Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST)

by

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DECLARATION

I, Tertu Ponhele Shiweda declare that:

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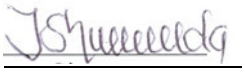
Signature:  Date: _____

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DEDICATION

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This thesis is dedicated to my daughter Azariah who have been patient and endured long hours without me during this study, my late mother Ruth Velimondjila Abisai, and my late father Fillemon Haixwa. I know you would have been proud of me if you had been still alive toda

ABSTRACT

The aim of this study was to investigate theUsability of Digital Institutional Repositories (DIRs) by faculty and postgraduate (PG) students at the Namibia University of Science and Technology (NUST).The study addressed the following research questions:1) What are the attitudes and perceptions of PG students and faculty towards DIRs? 2) To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR? 3) What is the perceived usefulness of DIR by PG students and faculty? 4) What is the level of satisfaction of PG students and faculty with DIR? 5) What is the extent of system usability of the DIR by PG students and faculty?

Technology Acceptance Model (TAM) and post-positivist ontology were used to underpin the study. Interviews, survey questionnaire, document review, observation and expert evaluation methods were used to collect data. The population comprised of faculty, PG students, Librarians and system developers. Statistical Package for the Social Sciences **(**SPSS) was used to analyse Quantitative data while qualitative data was analysed using content analysis. Reliability and validity were achieved through methodological triangulation, pretesting the questionnaires, and careful transcription of the data. The findings revealed lack of awareness about DIR among PG students and faculty. The findings further revealed weak institutional policy, which does not clearly stipulate processes and standards on the submission of scholarly works to the repository. The findings revealed misconception by faculty and PG students about DIR and open access. The findings further revealed that the usage of the repository was undermined attitudes, subjective norms, facilitating conditions, and publisher's policies related to copy right issues. Nevertheless, the findings revealed that PG students generally perceived DIRs as useful.

The findings of the study provide evidence based data upon which relevant academic library institutional repositories policies can be formulated. Moreover, the study provides data that is expected to inform budget allocation for ICT infrastructure development for academic libraries, human resource development, and staffing in academic libraries in Namibia. By using the TAM model, this research adds to literature on the aspects that influence the self-archiving and use of information systems such as DIRs in academic libraries from a developing country context.

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LIST OF ABBREVIATIONS AND ACRONYMs

AD	Active Directory
ARPA	Archaeological Resources Protection
BI	Behavioural Intention
C-TAM-TPB	Combined TAM and TPB
DIR	Digital Institutional Repository
DTPB	Decomposed Theory of Planned Behaviour
EoU	Ease of Use
FAIR	Focus on Access of Institutional Resources
GS	Google Scholar
HABRI	Human-Animal Bond Research Initiative
HE	Heuristic Evaluation
HCI	Human-Computer Interaction
HPGSB	Harold Pupkewitz Graduate School of Business
ICT	Information and Communications Technology
ICT	Information Communication Technology
IR	Institutional Repository
IRUS-UK	Institutional Repository Usage Statistics UK
ISO	International Organisation for Standardization
JISC	Joint Information System Committee
KB	Knowledge Bank
LAN	Local Area Network
LIST	Library Information Training Skills
LOCKSS	Lots of Copies Keep Stuff Safe
MARC	Machine Readable Cataloguing
MIT	Massachusetts Institute of Technology
NUST	Namibia University of Science and Technology
NUST	Namibia University of Science and Technology
OA	Open Access
OAI	Open Archive Initiative
OAI-PMH	Open Archive-Protocol for Metadata Harvesting
OCLC	Online Computer Centre
OCP	Open Citation Project

OPACs	Online Public Access Catalogues
OSU	Ohio State University
PRR	Education Commission Pakistan Research Repository
RoMEO	Rights Metadata for Open Archiving
SDL	Saudi Digital Library
SEO	Search Engine Optimization
SPARC	Scholarly Publication and Academic Resources Coalition
SPSS	Statistical Package for the Social Sciences
TAM	Technology Acceptance Model
TEI	Technological Educational Institute
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
U	Usefulness
UK	United Kingdom
UNAM	University of Namibia
US	United States of America
UT	Usability Testing
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE

BACKGROUND TO THE STUDY

1.1 Introduction

This study focuses on computer based institutional repositories (digital institutional repositories) (DIRs) which house E-print publications. Rieger (2008) describes digital institutional repositories (DIRs) as databases that are accessible online, of which scholarly materials such as articles, reports or datasets are used to enable the sharing, discovery and archiving of scholarly resources produced in a given institution. While the concept of an Institutional Repository (IR) has been assumed to refer to computer-based collections of scholarly works, the term can also be used to describe manual-based collections of scholarly publications. Institutional repositories based on manual systems are simple institutional archives with paper or print publications. Lynch (2003) asserts that DIRs are modern services for academic research which enable community members to manage and disseminate their intellectual works and creations through a digital mechanism. The term institutional repository is used in this thesis; it also connotes digital institutional repository (DIR).

During the 1990s, the preservation and dissemination of intellectual works and scholarly knowledge was exclusively the responsibility of scholarly journals and university libraries. University libraries have always served as access points for information, starting from closed stacks, card catalogues and punched cards right up to the Online Public Access Catalogues (OPACs) (Christian, 2008).

UNESCO (2015), points out that generally the majority of institutional repositories are now based on ICT and that they are designed around open source software, thereby enabling institutions to increase the visibility and the impact of their research output. Such DIRs also enhance interoperability with similar systems in other institutions and this helps them to benefit from technical support that may be shared across such different organisations. Institutional repositories enable open access, which is a practice that offers timely, instant and free opportunities to access scholarly communication and they also enable free, timely, everlasting, full-text and online access to online, scientific and scholarly materials for any use within the internet (Koutras, 2013), to scholarly publications at limited or no charge and free of copyright restrictions (Koutras and Bottis, 2014). In relation to open access, institutional repositories

enable open access to scholarly publishing (Koutras and Bottis, 2014) which Kennan (2008) explains that this is supported and facilitated by new technologies such as the Internet and the World Wide Web and their associated standards and protocols.

Institutional repositories are progressively being recognised by academic institutions as vital infrastructures for preserving and disseminating scholarly materials (Jain, Bentley and Oladiran, 2013). Alemayehu (2010) asserts that open access has provided academic institutions and libraries with new methods of extensively preserving and disseminating their research output. Kennan (2008) points out that free access to institutional repositories is enabled by new technologies such as the Internet and the World Wide Web using standard protocols. The Open Access model of scholarship has the potential to bridge the gap between the 'info-poor' and the 'info-rich' in developing and developed countries respectively (Koutras, 2013).

1.1.1 Institutional repositories

Lynch (2003:2) describes an institutional repository as "a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members". Similarly, Joan (cited in Halder, 2012:45) defines an institutional repository as "a set of services such as e-prints, technical reports, theses and dissertations, data sets, and teaching materials offered by a university or group of universities to members of its community for the management and dissemination of scholarly materials in digital format created by the institution and its community members". According to Harder and Chandra (2012:45):

> Stewardship of institutional repository materials entails their organization in a cumulative, openly accessible database and a commitment to long-term preservation when appropriate. Some institutional repositories are also used as electronic presses to publish e-journals and e-books. Institutional repositories are part of a growing effort to reform scholarly communication and break the monopoly of journal publishers by reasserting institutional control over the results of scholarship. An IR may also serve as an indicator of the scope and extent of the university's research activities.

Closely allied to the concept of an institutional repository is the digital institutional repository (DIR) which is linked to the notion of a digital library in terms of collecting, housing, classifying, cataloguing, curating, preserving, and providing access to digital content (Miller, 2017). Crow (2002:2) defines a digital repository as the "collections that capture and preserve

the intellectual output of universities". The two rationales offered by institutional repositories are: to supplement scholarly publishing models existing now and to aid as solid indicators of a university's quality as well as intensify its visibility (Crow, 2002).

Kim (2005) proffers that in the management and implementation of institutional repositories, DSpace and Eprints are two kinds of "open source software" that are mostly used. The Department of Computer Science at the University of Southampton in the UK developed Eprints in the year 2002. Thereafter, MIT libraries and Hewlett-Packard DSpace were developed in May 2003. According to Kim (2005), libraries in the United States of America largely adopted DSpace, while generally European and Australian library communities used Eprints.

1.1.2 Types of objects stored in digital repositories

Van Westrienen and Lynch (2005) outline the types of objects usually stored in digital repositories, which include articles, theses, unpublished/working papers, conference/workshop papers, books, book chapters and sections, learning/course materials, multimedia/audio-visual materials, bibliographic references, datasets, and patents. Nazim and Mukherjee (2011) assert that the types of objects currently stored in IRs globally include journal articles, conference and workshop papers, unpublished reports and working papers plus books or book chapters/section of books.

Despite the wide and varied types of objects stored in digital repositories, the use remains low for various reasons including but not limited to (Davis and Connolly, 2007): copyright concerns about what is permitted by the publisher, lack of understanding of a publication, whether a preprint in a DIR is recognised as a publication and if the answer is "yes", the implication for having a researcher's work accepted in journals that prohibit research work that are previously published from being submitted into institutional repositories, and quality concerns. Furthermore, some scholars are wary of materials of questionable quality being deposited in the repository, fear of plagiarism and also being scooped. The early distribution of the researcher's work comes with real plagiarism risks and this is an actual concern which causes reluctance in the early dissemination of research work in digital formats by some scholars. Moreover, the fear of dishonest use of information and findings leads to the overall fear results being released prior to article publication and thus compromising one's discoveries and competitive advantages (Çenberci, 2018).

Some authors are concerned about reoccurring threats or obstructions that are linked with depositing content in repositories. According to Cullen and Chawner (2009), there is a concern over the possibility of publishing the research output when a pre-print of a thesis or an article is already accessible through the DIR. Additionally, a recurring theme in the literature includes misperceptions and worries about "copyright, provenance, and quality control, particularly the risk of copyright infringement or plagiarism" (Gadd et al. 2007:243). Gadd et al. (2007) highlight that no single copyright can be a solution for repository archiving, following the fact that the institutional repository houses different kinds of intellectual output (such as, theses, data sets, teaching materials, grey literature, pre- and post-prints).

