this contradiction might be that whereas the research participants for this study were trained in using DFs, which contributed to their improved ease-of-use, the elderly usually lack sufficient training in using mobile phones that are often handed down to them by relatives or friends.

5.2.9 Behavioural intention to use DFs

Behavioural intention can be defined as "the degree to which a person has formulated conscious plans to perform or not perform some specified future behaviour" (Warshaw & Davis, 1985:214). The majority of the study's participants demonstrated a positive behavioural intention towards the usage of DFs. Although Drew expressed concerns regarding the introduction of DFs in all her subjects, the rest of the participants loved the idea:

> I would want them in subjects that I struggle with mostly. Having them in all subjects might be too overwhelming. But it couldn't do any harm just by popping in and see what the discussions are about (Drew).
>
> It would be nice if all other subjects could utilise DFs to help student performance (George).

Greg disagreed with Drew and said that it would not be too difficult to keep track of the various discussions if they were used in all her subjects:

> I believe that DFs are there to help us and that they might reduce one's workload. Someone might post a better answer or explanation of something and this could reduce the time spent on the topic and prevent hours wasted on trying to figure out the solution by yourself (Greg).

All participants claimed that they will often reuse DFs. Andy and James had this to say:

> I would definitely reuse DFs if all courses utilise them and educators keep on posting questions (Andy).
>
> I would go back often. If I came across a question I was able to answer, I would reply and try to contribute (James).

Most participants believed that they would continue using DFs in order to help others by sharing their knowledge, or to ask questions should they need assistance. On the other hand, Andy and Mary were sceptical about whether they would continue using DFs if new threads are not created by the lecturer or other students.

> It depends on the situation. Students don't usually take the initiative unless the lecturer is involved. Students consider themselves on the same level, sharing the same knowledge. The lecturer plays an important role in discussions. We look up to them for guidance. If I was to start a new thread, I think most of my friends would participate and maybe others if they see the discussion is useful to them, but I would want the educator's knowledge and input on the topic as well (Andy).
>
> Students are expecting to receive the correct answer to posts and if they see that lecturers and peers are not actively making an effort to reply to questions anymore, students will not be motivated to participate (Mary).

When the opportunity presented itself, all participants answered a quick 'Yes' when asked if they intended to use DFs in the future. This indicates that participants have consciously formulated plans to use DFs again in future:

> I am disappointed that I have never been introduced to DFs before, as they would be perfect for me, as I am working and am not always able to attend classes (Tsidi).

James supported the relationship between attitude towards using DFs and the behavioural intention to use them:

> Someone must have the right attitude, otherwise they would use DFs half-heartedly and end up not using them at all (James).

James also stated that if he discovered some new or exciting knowledge, he would share it on DFs:

> I would share my knowledge because someone might just understand things the way that I do. I like to compare ideas and find the best possible solution to a problem (James).

Park (2009) measured university students' behavioural intention to use e-learning systems. Results from Park's study indicate that the majority of participants intend to become heavy users of e-learning systems, especially by checking announcements posted on these systems. The validated TAM provides a useful framework for technology implementers who need to assess the possibility of success for technology innovations, and pro-actively design technology-based campaigns (Jayasingh & Eze, 2010). A minority of participants were sceptical about whether they would use DFs persistently, especially in responding to new threads posted by amateurish or inexperienced peers, whose credibility could not be confirmed. Most participants said that they would continue to use BB DFs. This construct, behavioural intention to use DFs, should thus form part of the adoption model.

5.2.10 DF usage

Although the majority of participants have a positive attitude towards DFs and found them to be enjoyable, user-friendly, and very useful for their learning, the underutilisation of DFs at CUT was identified. Even though participants claimed that they do not use DFs every day, or only use them when the opportunity presents itself, they did recommend them for future use:

> When using DFs you learn to think for yourself and I think when you get to industry you will also take the initiative to make decisions for yourself and not just be a brick in the wall (Wearne).
>
> I would definitely recommend them for future use in all subjects, for all courses. They are very useful, especially for first year students (Drew).