1.1.3 Benefits of IRs

There are many benefits of DIRs to both institutions and individuals (Pickton and Barwick, 2006). Particularly, to the University, a DIR encourages the worldwide visibility of the university's records and reputation. It discloses the output of the institution's intellectual output to researchers around the globe who would not otherwise have access to it through traditional mediums (Bariwick and Pickton, 2006). Crow (2002:4) explains in SPARC (Scholarly Publication and Academic Resources Coalition), that there are two ways that repositories are capable of bringing out an anoptimistic "paradigm shift" in the process of scholarly communication: firstly, capability of supplementing the existing way of publishing and motivating modifications to the current scholarly publishing mode (mainly moderating the collective expense of having scholarly publishing access); and secondly, the capability to enable the visibility of an institution's research outputs in an effort to demonstrate the relevance of its research activities and increase the status and public value of the institution.

According to Ashworth et al. (2013), an advanced Digital Institutional Repository can be used as a marketing strategy to attract high quality prospects and funding opportunities to the university, as well as supporting learning and teaching. Academics and students will have central and equal accessibility to teaching and learning materials, and long-time preservation of the institution's digital output; as well as the ability to keep track of research performance. According to The Open Citation Project (cited in Ashworth et al. 2013), a DIR furthermore, improves the impact of scholarship and the dissemination of information. Literature indicates that articles on open access are likely to be cited more than those that are not open access articles. On average, online files receive 300% more citations than paper based materials in some disciplines. Furthermore, literature indicates that the researchers should take a message that the research is incomplete pending the extensive sharing and dissemination of the output. In addition, an extensive set of materials storage and access is guaranteed. Since many authors

might experience lack of resources, time, or expertise to be able to preserve their own scholarly work, therefore, a DIR comes in to aid these scholars (Ashworth et al., 2013).

Moreover, Cullen and Chawner (2009) state that via the organisational based DIR strategy, a long-standing availability and better security of research work is guaranteed. Cullen and Chawner (2009) further emphasise that archiving enables a greater exposure of research work, for example, via the Google Scholar search engine, hence a better possibility of a higher "research impact". According to Kingsley (2008), maximised exposure is partially attained through maximise readership by including other researchers that would normally not have access to subscribed journals. Through the DIR, items acquire an everlasting URL compared to a personal or departmental web site. Therefore, users can follow the URL and still access the document after many years. Furthermore, it gives the idea of what others think about the author's work. There are also some extra value services such as "hit counts" on the article or thesis, publication lists that are personalised, and an analysis of the citation is also provided. In addition, the DIR provides a "centralised archive" of the researcher's work and the profiles of researchers. Institutions benefit in that the institution gets prestige and opportunities for funding (Jain, Bentley and Oladiran, 2009).

In terms of society/community, scholarly content is distributed among people and the whole public at large also benefits. In addition, an increased online public access to the research output in return increases the research visibility, usage and its impact. This also increases the research benefits in terms of information and knowledge distribution, application and growth, research output and development (Kingsley, 2008). In addition, some sponsors of research have obligations over the researchers to submit their research findings as a condition for funding. Open access of funded research is encouraged and promoted through some policies. These necessities are planned to maximise readership, reuse, and distribution of research outputs (Jain, Bentley and Oladiran, 2013).

Furthermore, adding to enhancing statistics of repositories, the electronic theses' inclusion in repositories permits the undertaking of original research by evolving scholars to be noticeable and available, thereby enabling its usage by the research community at large. Studies have revealed that theses and dissertations which are made available online are more extensively used and cited in on-going research (Troman et al., 2007). Moreover, IRs capture the intellectual capital of the institution; affords better service to contributors; maximise the library's role as a viable partner in the research enterprise; the long-time preservation of the institution's digital output is facilitated; provides a solution to the problem of preserving the

institution's intellectual output; increases accessibility to knowledge assets; maintains control over the institution's intellectual property; contributes to the reform of the entire enterprise of scholarly communication and publishing; provides new services to learning communities beyond what the institution can offer; reduces the amount of time between discovery and dissemination of research findings; and provides maximal access to the results of publicly funded research (Rieh, Markey, Yakel, St Jean and Kim, 2007). IR enhances an increase in citation counts of the institution's intellectual output and reduces user dependence on the library's print collection (Barton and Waters, 2004). In addition, an IR allows the preservation of research outputs in digital formats, enabling easier retrieval (Performance-Based Research Fund Sector Reference Group, cited in Barton and Waters, 2004).

Rogers (1995) asserts that "innovation" is prone to be accepted when it is perceived to be more beneficial compared to the one it replaces. The majority of participants in Stanton and Liew's (2011) study reported not being aware of the key advantages of archiving in the repository, for example enabling research work accessibility through Google Scholar. However, the authors were positive about other benefits of depositing in a repository. In addition to the research work being placed in a physical library collection, interviewees pointed out that they believe that their work would be more exposed to citations and get more readers once placed in a digital repository which was seen as an advantage. In terms of gaining influence and direct rewards, participants asserted that they did not expect direct rewards for availing their research output through open access archiving.

Participants in Stanton and Liew's (2011) study pointed out that it is their wish to find the work of other students online, sharing of research findings to the public and adding their knowledge to the broader research community. There have been indications that the participants anticipate sharing their own research work with other researchers and using research outputs produced by other students within their own research, hence the majority of respondents in Stanton and Liew's (2011) study favoured mandatory submissions. Ninety-five percent of the respondents wanted to see other doctoral theses of other students in the DIR.

Stanton and Liew (2011) expressed that as a modern technology, DIRs function as an effective mode of distributing doctoral research output and they have stronger advantages compared to the traditional publication mode. As latest technologies, the repositories enable researchers to drive their research outcomes into an international research community as much as possible. Moreover, Stanton and Liew (2011) state that the dispersal of digital institutional repositories

throughout the research cluster remains at a nascent phase. Therefore, there is still a lot to be done until extensive recognition and adoption of open access archiving can be attained.

Several open source institutional repository (IR) systems are currently in use, with the majority of these having rich sets of functionalities to facilitate depositing, accessing, and retrieving scholarly materials. Foster and Gibbons (2005) however, point out that DIRs have only partially fulfilled their original intention; hence their acceptance by possible users has been inadequate for various causes including usability shortcomings imposed by system interface designs. In addition, the quantity of deposited content remains very few. In the context of Namibia, the deposition by scholars of their publications in the DIRs remains very low (Ondari-Okemwa, 2007). For example, by the year 2016 the country had only 1,207 scholarly publications in the DIRs at both the University of Namibia (UNAM) and NUST, compared to Mozambique with 3,103 publications in one repository alone and 3,395 for Zambia also in a single repository respectively (Ezema and Onyancha, 2016).

Uzuegbu (2012) asserts that, Africa contributes only 4% of publications of the world's open access repositories. Westell (2006) points out that the depositing of material in the repositories and their use remain low across the world but more so in Africa. One of the major constraints in depositing and using publications in the DIRs is related to usability issues, especially poorly designed systems interfaces as well as Internet accessibility. The International Organization for Standardisation (ISO, 1998) describes usability as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness (ease of use), efficiency, and satisfaction (visual appearance, consistency, and standards) in a specified context of use" (Jeng, 2005:48). Reeves, Apedoe and Woo (2005:28) point out that "Usability testing signifies a process of systematic evaluation by using human-computer interaction with the system interface". It is a vital tool in the development of computer systems such as interface design (Ferreira and Pithan, 2005:314).

Bevan and Macleod (1994) state that the usability of a product is always examined in relation to consumers, objectives and settings. ISO 9241 asserts that usability has become a recognised area of activity in software development. It is also increasing in importance in the field of consumer product design as well (Jordan, Thomas and McClelland, 1996b; Wiklund, 1994 and Keinonen, 2007). Zhang, Maron and Charles (2013:9) note that "there is limited literature on how the content submission process itself may hinder self-archiving practices". Xia and Li (2007) examined self-archiving practices in nine well-known open access institutional repositories using the EPrints system and found that the researchers have not really broadly

adopted the DIRs self-archiving. Thus, this study sought to understand how usability factors in DIRs affect the acceptability of the DIRs by scholars from the perspective of Namibia. Figure1 below depicts the contribution of scholarly works by continent worldwide.

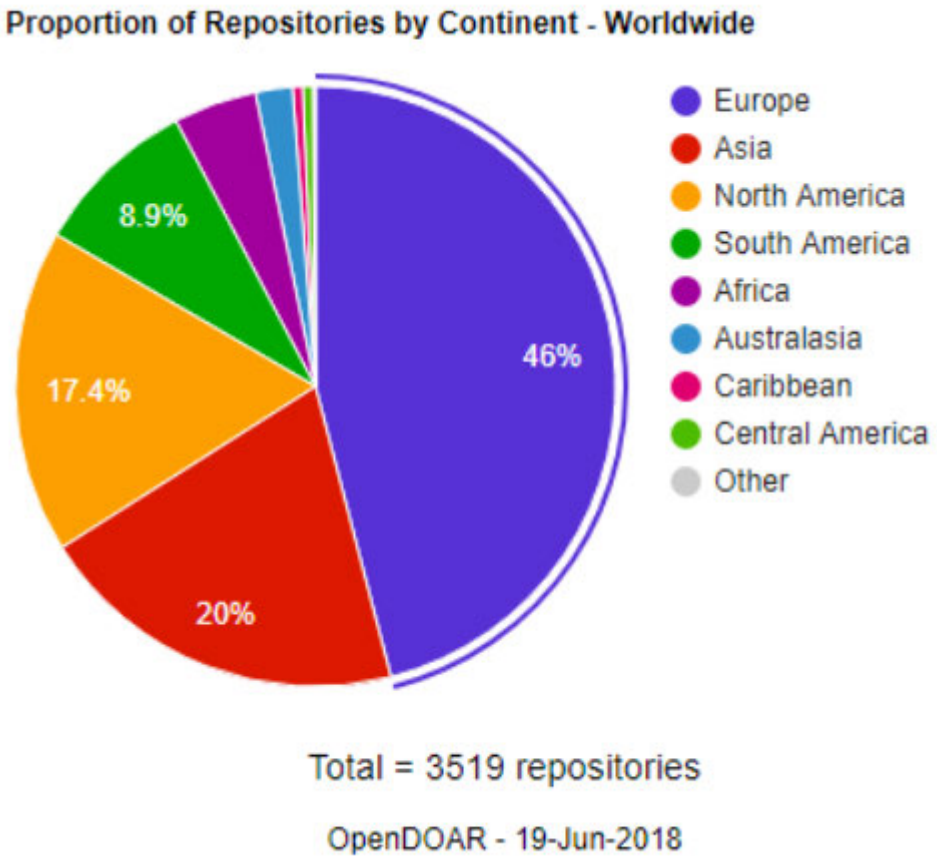

Figure 1.1: Directory of Open Access Repositories (DOAR) statistics

1.2 Namibia University of Science and Technology

The Namibia University of Science and Technology (NUST), previously known as the Polytechnic of Namibia, was established in 1994 by the National Assembly Act no.33 of 1994, and in 2015 the Polytechnic of Namibia was renamed NUST. NUST comprises of six academic faculties and offers undergraduate as well as postgraduate degrees in the areas of business and management, engineering, information technology, journalism, human sciences, hospitality, natural resource management, and medicine. NUST offers its course through the full-time, part-time and distance modes of study.

NUST has six faculties namely: Faculty of Computing and Informatics, Faculty of Engineering, Faculty of Health and Applied Science, Faculty of Human Sciences, Faculty of Management Sciences, Faculty of Natural Resources and Spatial Sciences and HPGSB

(Herold Pupkewitz Graduate School of Business). NUST has currently a student enrolment of around 11,536 and offers six qualifications including Certificates, Diplomas, Bachelor's degrees, Honours degrees, Masters and PhD degrees. At NUST, centers that assists with facilitating teaching and learning have been established, namely, Centre for Teaching and Learning, the Centre for Open and Lifelong Learning, the Graduate School of Accounting, and the Centre for Entrepreneurial Development. The university aims to add value to its programmes through other centres such as the German-Namibian Centre for Logistics (GNCL), the Namibia Business Innovation Centre (NBIC) and the Graduate School of Business.

1.3 Statement of the problem

Over the years, Namibia University of Science and Technology (NUST) has experienced an increase in student enrolment at both undergraduate and postgraduate levels. In 2015 alone, the university enrolled a total of 11536 students of which 10536 were undergraduate students and 1000 were postgraduate students (NUST Statistics – Strategy and Physical Planning, 2015). However, anecdotal evidence sourced from the Namibia University of Science and Technology websites reveal limited depositing of scholarly work in the digital institutional repository in the institution. This situation is of concern to the university because of the cost and effort involved in establishing DIR. Low depositing of scholarly works and non-use of the institution's repositories has raised concern among scholars and university administrators (Shukla, 2018).

Despite the increasing importance of institutional repositories in promoting scholarship, it is not clear why there is low deposition of scholarly materials in the DIR at NUST. The low deposition to the DIR has also been reported across the world. For example, Cameroon had only 31 items in the country's DIR during 2016 (Ezema and Onyancha, 2016). According to figure 1.1, Directory of Open Access Repositories (DOAR) statistics indicate repositories distributed by continent, of which 1,617 (46%) are from Europe, 705 are from Asia (20%), 614 from North America (17.4%), 312 from South America (8.9%), and 158 (4.5%) from Africa only one percent being from Cameroon.The low usability of DIRs in literature has been attributed to factors such as interface challenges, lack of skills among faculty and librarians, shortage of internet connectivity and ICT facilities, lack of awareness, preference of print resources by researchers, and lack of IR policies. Whether these factors also obtain in the context of NUST was the subject of investigation in this study.

Currently, there is no empirical research that has been undertaken in Namibia to understand the depositing and usage patterns of scholarly publications by postgraduate students and

academics. This study therefore investigated patterns of depositing of materials and the usability factors influencing the use and non-use of institutional repositories by faculty and postgraduate students at NUST. The outcome of this study can facilitate the formulation of appropriate policies and practical interventions to alleviate the problems of non-use and also low depositing of scholarly works in the institutional repositories at NUST and other universities in Namibia.

1.4 Research objectives

The study addressed the major research objectives that are:

- To examine the behavioural intentions of PG students and faculty to archive their research output in the DIR;
- To find out the extent of use of the DIR by PG students and faculty; and
- To determine the usability of the DIR by PG students and faculty at NUST.

The study addressed the following specific research objectives:

- To determine the attitudes and perceptions of PG students and faculty towards DIRs;
- To find out the extent to which PG students and faculty at NUST: a) archive their research output in the DIR, b) use content in the DIR;
- To examine the perceived usefulness of DIR by PG students and faculty;
- To determine the extent of system usability of the DIR by PG students and faculty; and
- To establish the level of satisfaction of PG students and faculty with the DIR.

1.5 Key research questions

This study addressed the major research question: What system usability factors influence the depositing and use of scholarly content in the DIR by PG students and faculty at the Namibia University of Science and Technology?

This study addressed the following specific research questions:

1. What are the attitudes and perceptions of PG students and faculty towards DIRs?
2. To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR?
3. What is the perceived usefulness of the DIR by PG students and faculty?
4. What is the extent of system usability of the DIR by PG students and faculty?
5. What is the level of satisfaction of PG students and faculty with the DIR?

1.6 Significance of the study

The importance of this study is found in the dearth of literature on digital institutional repositories around the world as revealed by the studies of Kim and Kim (2008); Boock (2005); Nielsen (1993); Ssemugabi (2006) and Zhang, Maron and Charles (2013) covering support, usefulness, effectiveness and user satisfaction. Similarly, studies by Lynch and Lippincott (2005); Fernandez (2006); Jain, Bentley and Oladiran (2009); Stanton and Liew (2011); Rotich (2011) and Zhang, Maron and Charles (2013), who have decried the paucity of research work on institutional repositories especially in developing countries. Narayan and Luca (2017), remark that generally more literature has been generated about the "information retrieval systems". However, research focusing on examining the accessibility and usability of the DIRs from the end user's point of view is still limited. This lack of information on repositories from the perceptive of users is probably a factor in the lack of accessibility and acceptance of DIR systems. This study therefore, was designed to investigate the patterns of depositing of materials and the usability factors influencing the use and low use of institutional repositories by PG students and faculty at NUST. The findings of this study provide evidence founded on empirical data upon which appropriate academic institutional repositories policies may be formulated. Moreover, this research project provides information that is expected to acquaint ICT infrastructure development budget allocations for academic libraries, human resource development, and staffing in academic libraries in Namibia. By using the TAM model, this research adds to existing literature on the aspects that influence the archiving and use of information systems such as DIRs in academic libraries from a developing country context. This study also fills the gap in literature, especially concerning self-archiving policies and the training that is required to fulfil the DIRs usability.

1.7 Delimitations of the study

In conducting research, it is necessary to indicate what and how much it aims to cover. Creswell (1994:105) states that, "boundaries are necessary in a study to provide direction for the terms used, for the scope of the study and for the potential audience". In terms of delimitations of this study, it focused on the usability of Digital Institutional Repositories (DIRs) by PG students and faculty at NUST. The study was limited to faculty, librarians, and PhD and Masters Students only. The researcher chose faculty, Masters and PhD students because they are the main producers of research outputs at NUST. The PG students are also required to carry out research in partial fulfilment of the requirements for their respective degrees. It was also assumed that PG students were most likely to have used, and to continue

using the digital repositories in order to meet information needs related to their academic and research work.

1.8 Theoretical perspectives

This section gives a short overview of the theory that underpinned this study. An extensive overview on the theory is provided substantively in chapter two of this thesis. This research was underpinned by the Technology Acceptance Model (TAM), complemented by other theoretical models such as Theory of Reasoned Action (TRA); Theory of Planned Behaviour (TPB) and Decomposed Theory of Planned Behaviour (DTPB). These models were chosen because they have been used widely in related studies to understand end users' acceptance and information systems use behaviour (Kripanont, 2007). In this research, other models are reviewed to aid in providing a concrete foundation for extending research on the acceptance of technology in the context of usability and the extent of use of DIRs by PG students and faculty at NUST.

Oulanov (2008) proffers that usability testing offers an operative method for assessing the system's effectiveness, usefulness and user satisfaction. Several scholars such as Hu, Chau, Sheng and Yan (1999) have used TRA, TPB, DTPB, and TAM models to expound on "behavioural intention" and for forecasting user acceptance of technology. According to Malhotra and Galletta (1999), and Kowitlawakul (2011), Technology Acceptance Model, however, appears to be an ideal model with potential and influential potency that has been used to explain the technology acceptance systems compared to TRA, TPB and DTPB. TAM offers a foundation for giving clarity on the influence of variables such as attitudes and intentions of using a technology (Sahin and Shelley, 2008).

The correlation among user attitudes, perceptions, beliefs, and eventually the system is further explained in other significant theoretical models including TRA, in addition to TAM (Ajzen and Fishbein, 1980) and TPB (Agarwal and Prasad, 1999). Legris, Ingham and Collerette (2003) have however pointed out that TAM is weak because of its thrifts. This weakness was overcome through the extension of the model in order to give a better-off explanation for computer technology acceptance. Venkatesh, Davis, and Morris (2007), caution that common criticisms of TAM are also its key strengths, such as simplicity and thrift.

This study therefore adopted the TAM, taking into consideration the various extensions by Venkatesh and Davis (2000) that have been made on the model. Venkatesh and Davis extended the original TAM model to explain the PU (perceived usefulness) and intentions of use in

terms of “social influence” (which include subjective norms, voluntariness and image); and “cognitive instrumental processes” (which include job relevance, output quality, result demonstrability, perceived ease of use). Additionally, TAM has been widely used in understanding the adoption of technology as well as the use of technology in libraries and other institutions. For example, Miller and Khera (2010) used TAM to examine the functionality of digital library adoption in Kenya and Peru. Hong (2002) also used TAM to analyse the user acceptance of digital libraries and the roles of interface characteristics, organisational context, and individual differences.

1.9 Preliminary literature review

The review of literature is substantively given in chapter three of this thesis. The chapter presents empirical research with regards to the usability of the Digital Institutional Repository from the perspectives of both developing and developed countries. The literature chapter covers the themes reflected in the research questions, the theoretical model’s main variables, and issues surrounding the research problem. Particularly, the literature focuses on the extent to which PG students and faculty self-archive their research output in the DIRs, the system usability factors affecting the use of DIRs and the attendant depositing of scholarly works in the DIRs, the perceived usefulness and perceived ease of use of DIRs, the level of satisfaction of faculty and postgraduate students with DIRs, and the attitudes and perceptions of faculty and PG students towards DIRs. The other areas upon which literature is reviewed include self-archiving and content usage, usability of the digital repositories domain knowledge, relevance of search output, system interoperability, computer self-efficacy, screen design, and more. In addition, literature is reviewed on the following broad issues around the research question including open access, scholarly communication, policy and legal framework, and level of awareness.