5.3 Conclusion

Chapter 5 examined themes developed from interview data, based on the constructs of the study model. Student perceptions were drawn based on the following constructs of the study model: collaborative e-learning, digital inclusion, perceived enjoyment, perceived ease-of-use, attention, perceived usefulness, attitude, behavioural intention, and usage. Chapter 6 will provide a discussion of the study and present the findings and contributions of the study. The discussion will cover both quantitative and qualitative results. The limitations of the study and future work will be explained, along with some recommendations.

CHAPTER 6: DISCUSSION AND CONCLUSION

6.1 Introduction

In chapter 5 an analysis of the qualitative data was presented, including a thematic analysis guided by the study model's constructs. Qualitative analysis themes were developed on the following constructs: collaborative e-learning, digital inclusion, attention, perceived enjoyment, perceived ease-of-use, perceived usefulness, attitude, behavioural intention, and usage. Chapter 6 will cover the discussions of both quantitative and qualitative data which was presented in chapters 4 and 5. The study implications, limitations and future work, and recommendations drawn from the conclusions will also be discussed in this chapter.

6.2 Findings

In this study the factors that influence behavioural intention towards the actual use of e-learning DFs were investigated by means of using an extended version of the TAM-framework developed by Davis (1986). Results of this study generally support the hypotheses derived from the original TAM model and from earlier empirical studies. However, apart from behavioural intention to keep using e-learning DFs, the study also indicated that there were other variables that played an important role in accounting for actual system use. The current study extended the TAM with three additional constructs: digital inclusion, attention and perceived enjoyment. Figure 6.1 portrays the extended TAM model used in this study. The individual lines represent the hypotheses with their (β) path coefficients as extracted from Tables 4.7 and 4.8 in chapter 4.

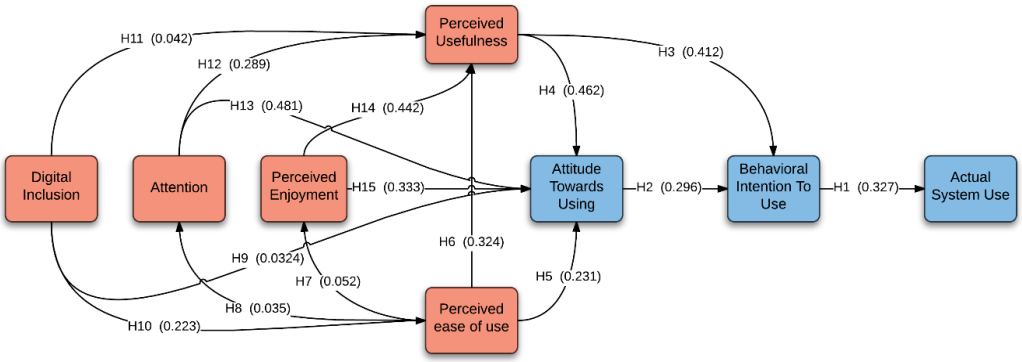

Figure 6.1 Extended TAM with (β) path coefficient results.

The findings of the quantitative data reveal that perceived ease-of-use (β=0.324), attention (β=0.289), and perceived enjoyment (β=0.442) had positive effects on students' perceived usefulness of DFs. As indicated by the β-values, of the constructs that influenced students' perceived usefulness, perceived enjoyment had the greatest effect and attention the least. This finding is consistent with findings of previous studies which show that perceived enjoyment exerts a positive effect on perceived usefulness (Bagozzi *et al.*, 1992; Ha & Stoel, 2009; Lu, Zhou & Wang, 2009; Çelik & Yilmaz, 2011). As for perceived enjoyment in this study, participants enjoyed having sufficient time to read and respond to the questions in the DF, resulting in perceived usefulness of DFs among the students. According to participants, having enough time to research and then respond to questions with confidence enhanced their problem-solving skills which, in turn, may have contributed to the perceived usefulness of the DF. The qualitative data from chapter 5 also revealed that participants enjoyed sharing ideas and benchmarking their competence with their peers. Van der Heijden (2004) included perceived enjoyment and attractiveness with the original TAM constructs to provide the right combination of measurements to accurately test user adoption of a web-based system (see chapter 2 (p.44)). These findings also correspond to Liao *et al.*'s (2008) study where results indicate that the relationship between perceived usefulness and perceived enjoyment has statistical significance.

With reference to perceived ease-of-use, participants indicated that posting comments and interacting on the DF were easy to do. These aspects contributed to participants' perceived usefulness of the DF. Due to the user-friendliness of the system, the students felt comfortable using the DF for test and examination preparations, thus enhancing their positive perceptions of DF usefulness. Several studies on TAM have confirmed a positive correlation between perceived ease-of-use and perceived usefulness (Gillenson & Sherrell, 2002; Yu, Ha, Choi & Rho, 2005; Burton-Jones & Hubona, 2006; Hassanein & Head, 2007; Ha & Stoel, 2009; Lu *et al.*, 2009; Çelik & Yilmaz, 2011). Findings of this study are consistent with the findings of these studies.

As for attention, findings show that asking challenging questions positively influenced the perceived usefulness of the DF, as it stimulated interest and motivated participants to search for more information about the topic or related topics. Furthermore, allowing participants to engage in topics of their choice also contributed to their positive

perception of DF usefulness. The use of various content modes, such as video, text, audio, and images increased students' attention to learn through academic engagement, resulting in perceived usefulness of the DF. Findings for this study agree with Keller's (1983) and Keller's (1987) attention strategies (see chapter 2 (p.44)).

Digital inclusion, however, had no effect on perceived usefulness (β=0.042). Hypothesis 11 (Digital inclusion will have a positive effect on a student's perceived usefulness of DFs) was rejected. Similar findings where perceived access barriers are not associated with perceived usefulness were recorded by Sipior, Ward and Connolly (2011). A possible reason for this could be that the majority of students were already digitally inclined; therefore their perception on the usefulness of DFs was not influenced. In addition, digitally excluded participants learned how to use the DF without difficulty; however, this also did not influence DF usefulness. Findings of this study suggest that participants who generally understand and enjoy using technology (digitally included) are not necessarily positively inclined towards the usefulness of technology.

The results of this study indicate that digital inclusion has a positive relationship with perceived ease-of-use (β=0.223). Previous studies report on digital inclusion and perceived ease-of-use having a significant association with usage (Sipior *et al.*, 2011). Digitally included participants demonstrated proficiency in using the DF, with no need for extensive training in DF usage. The DF's user-friendly interface and ease of operation enhanced the perceived ease-of-use of the DF. Findings of this study suggest that digitally included participants do not really struggle with using technology effectively. However, a system's user friendliness does not necessarily improve students' attention to the system. This is indicated by the rejection of hypothesis 8, which states that a positive relationship exists between perceived ease-of-use and attention (β=0.035). Attention was, however, influenced by a variety of content modes employed in the DF, such as video, text, audio, and images. Hypothesis 7 (Perceived ease-of-use directly influences a student's perceived enjoyment to use DFs) was also rejected (β=0.052). These findings contradict those of Ha and Stoel (2009) who claim that perceived enjoyment has a positive impact on user-friendliness. Possible reasons for this contradiction can be due to the fact that Ha and Stoel's study focused on electronic shopping, whereas this study

focused on electronic e-learning. One might conclude that shopping may be seen as more enjoyable than learning.

Findings of this study further suggest that perceived usefulness (β=0.462), perceived ease-of-use (β=0.231), perceived enjoyment (β=0.333), and attention (β=0.481) all had positive effects on students' perceived attitude towards using DFs. The β-values indicate that whereas attention had the most significant effect on students' attitude towards DF usage, perceived ease-of-use had the least. As for attention, findings of the study reveal that once a system captures a student's attention, whether through the use of different auditory affordances in learning material, or posting challenging questions, the student will develop a positive attitude towards the usage of such a system. These findings suggest that attention motivates participants to academically utilise DFs since it positively impacts their attitude towards its usage. Keller's (1987) sentiments that attention significantly motivates students to learn are in line with the findings of this study.