1.10 Research methods

A comprehensive research methods overview is presented in the fourth chapter of this thesis. This section covers a preliminary introduction to the methodology. The study was underpinned by the “post-positivist paradigm”. According to Teddlie and Tashakkori (2009:5), the “post-positivism paradigm is a revised form of positivism that addresses several of the more widely known criticisms of quantitative orientation and, yet maintains an emphasis on quantitative methods”.

The post-positivism paradigm is rooted in multiple methods. With regards to the post-positivist approach, Mason (1992) explains that an experimental quantitative core is buttressed by

critiques from varied analyses, theoretical perspectives, and value frameworks, combining the use of survey and observational data with regression and cluster analyses. The usage of multiple methods or triangulation enables researchers to group elements of qualitative and quantitative research approaches (for example in data collection, and analysis) for the purposes of extensiveness of understanding and validation. The gathering different of types of data by various methods from diverse sources has been found to provide extensive coverage that might end up in an understanding of the full view of the research project (Bonoma, 1985). This study adopted a survey research design because it involves systematically collecting data through the use of interviews and a questionnaire.

The target population in this study comprised of faculty (lecturers, senior lecturers, associate professors and full professors), PG students (Masters and Doctoral students). Both groups are involved in generating and using research. In addition, librarians (library professional staff holding Bachelor of Arts, Honours and Master's Degrees in Library and Information Science) were also targeted in the study as they are the custodians of research acquired or generated at NUST.

The researcher employed several data collection methods comprising of interviews, survey questionnaires, heuristic evaluations and observations of library facilities. The survey used self-administered questionnaires to collect data from PG students and faculty, while interviews were administered to librarians. The self-administered questionnaire was distributed to PG students and faculty because of their busy schedules. The questionnaires and interview schedules were used to gather data on DIR usage behaviour, feelings, thoughts, and opinions regarding the use and usability of the DIR. In addition, observations, document review, and heuristic expert evaluation were used to collect data from expert evaluators to help assess the system of the knowledge domain (Nielsen, 1994:26).

1.11 Definition of key terms

When carrying out research, it is imperative to provide clear definitions of key concepts. In the case of the current study it was imperative to define key concepts around usability and digital institutional repositories.

Digital institutional repository

Digital institutional repository is partly linked to the notion of a digital library in terms of collecting, housing, classifying, cataloguing, curating, preserving, and providing access to

digital content. This is analogous with the library's conventional function of collecting, housing, classifying, curating, preserving and providing access to analogy content (Kumar, 2014). Thus, in this study the DIRs are treated as digital libraries.

Digital library

Smith (2001) defines a digital library as an organised and focused collection of digital objects, including text, images, video and audio, with the methods of access and retrieval and for the selection, creation, organisation, maintenance and sharing of the collections. For the purpose of this study, a digital library is considered to incorporate the online library which serves as a medium of preserving and disseminating information.

Digital preservation

Digital preservation is a formal practice to ensure that digital information of ongoing value remains accessible and usable. It involves the planning, allocation of resources, and preservation of implementation methods and technologies, and it combines policies, strategies, and actions to ensure access to reformatted and 'born-digital' content, irrespective of the challenges of the media fiasco and technological changes (Michael, 2006).

Institutional repositories

Lynch (2003:2) describes institutional repositories as "a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members". Joan (2004 cited in Halder, 2012:45) also defines an institutional repository as "a set of services such as e-prints, technical reports, theses and dissertations, data sets, and teaching materials offered by a university or group of universities to members of its community for the management and dissemination of scholarly materials in digital format created by the institution and its community members". Stewardship of such materials entails their organisation in a cumulative, openly accessible database and a commitment to long-term preservation. The present study used the definition of institutional repository provided by Lynch (2003:2) and also Reitz (2004, cited in Halder, 2012:45) as "a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members".

Institutional repositories capture the research output generated by an institution's constituent population that is active in many fields. Institutional repositories therefore, represent the intellectual life and output of an institution. An institution in this sense can represent a group, an institution, or a group of institutions. While much of the literature about IRs refers to

academic institutions, any organisation that generates research and wishes to capture and openly disseminate its intellectual products can implement an institutional repository (Shearer, 2013).

Interoperability

Shearer (2013:90) defines "interoperability" as "the ability of different systems to exchange data using the same file formats and protocols". This includes systems that interoperate to enable data exchange and those that exchange data because of communication.

Open access

Open access refers to the literature that is freely accessible online, which scholars give to the world without payment expectations. Primarily, this category includes peer-reviewed journal articles, but it also encompasses any non-reviewed preprints that scholars might wish to put online for comments or to alert and notify colleagues to important research findings (Bailey, 2007). Open access refers to free availability of literature on the public internet, authorising any users to read, distribute, copy, print, search, download, or use them for any other legal purpose, without financial, legal, or technical barriers other than those attached on gaining access to the internet itself (Bailey, 2007).

Perceived user satisfaction

Shearer (2003:5) defines perceived user satisfaction as "the extent to which users believe a system meets their information needs". In self-archiving systems, satisfaction is merely linked to the user's input activity (Shearer, 2003:5).

Scholarly communication

Scholarly communication refers to the process whereby academics, scholars, and researchers share and publish their research findings so that they are accessible to the broader academic community and beyond in the world wide world (Maron, Smith and Kirby, 2009).

ACRL (2004, cited in Mukherjee, 2009:1) define scholarly communication as "the system through which research and other scholarly writings are created and evaluated for quality, disseminated to the scholarly community, and preserved for future use". The system encompasses both formal means of communication such as publication in peer-reviewed journals and informal channels (Maron and Smith, 2009).

Self-archiving

The literature gives different meanings of self-archiving. According to Bailey (2007), self-archiving is when authors make their articles available freely in digital form on the Internet. These articles can either be "preprints" or "post-prints". Harnad (2001) describes self-archiving as the act of (the author's) depositing a free copy of an electronic document on the Internet, or more specifically on the World Wide Web in order to provide open access to it. The term usually refers to the self-archiving of peer-reviewed research journals and conference articles, as well as theses and book chapters, deposited in the author's own institutional repository or open archive to maximise its accessibility, usage and citation impact. In this study, self-archiving refers to authors depositing the items in the repository by themselves rather than someone doing it on their behalf.

Usability

"Usability is the degree to which software can be used by specified consumers to achieve quantified objectives with effectiveness, efficiency, and satisfaction in context of use" (ISO 9241-11, 1998) cited in Katy (2016:11).

1.12 Summary

This chapter gave an introduction on the usability of DIRs and the importance of current information in enhancing the effective use and the usability of DIRs. The major issues described in the chapter include the background to the problem, the problem statement, delimitations and limitations, research objectives and research questions. The study presented the theoretical framework, and the methodology adopted in collecting data from the study population. The chapter provided a definition of key terms used in the study. In the Namibia context, studies show a need for assessing the current status of DIRs regarding the usability of these systems.

1.13Outline of the rest of thesis

The thesis structuring has been discussed by different scholars including Neuman (2006:473). Although several authors illustrate thesis structuring in different ways, they all emphasise the basic elements of a thesis which are the introduction, literature review, theoretical/conceptual framework(s), research methodology, data presentation, and discussion of the research findings.

This thesis comprises of seven chapters, based on the University of KwaZulu-Natal, and College of Humanities PhD thesis compilation guidelines. A detailed elaboration of the chapters is provided below.

Chapter One provides general introductory information on the research study. It includes the introduction (the background to the study), information about the Namibia University of Science and Technology, statement of the problem, key research questions, research objectives, significance of the study, delimitations of the study, theoretical perspectives, preliminary literature review, research methods, and definition of key terms.

Chapter Two presents a discussion of the technology acceptance theories and models, and provides a justification of the model used to underpin this study. This chapter presents the detailed discussion of: Theory of Reasoned Action (TRA); Theory of Planned Behaviour (TPB); Technology Acceptance Model (TAM); Innovation Diffusion Theory (IDT) and Decomposed Theory of Planned Behaviour (DTPB).

Chapter Three gives a detailed review of existing empirical and theoretical literature from books, journals, conference proceedings, databases, technical reports and more. The gaps in literature are identified and a proposal on how they are addressed in this study provided.

Chapter Four describes the research paradigm, approaches, research design, population, sampling procedure, data collection procedure, and data analysis.

Chapter Five presents the results of the study. In this chapter qualitative results are presented thematically, while quantitative results are presented using frequencies, charts, figures, tables and narrations.

Chapter Six discusses and interprets the results using existing literature and the theory that underpins the study.

Chapter Seven provides the summary, conclusion, and recommendations; areas for further research are also suggested.

CHAPTER TWO

THEORETICAL FRAMEWORK

2.1 Introduction

Neuman (1997) defines a theoretical framework as a universal theoretical framework which comprises of specific social theories, concepts, and assumptions. This chapter presents an outline of the technology acceptance models and thereafter provides a detailed discussion of specific theories and models that are used to study technology acceptance, adoption, and use. These models include TAM (Technology Acceptance Model), IDT (Innovation diffusion theory), TRA (Theory of Reasoned Action), TPB (Theory of Planned Behaviour) and DTPB (Decomposed Theory of Planned Behaviour). According to Kripanont (cited in Hamutumwa, 2014), these theories have been used broadly to explain end users' information systems behaviours in different disciplines. In this research, these theories and models are reviewed to aid in providing a comprehensive foundation for aligning this research on technology acceptance in the context of usability and use of DIR by academics and postgraduate students at NUST.

According to Munger (cited in Hamutumwa, 2014), usability testing offers an efficient way for evaluating the system's effectiveness and user satisfaction. Several scholars and researchers such as Hu, Chau, Sheng and Yan (1999) have also used TAM (Technology Acceptance Model), IDT (Innovation diffusion theory), TRA (Theory of Reasoned Action), TPB (Theory of Planned Behaviour) and DTPB (Decomposed Theory of Planned Behaviour) to understand behavioural intentions and to predict user acceptance of technology. According to Kowitlawakul (2011), TAM however, has emerged as an ideal model which is promising and influential and as such it has been used extensively to explain the acceptance of technology compared to others (see also section 1.8).