The relationship between perceived enjoyment and attitude in this study is consistent with Hassanein and Head (2007), found that perceived enjoyment positively affects attitude. Findings of the study suggest that participants enjoy using DFs that help them develop the right attitude to learn. Students enjoyed sharing ideas with peers, which helped them in gaining problem-solving skills. Sharing ideas in the DF significantly contributed to participants' positive attitude towards using the DF. Furthermore, participants shared ideas through academic collaborations that were conducted in a fun and informal way which further enhanced the positive attitude towards DF usage.

With regards to perceived ease-of-use, findings of this study show that it has a positive effect on attitude towards DF usage (β=0.231). These findings are consistent with previous studies that applied TAM (Moon & Kim, 2001; Gillenson & Sherrell, 2002; Shih, 2004; Yu *et al.*, 2005; Ha & Stoel, 2009)., The original TAM used in a study by Moon and Kim (2001) also reports on a strong statistical relationship between perceived ease-of-use and attitude towards usage, having a relatively high path-coefficient (β=0.305). Furthermore, this study's findings on the relationship between perceived usefulness and attitude (β=0.462) are also consistent with other studies that corroborate the positive relationship between these two variables (Çelik & Yilmaz, 2011). Findings of this study show that students who experienced academic benefits through the pedagogical

use of a DF, which includes engaging anytime and anywhere, expressed a very positive attitude towards its usage.

According to this study's findings, as this hypothesis was rejected, digital inclusion has no relationship with perceived attitude towards DF usage (β=0.0324). Prensky (2001:1) posits that "the arrival and rapid dissemination of digital technology in the last decade of the 20th century has changed the way students think and process information". In other words, digitally included students have been raised in a digital, media-saturated world and thus require a media-rich learning environment to keep their attention. A possible reason for the failed hypothesis could be that digitally included students simply use technology because this is how they were raised; it does not necessarily depend on attitude towards DF usage. In this study students were identified who did not know what DFs were, saying that they definitely would have used them had they been made aware of them.

Both attitude towards usage (β=0.296) and perceived usefulness (β=0.412) had positive effects on students' behavioural intention to use DFs. In this study, participants generally had a very good attitude towards using DFs for their learning. Previous studies also confirm the positive relationship between attitude and behavioural intention (Moon & Kim, 2001; Gillenson & Sherrell, 2002; Ha & Stoel, 2009; Çelik & Yilmaz, 2011). Findings further reveal that participants definitely intended to reuse DFs as they found it beneficial to their learning. As for perceived usefulness, Kashi and Zheng (2013) argue that it has a significant effect on behavioural intention. Park, Lee and Cheong's (2007) findings are in line with Hong *et al.*'s (2002) which state that the relationship between perceived usefulness and behavioural intention are statistically significant, and that the hypothesis formulated in relation to this argument was supported.

Study findings indicate that behavioural intention has a significant effect on DF usage (β=0.327). Hypothesis 1 (A student's behavioural intention to use DFs is directly related to DF usage) was thus supported. Findings of the study reveal that participants intended to use DFs again in the future. However, some claimed that they would not visit DFs on a daily basis, but would visit DFs more often when preparing for tests and examinations or if they urgently needed some information. These findings agree with findings of previous

research (Gillenson & Sherrell, 2002; Klopping & McKinney, 2004; Kim, Ferrin & Rao, 2008; Çelik & Yilmaz, 2011).

From the 15 hypotheses for this study, eleven were supported (H1, H2, H3, H4, H5, H6, H10, H12, H13, H14 and H15) and four were rejected (H7, H8, H9 and H11). These findings provided valuable insights into the possible DF usability patterns of students. Of the extended constructs of the TAM for this study, both attention and perceived enjoyment was found to have a positive relationship on perceived usefulness and attitude. Digital inclusion could be implemented to improve the perceived ease-of-use of the system, which ultimately leads to improved behavioural intention and usage. Improved usage of components within the LMS leads to a healthy, functioning system that is used to its full potential and that benefits the learning and teaching experience for both student and academic.

6.3 Contribution

The main contributions of this study are fourfold. Firstly, it has successfully applied the TAM in an LMS context (that is, the DF within the LMS), of which a limited number of studies have reported on previously. Secondly, this research's results reveal that the external variables that were identified at the beginning of this study have a significant impact on user adoption of DFs within LMSs. Perceived enjoyment has a significant effect on students' perceived usefulness of DFs and both perceived enjoyment and attention have significant effects on student attitude towards usage. Thirdly, this study raises awareness of the importance of DFs, which may in turn lead to improving academic and student behaviour and attitudes towards the use of DFs. Student academic achievement may also increase as students engage more with their peers and academics regarding the course content. Finally, this study identified gaps in the usage of DFs in the current LMS. Possible recommendations to address these gaps may be of keen interest to CUT, system developers and other IT stakeholders (refer to section 6.5).

6.4 Limitations and Future Work

Despite some interesting findings derived from this study, key limitations remain. Firstly, this study was conducted within a single department at one university of technology, as

the researcher wanted to maintain a manageable population. However, this can call external validity into question. Future researchers of this topic are encouraged to employ multiple institutions and other departments in order to prove the validity of the model. Secondly, only one feature of the LMS was investigated, while many other different features exist, which, if considered, would make the scope of this study too big. Future research should investigate other features of the LMS. Another recommendation would be to also apply the model to students who did not have access to BB LMS. This could further clarify the nature of interaction between students, and the trajectory of their learning, resulting in improved study validity.

6.5 Recommendations

Some of the most important things to remember when trying to improve adoption of DFs are firstly, there needs to be full, long-term commitment and support form senior management. The initial implementation of the system into a department may be flawless, but if consistent support and contribution from academics start to decrease, participation among students can very easily come to a halt. Secondly, academics and students need increased awareness of the system they are intending to use. If users are not properly made aware of the system, they may develop a lack of interest in using the system. If they struggle to work with a system that they are not familiar with, users might develop a bad perception of this system. Thirdly, institutions need to employ systems that enhance confidence in students and provide a level of comfort in using it. This will also be strengthened through proper training.

Results from this study also demonstrate that using different content modes in teaching can have a significant impact on student adoption of DFs. Felder and Silverman (1988) posit that although there are numerous styles with which students learn, it would be sufficient for an instructor to include a relatively small number of techniques to meet the needs of many students in any class. Another valuable discovery obtained from this study is that students react very well to a system that stimulates a sense of perceived enjoyment. The incorporation of short threads, different content modes and promotions within the DF may lead to an improved adoption of this e-learning system. In interviews conducted in this study participants claimed that affordances like competitions, video sessions, and

multiple choice questions would greatly enhance the pleasantness of the system and thus make it more enjoyable.

6.6 Conclusion

Chapter 6 presented a discussion of the data analysis that were discussed in chapters 4 and 5. The results were explained and possible reasons were provided for the support or rejection of each of the 15 hypotheses. The contributions to the study were highlighted, followed by its limitations and future work. Lastly, this chapter provided key recommendations regarding the most suitable techniques for implementing DFs in an effort to improve its adoption. In this study the TAM was extended in e-learning DF adoption and the perspectives of students at a UoT in SA were reported on.

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ANNEXURE A: QUESTIONNAIRE

Dear Sir/ Madam

Introduction

Thank you for participating in this research. This questionnaire is part of a masters study designed to establish factors that contribute to underutilisation of Learner Management System (E-Thuto) discussion forums. The questionnaire should only take up to 10 minutes of your time. Your cooperation will be appreciated.

The following instructions and conditions must be understood by all respondents:

- Answer from your own perspective, as honestly as possible;
- Please complete all sections, do not leave any unanswered questions;
- Please note that your name is not required nor is it requested, hence confidentiality is assured.
- Participation is optional.
- Where applicable, mark the chosen block with an '**X**'.