2.2 Technology adoption and acceptance theories

Technology acceptance is defined by Hu, Chau, Sheng and Yan (1999:96) as "an individual's psychological state with regards to his or her voluntary or intended use of a particular technology". Hong et al. (2002), state that according to TAM, the acceptance behaviour of technology is determined by the "intention to use" an actual system, which in turn is determined by "perceived usefulness and perceived ease of use" of that technology or system.

Hong et al. (2002) also looked at the use of TAM to explain the information system usage. Hong et al. (2002), state that the usage of an information system is explained through users' intention to use the system, which in return is defined by the perception of users about the system. Hong et al. (2002) note that regardless of efforts targeted on creating a "usable" online repository to offer improved access to an enormous number of digital collections, these digital repositories remain ignored by researchers, or they are extremely underutilised regardless their accessibility and availability. Therefore, the understanding of acceptance of digital repositories by users and the identification of issues that may have an impact on their intention to use these systems is essential.

Munger (2003) observes that "usability testing" gives an effective way of assessing the effectiveness of the systems and the satisfaction of users. Davies (1997) states that increasingly, LIS (Library and Information Science) scholars are of the view that the digital repositories enable interactions between the users and the systems. The present research was therefore anchored on the basis that the best usage of the DIR at NUST cannot be achieved when postgraduate students and faculty lack the awareness of the facility and the basic system user skills, as well as they lack the eagerness to access or contribute their scholarly work into the system.

This study sought understand the readiness and willingness of postgraduate students and faculty to use the facility (DIR) so that the system usability can be improved and accessibility made easier as articulated by Hong et al. (2002). Through clarifying usage intentions from both the perceptive of users and of the systems, the outcome of this study is not only expected to help university management to develop "user-accepted" digital repositories, but this gives clear information on how to equip possible users for these new information technologies (IT)(Hong et al., 2002).

2.3 Technology adoption and use models

This section provides a discussion of the following theoretical models: Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), and Innovation Diffusion Theory (IDT).

2.3.1 Theory of reasoned action (TRA)

The TRA is an essential model that was created by social psychologists to study conscious intentional behaviour (Fishbein and Ajzen, 1975). It has been useful to a wide variety of behaviours (Sheppard, Hartwick and Warshaw, 1988). Intention to perform behaviour in TRA

comprises of attitudes (AT) and subjective norms (SN). Intention represents the reasoning part of the Fishbein and Ajzen theory. “Behavioural intentions capture the motivational factors that influence a behaviour; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert in order to perform the behaviour” (Ajzen, 1991:181).

Furthermore, attitude is the status of a person’s general perception of favourableness or unfavourableness towards a concept. In other words, it represents the amount of effect (Fishbein and Ajzen, 1975). The attitude towards behaviour considers behaviour as a concept, it represents the person's general feeling of favourableness or unfavourableness for the behaviour in question (Ajzen and Fishbein, l980:285). Based on TRA, the first determinant of individual intention to act, as mentioned earlier, is the approach. According to Ajzen and Fishbein (1980), the attitude towards behaviour is the estimation of positive or negative self-evaluation in relation to certain behaviour. This theory depends on whether behaviour is positively or negatively esteemed. It is “determined by a total set of accessible behavioural beliefs linking behaviour to various results and other aspects (Ajzen and Fishbein, l980:283). Thus, attitude is an individual’s salient belief as to whether the ending of his or her behaviour will be positive or negative.

Ajzen and Fishbein (1980) explain subjective norms as “a person’s own estimate of the social pressure to perform or not perform the intended behaviour” (Ajzen and Fishbein, 1980:6). It refers to an individual’s perception about what other people think of his or her behaviour in question. This involves perceptions about what family members and friends may think about the consequence of the behaviour (normative belief), and the degree to which this influences the behaviour or action of the person responsible (motivation to comply) (Ajzen and Fishbein, 1980:6).

This model is relevant to this study because the researcher used normative beliefs and motivation to measure students’ and faculty’s beliefs that make them to or not to self-archive their work and what makes them to comply or not to comply with self-archiving. Normative belief is described as the perceptions about what a person thinks about the outcome of the behaviour and the degree to which this influences the behaviour or action of the person responsible (motivation to comply) (Alsughayir and Albarq, n.d.). The TRA is presented in Figure 2.1 below.

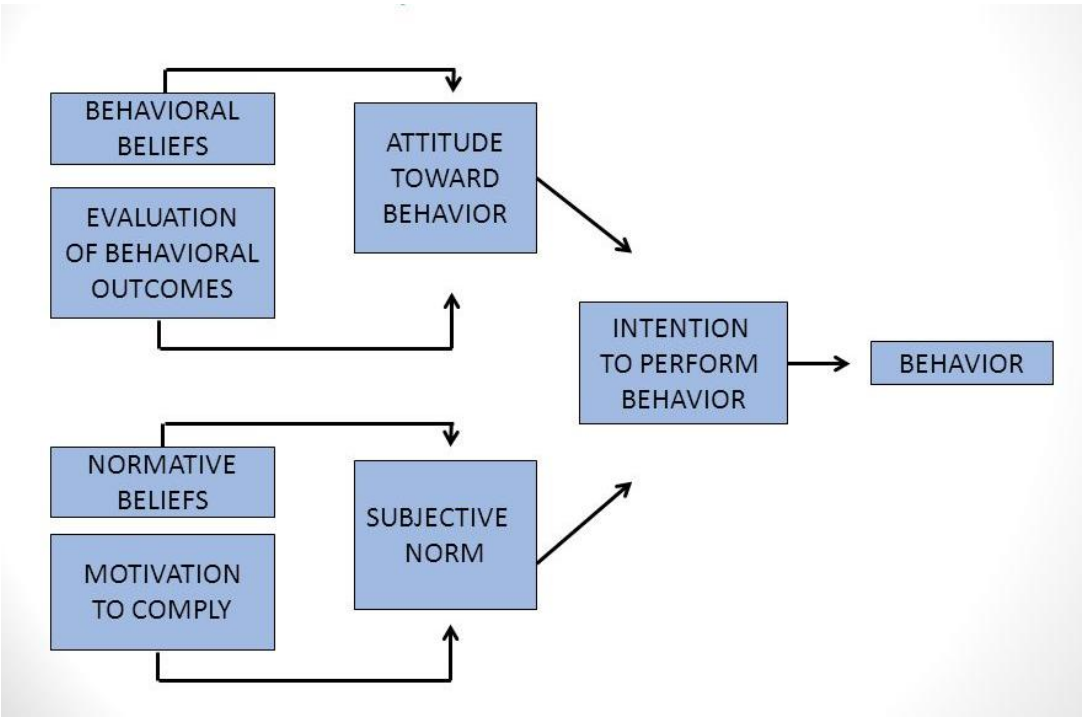

Figure 2.1: Theory of Reasoned Action (Source: Fishbein and Ajzen, 1975, adapted from: Malhotra and Galletta, 2001:2)

2.3.2 Theory of planned behaviour (TPB)

Shih et al. (2011) describe the Theory of Planned Behaviour as a behavioural model used to study a broader acceptance situation. Theory of Planned Behaviour (TPB) evolved from TRA by integrating an extra "construct" known as Behavioural Control or Perceived Behavioural Control (Chau and Hu, 2001). The motive for this additional construct was "to account for situations where an individual lacks the control or resources necessary for carrying out the targeted behaviour freely" (Kripanont, 2007:50). Perceived behaviour control is described as "the perceived ease or difficulty of performing the behaviour" (Tan, 2013:5). Figure 2.2 below presents the "Theory of Planned Behaviour".

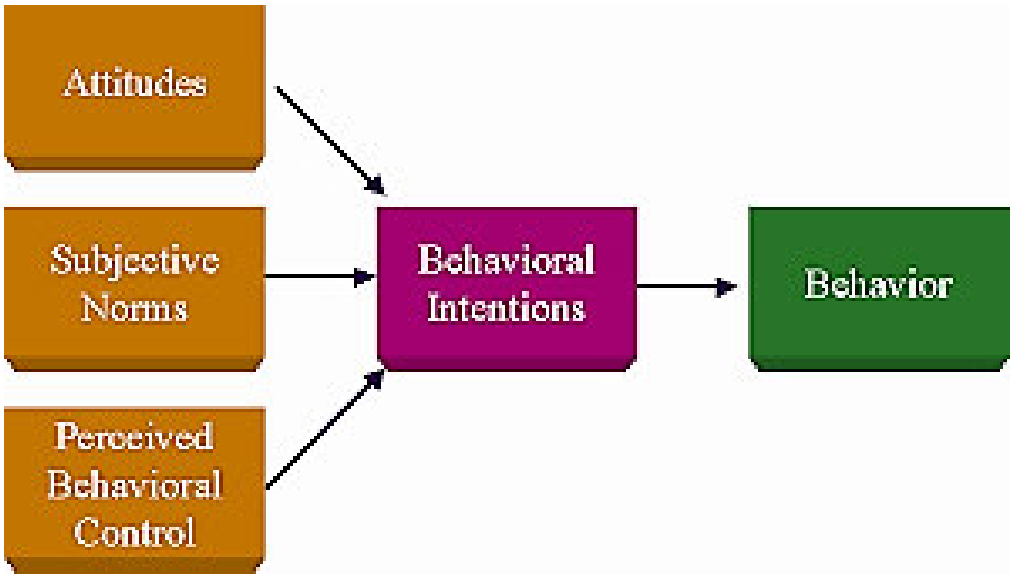

Figure 2.2: Theory of Planned Behaviour (Source: Shih et al., 2011:5057)

2.3.3 Decomposed Theory of Planned Behaviour (DTPB)

Venkatesh, Morris, Davis and Davis (2003) assert that DTPB is understood to be similar to Theory of Planned Behaviour and Technology Acceptance Model. Nevertheless, besides its likeness to Technology Acceptance (TAM), DTPB includes extra constructs such as SN (subjective norm) and PBC (perceived behaviour control) which are not available in TAM. These extra constructs are found to be significant determinants of behaviour (Ajzen, 1991 cited in Kripanont, 2007:50). DTPB offers a totality on the explanation of the determinants of intention. According to Taylor and Todd (cited in Hamutumwa, 2014), DTPB comprises of three key factors influencing behaviour intentions (BI) and actual behaviour (adoption), which are namely attitude (ATT), subjective norms (SN) and perceived behaviour control (PBC). Attitude describes an individual's positive or negative behaviour towards innovation intention and adoption. It encompasses perceived ease of use (PEOU), perceived usefulness (PU) and compatibility. Davis (1989:320) states that PEOU refers to the degree to which a person believes that using a particular system would be free of effort, while PU refers to the degree to which a person believes that using a particular technology will improve his/her performance. Compatibility (Comp) refers to the extent to which "an innovation is perceived as being consistent with past experiences, and needs of potential adopters" (Moor and Benbasat, 1991:195). According to Ajzen and Fishbein (1980), SN defines the social pressure that may affect an individual's intention to perform.