Thank you,
Jenny Louw

Section A: Personal Information of Students

AGE	<20	20-25	26-30	31-35	36-40	41+
GENDER	Male	Female	**DO YOU HAVE ACCESS TO E-THUTO FROM HOME?**		Yes	No
LEVEL OF STUDY	3rd Year		B-Tech			
I PREFER TO LEARN	Face-to-Face only		Face-to-face and e-learning/online		Only e-learning/online (i.ee no face-to-face)	

Section B:

Question 1					
Digital inclusion (DI)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
E-Thuto discussion forums are totally new to me.					
My lecturers often make use of E-Thuto discussion forums.					
E-Thuto discussion forums are being neglected in most of my subjects.					
Most students are not aware of E-Thuto discussion forums.					
Question 2					
Perceived Enjoyment (PE)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
E-Thuto discussion forums allow me to express myself in a fun, informal way.					
E-Thuto discussion forums enjoyment contributes to my effective learning.					
E-Thuto discussion forums offer me enjoyment that prevents me from learning.					
I found the experience of using E-Thuto discussion forums enjoyable.					
Question 3					
Attention (ATN)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
The ability to post and receive learning material in different formats e.g. text, audio, video and graphics on E-Thuto discussion forums captures my attention to learn.					
The questions posted by the facilitator challenges my intellectual ability.					
The facilitator's problem solving					

guidance skills helps me to learn.					
Academic debates/discussion with my peers using E-Thuto discussion forums challenges my thinking ability.					
Question 4					
Perceived ease-of-use (PEU)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Learning to use E-Thuto discussion forums was easy for me.					
My interaction with E-Thuto discussion forums is clear and understandable.					
It is easy for me to find learning material on E-Thuto discussion forums.					
It is easy for me to contribute academically on E-Thuto discussion forums.					
It is easy for me to become skilful using E-Thuto discussion forums for academic purposes.					
The training received in how to use E-Thuto discussion forums was useful.					
I found E-Thuto discussion forums easy to use.					
Question 5					
Perceived usefulness (PU)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Using E-Thuto discussion forums enhances my effectiveness in learning.					
Using E-Thuto discussion forums improves my course performance.					
Using E-Thuto discussion forums improves my question answering techniques.					
I found E-Thuto discussion forums useful for my learning.					

Question 6					
Attitude (ATD)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I dislike the idea of using E-Thuto discussion forums. (R)					
I believe it is a good idea to use E-Thuto discussion forums for my learning.					
Using E-Thuto discussion forums is a mere wastage of time. (R)					
I have a generally favourable attitude towards using E-Thuto discussion forums.					
Question 7					
Behavioural intention (BI)	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I will willingly return to E-Thuto discussion forums often.					
I intend to visit E-Thuto discussion forums frequently because it is a course requirement.					
I wish E-Thuto discussion forums could be utilised in other courses.					
I intend to continue using E-Thuto discussion forums in future.					
Question 8					
Usage	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
In future I would like to use E-Thuto discussion forums.					
In future I might use E-Thuto discussion forums.					
In future I plan to use E-Thuto discussion forums.					

ANNEXURE B: INTERVIEW QUESTIONS

Digital Inclusion

1. Are you aware of E-Thuto discussion forums?
   If no, then probe… are you aware that with DF you can send messages, upload pictures, files and videos, record from a webcam, search and share YouTube videos, SlideShare presentation and Flickr photos?
2. When did you first use E-Thuto discussion forums?
3. Why did you start using it?
4. With whom do you interact via the discussion forum?...How?
5. What do you use this technology for?
6. Which features do you use on these forums and why so?
7. What challenges do you find in your use of discussion forums?
8. In what courses have you used E-Thuto discussion forums before?
9. What has been done so far to make students aware of E-Thuto discussion forums?
10. How can the University improve E-Thuto discussion forums awareness to students?

Enjoyment

11. Do you find E-Thuto discussion forums pleasant?
    How did you find them pleasant?
12. Do E-Thuto discussion forums offer you playful learning?
    If yes, please elaborate your answer?
13. Do playful learning using discussion forums destruct your learning?
    Please elaborate your answer.
14. How can E-Thuto discussion forums be more pleasant to students?

Attention

15. What content modes (e.g. text, audio, video and graphics etc.) within E-Thuto discussion forums do you know?
16. Which of these content modes do you use?
17. Are you motivated to learn by using various learning mode?

a. Please elaborate

18. Do you find the questions posted on E-Thuto discussion forums challenging enough?

Perceived Ease-of-use

19. Did you find it easy to become proficient in using discussion forums?
    Please explain your answer?
20. Do you find posting comments/ interacting on E-Thuto discussion forums easy?
    Please explain your how?
21. Did you receive training on how to use E-Thuto discussion forums effectively?
    a. Please give more details to explain if the training was effective.
22. What usability challenges have you or are you experiencing when using E-Thuto discussion forums?

Perceived Usefulness

23. Do you find E-Thuto discussion forums relevant/useful to your learning?
    a. Please explain how?
24. What academic benefits do you get from using E-Thuto discussion forums?
25. Have your grades improved by using E-Thuto discussion forums?
26. Is E-Thuto discussion forums relevant/useful for your learning?
    If yes, please explain how it is relevant/useful?

Attitude

27. What is your general attitude towards using E-Thuto discussion forums?
28. Would it be advisable for educators and students to use E-Thuto discussion forums for your learning? Why/why not?
29. Do you feel that you benefited from the discussions?
30. If you had not participated would you still have felt the same?
    If yes to previous question, how did it benefit you?
    If no, explain why and what could be changed to make it more beneficial?

Behavioural intention

31. In which other courses would you like E-Thuto discussion forums to be utilized?

32. Will you reuse discussion forums often?
33. Will you continue using discussion forums even if new threads are not created by the lecturer or other students?
34. Do you intend to use discussion forums in future?

Usage

35. Do you use discussion forums often?
    a. If no, explain why?
36. Do you recommend E-Thuto discussion forums for future use?

ANNEXURE C: PERMISSION LETTER TO CONDUCT RESEARCH AT UOT

Attention: Director School of Information Technology

I am currently undertaking my Masters' Degree in E-learning adoption of discussion forums and I am required to carry out some research in this area. With this letter, I wish to seek permission to carry out my research in your department. I will conduct my research on third year and B-Tech IT students on their experiences in the use of discussion forums for teaching and learning.

I would like to investigate the pedagogical potential of discussion forums to enhance students' participation in an academic programme. If the initiative proves to be beneficial to teaching and learning, I will recommend its implementation to other subject lecturers. I would be grateful for the permission and your support. Data will be collected using questionnaires and one-on-one interviews.

I will treat information confidentially and only report information that is in the public domain and within law. The report will not contain any personal or comprising information. There will be total confidentiality of all names and I will not name the department or institution without your permission.

Yours faithfully
Jenny Louw

ANNEXURE D: RESEARCH PARTICIPANT CONSENT FORM

Extending the Technology Acceptance Model in e-learning discussion forum adoption: University of Technology student's perspectives.

Jenny Louw
Central University of Technology
School of Information Technology

Purpose of Research

The objective of this study is to establish factors that promote adoption of e-learning discussion forums, and consequently contribute to the utilization of the overall e-learning system. The study will seek to assess the utilisation of discussion forums for leveraging learner participation.

Benefits to the Individual

Participants will enjoy the benefits of anonymous learning and everywhere and anytime learning.

Confidentiality

Your name will not be linked to your interview response; instead, anonymous names will be used for data analysis and results section of the study. Any information that may be traced back to participants will not be included in the report. Data will be kept confidentially and it will only be accessible to those working on the research study. Information gathered from participants will be stored in a strictly confidential manner and will be stored for a period of five years and then destroyed through burning.

Voluntary Nature of Participation

No participants will be forced to take part in this study, hence your participation is voluntary. Participants can withdraw from the study at any given point. Furthermore,

they may refuse to participate in the process of data collection. You may also stop at any time and ask the researcher any questions you may have.