According to DTPB, Behaviour Intention (BI) is determined by the user's intention to accept, use, or adopt one or more of the information technologies. The DTPB is illustrated in Figure 2.3.

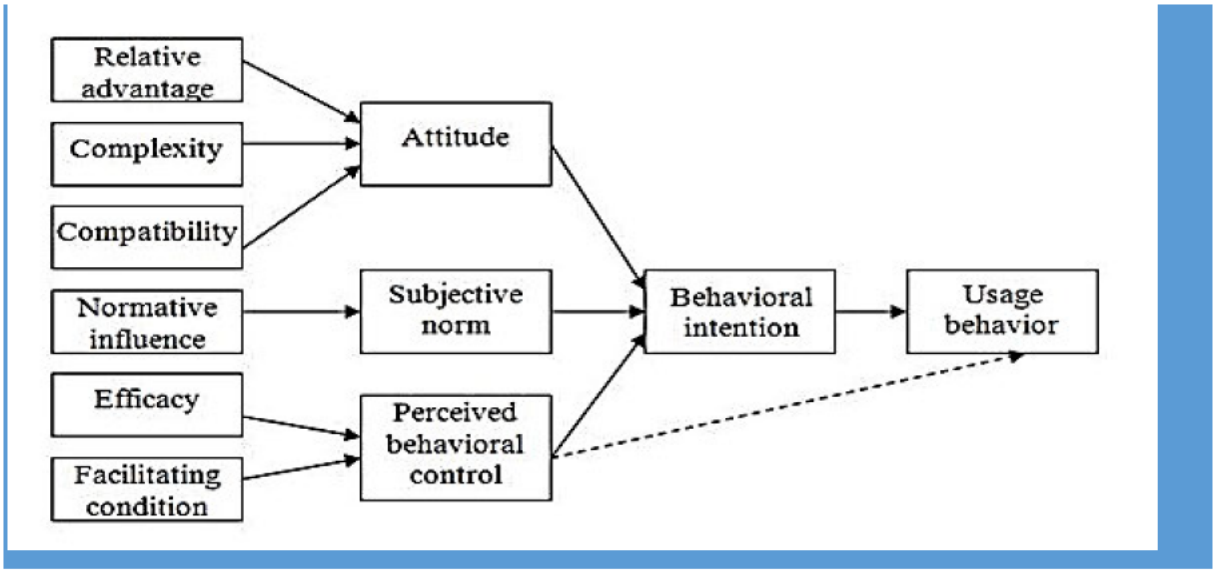

Figure 2.3: Decomposed Theory of Planned Behaviour (Source: Shih and Fang, 2004:217)

This model was useful in this study in investigating facilitating conditions in self-archiving by institutions.

2.3.4 Innovation Diffusion Theory (IDT)

Innovation Diffusion Theory (ITD) has been largely used in many disciplines (Sambamurthy and Stair, 2000). An innovation is "an idea, practice, or object that is perceived as new by an individual or another unit of adoption" (Rogers, 1995:11). Diffusion, on the other hand, is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995:5). Therefore, the IDT theory argues that, "potential users make decisions to adopt or reject an innovation based on beliefs that they form about the innovation" (Agarwal, 2000:90). IDT includes five significant innovation characteristics namely: relative advantage, compatibility, complexity, trialability, and observability.

According to Rogers (1995:209), relative advantage is "the degree to which an innovation is considered as being better than the idea it replaced". This construct is one of the powerful predictors of the acceptance of an "innovation". Compatibility refers to the degree to which innovation is said to be reliable and constant with the end-users' existing previous experiences and requirements. Complexity is the extent to which users find the innovation to be difficult to understand and its ease of use. Trialability is the extent to which the innovation can be tested on a limited basis. Observability is the extent to which the outcome of the innovation can be seen by others. These characteristics are used to explain the end-user adoption of innovations and the decision-making process. IDT is believed to be almost similar to Decomposed Theory

of Planned Behaviour. However, it does not incorporate characteristics that are found in Decomposed Theory of Planned Behaviour, such as attitudes, subjective norms, perceived behavioural control, and behavioural intentions. This model is considered relevant to this study for measuring students' and academics' self-archiving behaviour (Rogers, 1995). The innovation Diffusion Theory is presented in Figure 2.4 below.

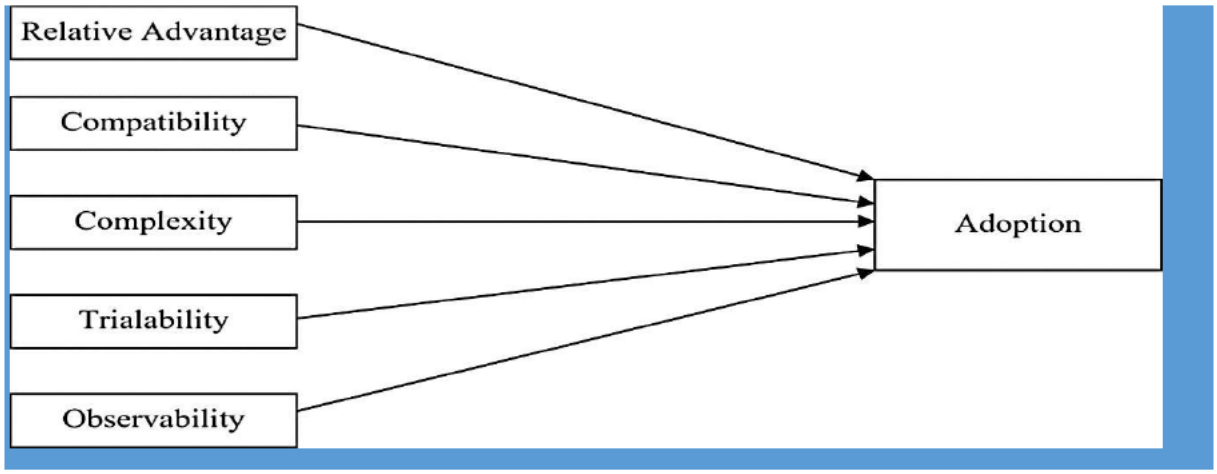

Figure 2.4: Innovation Diffusion Theory (Source: Rogers, 1995)

2.3.5 Technology Acceptance Model (TAM)

One of the famous models linked to technology acceptance and use is the technology acceptance model (TAM), originally proposed by Davis in 1986. TAM was selected as the main model to guide the present study due to the fact that TAM is predominantly understood to be strong in "predicting" the acceptance of technology and its usage in diverse circumstances (Dillon and Morris, 1996). TAM provides the foundation of explaining the influence of variables (i.e. beliefs, attitudes, and intentions) in the usage of a technological system. TAM similarly offers the ground for understanding PU (Perceived Usefulness) and PEU (Perceived Ease of use of a given technology (Sahin and Shelley, 2008). This model has been established as useful in assisting to illuminate and predict user behaviour of information technology (Legris, Ingham and Collerette, 2003).

TAM has its roots in the Human Computer Intraction theory revolution and development. According to Alshaali (2011), in 1989, what attracted focus on TAM were its managerial aspects and the efficiency of computer systems in it. In order to define how users engage with computer systems, Davis (1989:330) defined usability within information systems via the TAM "as two factors mainly: perceived usefulness and perceived ease of use as the precedents for intention to use and actual use". TAM highlights that two prominent beliefs, PU and PEU, determine technology acceptance and they are the main precursors of behavioural intentions

to use information technology. The first belief, perceived usefulness (PU) is the degree to which an individual believes that a certain system would boost job performance within an organisational setting (Davis et al., 1989).

2.3.5.1 Perceived usefulness

An intention for users to use an information system is determined largely by their perceived usefulness of the system (Davis et al., 1989). There is broad empirical evidence in the IS literature (Agarwal and Prasad, 1999; Davis et al., 1989; Fox et al., 1993; Jackson, 1997; Venkatesh, 1999; Venkatesh, 2000; Venkatesh and Davis,1996; Venkateshand Davis, 2000; Venkatesh and Morris, 2000 cited in Hong et al., 2002). The definitive motive why users make extensive use of digital platforms, for example, is because they perceive the technology (system) to be useful to their "information needs" or their search activities. Therefore, perceived usefulness will have a positive outcome on the behavioural intention to use an information system. The second key perception is the degree to which an individual believes that interacting with a particular system is free of effort (PEU) (Davis et al., 1989). Moreover, the model points out that system usage is indirectly affected by both PEU and PU.

2.3.5.2 Perceived ease of use

Broad research throughout the past years gives evidence of the substantial effect of perceived ease of use on intention, either directly or indirectly through its effect on perceived usefulness (Agarwal and Prasad, 1999; Davis et al., 1989; Fox et al., 1993; Jackson, 1997; Venkatesh, 1999; Venkatesh, 2000; Venkatesh and Davis, 1996; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000 cited in Hong et al., 2002). Users are likely to avoid the digital repository when the system is perceived to be complex and not easy to manage. In an effort to avert the usefulness system problem, digital systems "should be easy to learn and easy to use" respectively. Therefore, it was theorised that PEU (Perceived Ease of Use of the DIR would have a good impact on both PU (Perceived Usefulness) and BI (Behaviour Intention) to use the DIR (Hong et al., 2002).

Several scholars have carried out experiential studies to investigate the descriptive strength of the TAM, which produced comparatively repeatedly results on the technology acceptance behaviour of end-users (Igbaria, Zinatelli, Cragg and Cavaye, 1997; Venkatesh and Davis, 2000; Horton, Buck, Waterson and Clegg, 2001). Scholars are in agreement that TAM is relevant in predicting the user's acceptance of various technologies (Chin and Todd, 1995; Segars and Grover, 1993). TAM asserts that two salient beliefs (PU and PEU) determine technology acceptance and they are the key antecedents of behavioural intentions to use

information technology. In addition, the model indicates that system usage is indirectly affected by both PEU and PU.

The TAM model has been selected to reinforce this study because it is the most recognised and most used model in technology acceptance. In 1986, Davis originally proposed TAM and since then it has been proven to be a theoretical model that can help in understanding and predicting the user behaviour of information technology (Legris, Ingham and Collerette, 2003). The TAM model was considered as suitable for this study because of the attributes of perceived usefulness, perceived ease of use, and attitude towards using and actual system use which are central to the research problem investigated in the presented study. This model was helpful in understanding the actual use, perceived ease of use as well as perceived usefulness of the DIR by postgraduate students and faculty. In addition, the model was used to understand the attitudes and perceptions of both faculty and postgraduate students towards the DIR at the Namibian University of Science and Technology.

Davis, Bagozzi, and Warshaw (1989) define usability within information systems through the Technology Acceptance Model (TAM) and presented two factors, which are perceived ease of use and perceived usefulness as the models for "intention to use and actual use". Various usability features have been numerously suggested to lead an investigation into user interactions in a digital environment (Jagero et al., 2014). Nielsen (1993) proposed "learnability, efficiency, memorability, errors, and satisfaction", while in more other studies, Abran, Khelifi and Suryn (2003:325) proposed "effectiveness, efficiency, satisfaction, security, and learnability". These usability attributes are described as follows, usefulness refers to the content and services offered by a system, and how they closely meet user requirements (Savolainen, 2008).

In contrast effectiveness is linked to task completion in relation to user objectives and success rates. According to ISO (1998), related aspects of effectiveness are accuracy and completeness. Moreover, ISO (1998) describes learnability as the capability of the system to enable users to feel that they can successfully use the system right away and rapidly learn new functions and techniques (Seffah et al., 2006:159). Learnability evaluates how easily and effectively the user learns to accomplish the tasks. Lastly, satisfaction according to Rogers and Hugh (2009:201) involves users' attitudes and perceptions with regards to how pleasant, enjoyable and fun it is to use the information system. Jeng (2005) adds that satisfaction involves areas of ease of use, organisation of information, clear labelling and visual appearance, contents, and error corrections. Kim and Kim (2008:868) describe the attributes of usability as satisfaction (i.e.

visual appearance, consistency and standards; supportiveness which means being helpful and supported; usefulness, meaning flexibility of function or functionality; and effectiveness meaning ease of use).

Besides the fact that TAM is seen to be strong in anticipating and explaining the use of technology in various disciplines, the TAM model has also been confirmed to be successful in researches that intend to assess adoptions of technology among users. TAM has also been also used to measure PU (Perceived Usefulness and EU (Ease of Use) (Sahin and Shelley, 2008). Nevertheless, apart from its strength in predicting and explaining technology use, TAM has been reported to be limited in some ways. Malhotra and Galletta (1999) assert that TAM is weak in catering for theoretical and psychometric problems due to the fact that Davis (1989) did not consider the "attitude component". TAM is also weak in mediating the belief's influence on the "behavioural intention to use". The first TAM model also did not encompass the impact of "social and control factors" (Ghazizadeh, Lee and Boyle, 2012). These authors assert that TAM could not go beyond the general items that measured perceived usefulness and perceived ease of use. Consequently, it was challenging to identify the reasons behind the perceived ease of use or perceived usefulness variables that are used in the model. Furthermore, most studies in TAM focused more on voluntary environments with little consideration for mandatory settings (Chuttur, 2009). In addition, Tunner et al. (2010) add that TAM does not measure the benefits of using a technology. Nevertheless, most studies have provided strong evidence to support TAM as a model for predicting system usage behaviour. In addition, though Legris, Ingham and Collerette (cited in Hamutumwa, 2014) have pointed out that TAM is weak for its frugalities, this weakness has been addressed through the extension of the model in order to make room for extensive explanations on the acceptance of technology.

Venkatesh, Davis, and Morris (2007) emphasise that criticisms of Technology Acceptance Model can be turned into key strengths, namely simplicity and miserliness. Therefore, the current study embraces the TAM (Technology Acceptance Model) model, taking into consideration the numerous extensions by Venkatesh and Davis (2000) that have been made on the model. Venkatesh and Davis (2000:190) provided extensions to the TAM model to enable some explanations on the perceived "usefulness and usage intentions in terms of social influence (subjective norms, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, perceived ease of use)". Additionally, TAM has been widely used in explaining the adoption of technology and its use in libraries

and other institutions. For example, Miller and Khera (2010) used TAM to examine the functionality of digital library adoption in Kenya and Peru. Hong (2002) also used TAM to analyse user acceptance of digital libraries and the roles of interface characteristics, organisational context, and individual differences. The TAM model is presented in Figure 2.5 below.

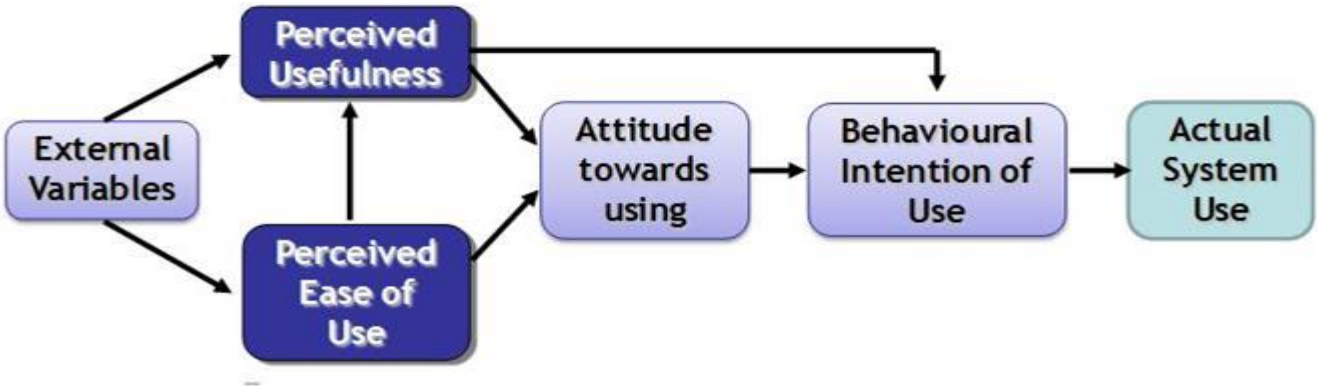

Figure 2.5: Technology Acceptance Model (Source: Davis, Bagozzi, and Warshaw, 1989)

Hong et al. (2002) also used TAM to analyse the user acceptance of digital libraries and the roles of interface characteristics, organisational context, and individual differences.

2.3.6 Extension of TAM

Two key categories of external variables, namely, individual differences and system characteristics have been identified though previous research (Agarwal and Prasad, 1999; Davis, 1993; Igbaria and Guimaraes, 1995) that influence technology acceptance. Hong et al. (2002) identified two individual differences and or variables namely: knowledge of research domain and computer self-efficacy. On the other hand, the system characteristics have three variables namely: screen design, relevance, and terminology (see Figure 2.5).

Previous researchers such as Borgman (1989), and Chen, Czerwinski, and Macredie (2000) state that in computer based environments, differences about individuals have been believed to be linked to the use of information systems and information retrieval success on online library systems. Similarly, Barry and Squires (1995), advocate for a shift from evaluating its usefulness from the perceptive of users, in a "longitudinal study of academic usage of a digital library". Ong et al. (2002) examined two individual variables namely: computer self-efficacy, and knowledge of search domain, and found these to be significant in the Library Information System. These two variables were selected for this study because they have been commonly understood to be relevant to the electronic repository systems.

Allen (1995), Davies (1997), and Jacobson and Fusani, (1992) explain computer self-efficacy in the literature from the library science research, stating that some researchers have suggested computer literacy as a possible effect on increasing information retrieval systems usage. Computer self-efficacy is defined as the degree of one's ability to use a computer (Compeau and Higgins, 1995). Computer self-efficacy has its roots in social cognitive theory, and computer self-efficacy has been regarded as an important predictor of Information Technology usage (Compeau and Higgins, 1995; Hill and Smith, 1987).

Yin Zhang, Li, and Wei (2011) endorse the crucial role that "computer self-efficacy" plays in explaining individual behaviour towards innovation. Davis (1989) developed the concept of PEU (perceived ease of use) and PU (perceived usefulness) and these were built on the self-efficacy theory. Davis (1989) recognised that self-efficacy is related to and can influence the perceived ease of use. Hong et al. (cited in Yin Zhang, Li and Wei 2011) assert that there is a theoretical back up that computer self-efficacy may directly influence PEU (perceived ease of use) of digital repositories. Yin Zhang, Li and Wei (2011) confirm that computer self-efficacy has a direct influence on PEU (Perceived Ease of Use), but not on PU (Perceived Usefulness).

Knowledge of the search domain is another aspect that may have an impact on the PEU of digital repositories. Studies on systems for information retrieval confirm that DK (domain knowledge) can support a search by aiding a user to make a distinction between relevant information and irrelevant responses, facilitating learning of search principles, and executing more precise research queries (Linde and Bergstrom, 1988; Marchionini et al., 1993; Meadow, 1995).

The correlation between characteristics of various systems and the beliefs constructs in TAM may be assessed through the usability construct. Instead of inspecting the ease of use or usefulness, library science researchers have paid more attention on the usability of digital libraries (repositories) (Barnett, 1998; Park, 2000). Usability is referred to as how effectively and easily a technology can be utilised by a particular group of users (Shackel cited in Hong et al., 2002:105). According to Hong et al. (2002:106), these two components of usability have a close similarity to the PEU (perceived ease of use) and PU (perceived usefulness) constructs in TAM. Based on Lindgaard's (cited in Yin Zhang, Li, Wei (2011) categories of usability factors, Hong et al. (2002:106) proposed three system characteristics as crucial external determinants of TAM, namely: relevance, terminology, and screen design.