Queries and concerns

Any queries, questions or concerns, about this research project should be addressed to Jenny Louw. The email address is jenny.aucamp@gmail.com

Declaration

I HAVE HAD THE OPPORTUNITY TO READ THIS **CONSENT FORM**, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND I AM PREPARED TO PARTICIPATE IN THIS PROJECT.

Participant's Signature and Date…….

Participant's Name……

ANNEXURE E: MEASUREMENT DEVELOPMENT FOR QUANTITATIVE ANALYSIS

Constructs	Items	Description	Sources
Demographics	Age	<20 or 20-25 or 26-30 or 31-35 or 36-40 or 41+	
	Gender	male or female	
	Do you have access to e-Thuto from home?	Yes or No	
	Level of Study?	3rd year or B-Tech	
	I prefer to learn?	face-to-face only, or face to face and e-learning/online, or only e-learning/online (i.e no face-to-face)	
Digital Inclusion (DI)	DI1	E-Thuto discussion forums are totally new to me.	Rice & Katz (2003), Akhter (2003) and Locke (2005)
	DI2	My lecturers often make use of E-Thuto discussion forums.	
	DI3	E-Thuto discussion forums are being neglected in most of my subjects.	
	DI4	Most students are not aware of E-Thuto discussion forums.	
Perceived Enjoyment (PE)	PE1	E-Thuto discussion forums allow me to express myself in a fun, informal way.	Van der Heijden (2004)
	PE2	E-Thuto discussion forums enjoyment contributes to my effective learning.	
	PE3	E-Thuto discussion forums offer me enjoyment that prevents me from learning.	
	PE4	I found the experience of using E-Thuto discussion forums enjoyable.	
Attention (ATN)	ATN1	The ability to post and receive learning material in different formats e.g. text, audio, video and graphics on E-Thuto discussion forums captures my attention to learn.	Keller (1983) and Felder & Siverman (1988)

	ATN2	The questions posted by the facilitator challenges my intellectual ability.	
	ATN3	The facilitator's problem solving guidance skills helps me to learn.	
	ATN4	Academic debates/discussion with my peers using E-Thuto discussion forums challenges my thinking ability.	
Perceived ease-of-use (PEU)	PEU1	Learning to use E-Thuto discussion forums was easy for me.	Al-Adwan & Smedley (2013)
	PEU2	My interaction with E-Thuto discussion forums is clear and understandable.	
	PEU3	It is easy for me to find learning material on E-Thuto discussion forums.	
	PEU4	It is easy for me to contribute academically on E-Thuto discussion forums.	
	PEU5	It is easy for me to become skilful using E-Thuto discussion forums for academic purposes.	
	PEU6	The training received in how to use E-Thuto discussion forums was useful.	
	PEU7	I found E-Thuto discussion forums easy to use.	
Perceived usefulness (PU)	PU1	Using E-Thuto discussion forums enhances my effectiveness in learning.	Davis (1989) and Davis et al. (1989)
	PU2	Using E-Thuto discussion forums improves my course performance.	
	PU3	Using E-Thuto discussion forums improves my question answering techniques.	
	PU4	I found E-Thuto discussion forums useful for my learning.	
Attitude (ATD)	ATD1	I dislike the idea of using E-Thuto discussion forums.	Davis (1989; Davis, 1993)
	ATD2	I believe it is a good idea to use E-Thuto discussion forums for my learning.	

	ATD3	Using E-Thuto discussion forums is a mere wastage of time.	
	ATD4	I have a generally favourable attitude towards using E-Thuto discussion forums.	
Behavioural Intention (BI)	BI1	I will willingly return to E-Thuto discussion forums often.	Davis (1989; Davis, 1993)
	BI2	I intend to visit E-Thuto discussion forums frequently because it is a course requirement.	
	BI3	I wish E-Thuto discussion forums could be utilised in other courses.	
	BI4	I intend to continue using E-Thuto discussion forums in future.	
Usage (U)	U1	In future I would like to use E-Thuto discussion forums.	Davis (1989; Davis, 1993)
	U2	In future I might use E-Thuto discussion forums.	
	U3	In future I plan to use E-Thuto discussion forums.	