With regards to relevance, it is "the degree to which the system matches tasks as carried out in the current environment and as specified in the task analysis" (Lindgaard cited in Hong et al.

2002:107). Relevance is also regarded as the extent to which an information system matches users' information needs (Rees and Schultz cited in Hong et al., 2002). Furthermore, recall (which is the ratio of relevant items retrieved to all relevant documents in the system) and precision (the ratio of relevant retrieved items to all retrieved items) have been the standard measures of the effectiveness of information retrieval systems (Rees and Schultz cited in Hong et al., 2002).

All these standards are grounded on the notion of "relevance". LIS scholars are beginning to recognise the significance of relevance based on user judgements in assessing the efficiency of "information retrieval systems" (Janes, 1994; Park, 1994; Spink et al., 1998). Gluck (1996) establishes that in terms of retrieved information, users' satisfaction is linked to how relevant the item is in response to the user's information queries. Hong et al. (2002) associate relevance with usefulness when and state that the document can only be useful when the user considers the relevance of the document. Thus, they anticipate that the relevance of the system's content to the user's information needs is positively linked to both PE (Perceived ease of Use and PU (Perceived Usefulness) of the repositories.

Constructs such as terminology denotes the text, sentences, and abbreviations used in a system (Lindgaard cited in Yin Zhang, Li and Wei, 2011). Lindgaard (cited in Yin Zhang, Li and Wei, 2011) further states that as an information retrieval system, the subject of terminology is inherent in the success of a digital repository. Users need to submit their queries to the system through structured phrases. Users should also grasp the guidelines, explanations, and results yielded from a search through the information system clearly and properly.

Screen design construct is the means by which information is presented on the screen (Lindgaard cited in Yin Zhang, Li, Wei (2011). It has long been recognised by information system researchers that the interface design and information presentation approach of an information system may significantly influence search strategies and performance for end users (Jarvenpaa and Lim, cited in Yin Zhang, Li, Wei (2011). In information retrieval systems studies, the user interface was reported as equally imperative as an information retrieval search engine have impact on system performance (Marchionini, Plaisan, Komlod, 1998; Meadow, Wang, and Yuan, 1994). A good screen design can produce an easy computer based environment where functional groups and navigation support can easily be identified. Figure 2.6 illustrates the extension of the TAM model.

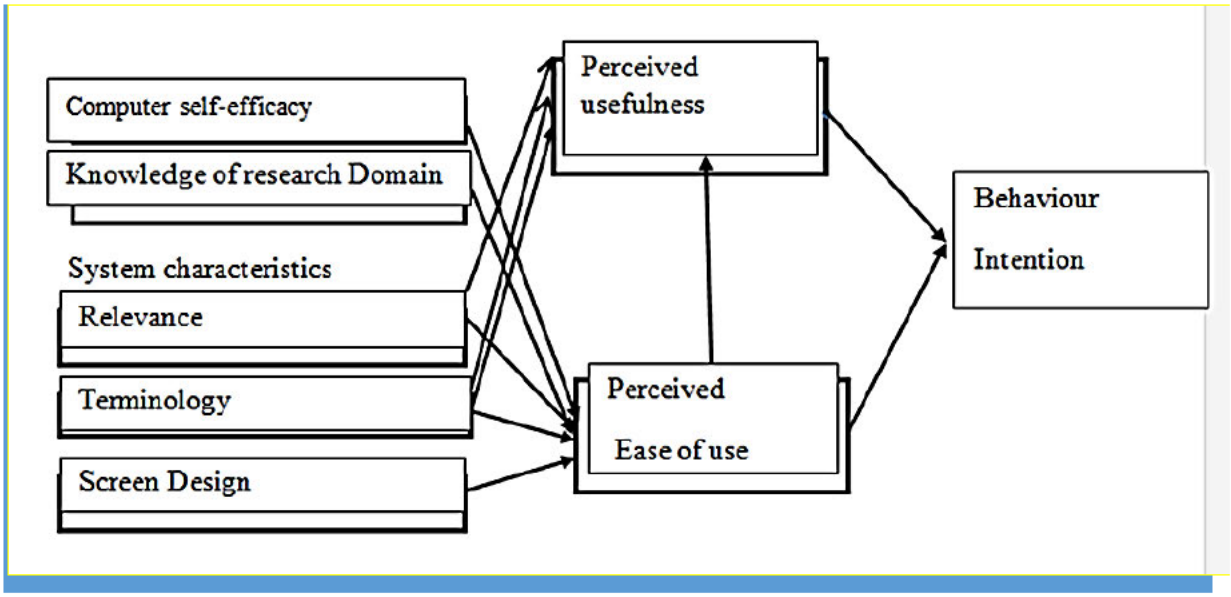

Figure 2.6: Technology Acceptance Model Extension (Source: Hong et al., 2002)

2.3.7 Unified theory of acceptance and use of technology (UTAUT)

Wirba Singeh, Abrizah, and Harun Abdul Karim (2013) state that "acceptance is seen as the researcher's readiness and awareness of those particular issues relating to self-archiving and those managed activities that address open access as well as the behavioural intention and plan to self-archive in an institutional repository; the researcher's level of awareness, current practices, behavioural intention, and barriers to self-archiving will determine their level of readiness towards self-archiving". Venkatesh et al. (cited in Wirba Singeh, Abrizah, and Harun Abdul Karim (2013) recommend UTAUT as an acceptance model after a thorough evaluation of prominent models used in user endorsement of technology, namely: the theory of reasoned action (TRA); and the technology acceptance model (TAM). The UTAUT model comprises of effort expectancy (EE), social influence (SI), performance expectancy (PE) and facilitating conditions (FC) as key determinants of behavioural intentions and use behaviour. Facilitating conditions (FC), behavioural intention, and use behaviour were found as relevant aspects to this study.

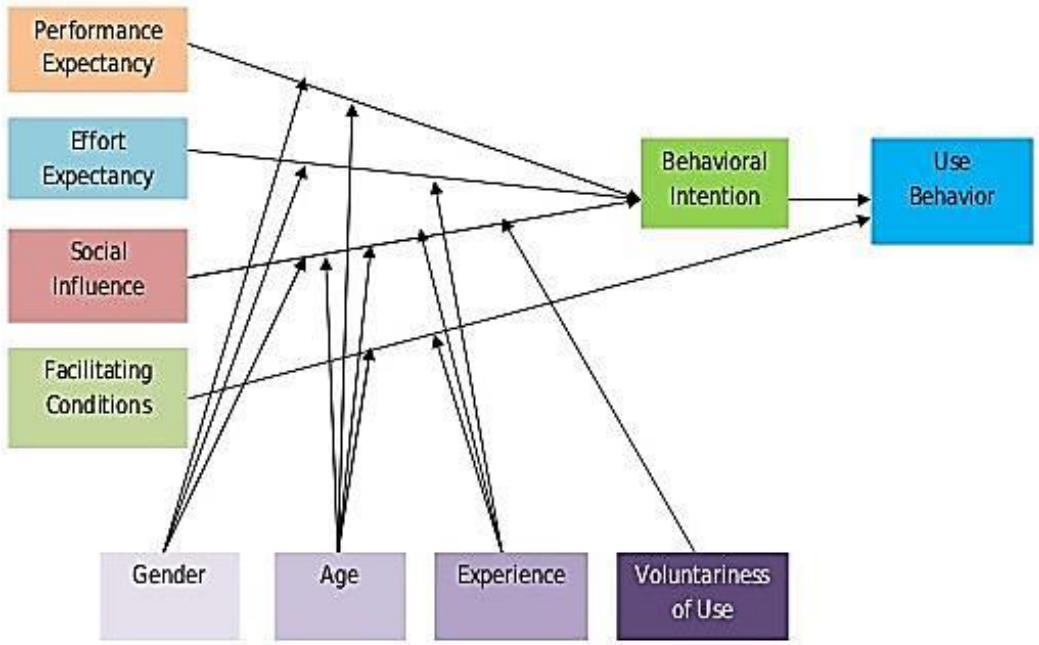

Figure 2.7: Unified theory of acceptance and use of technology UTAUT (Source: Venkatesh et al., 2003)

2.4 Summary

Chapter two presented technology acceptance models, namely: TAM (Technology Acceptanc e Model), IDT (Innovation Diffusion Theory), TRA (Theory of Reasoned Action), TPB (Theo ry of Planned Behaviour) and DTPB (Decomposed Theory of Planned Behaviour), to aid in u nderstanding the usability and the extent of use of the Digital Institutional Repositories by po stgraduate students and faculty. The models (TRA and UTAUT) were selected to supplement TAM given that they use behavioural intention to predict the usage of a system by a user thro ugh focusing on determinants such as voluntary use, perceived behaviour control, efficacy, no rmative beliefs and motivation to comply, and facilitating conditions, which are not in TAM. These constructs were useful in determining students' and faculty's behavioural intentions to use the information system by supplementing Technology Acceptance Model constructs, that is, PU and PEOU and external variables. The study broadly adopted the TAM model. Table 2.1summarises the mapping of research questions to the usability variables investigated in thi s study.

Research questions	**Usability variables in the TAM theories**
What are the attitudes and perceptions of PG students and faculty towards DIRs?	Attitude towards (AT) Motivation to comply (MC)

	Normative beliefs (NB) Subjective norm(SN)
To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR?	Effort expectancy (EE) and facilitating conditions (FC) Intention to use (IU) Usage behaviour (UB)
What is the perceived usefulness of the DIR by PG students and faculty?	Perceived usefulness (PU)
What is the level of satisfaction of PG students and faculty with the DIR?	Actual use (AU), user satisfaction (US)
What is the extent of system usability of the DIR at NUST?	Perceived ease of use (PEOU) External variables (Knowledge of search domain and system characteristics)

Table 2.1: Mapping of research questions to the usability variables in this study

The next chapter discusses the literature reviewed for the present study.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

A critical review of the literature is essential to help improve a thorough understanding of, and understanding into previous research that relates to the research question(s) and objectives (Saunders, Lewis and Thornhill, 2009). Furthermore, it is an evaluative account of literature which has been available on a particular topic, the key purpose of which is to summarise, synthesise, and analyse the arguments of others to reveal similarities and differences between published works and the new research. For a researcher to achieve this, s/he must not only read extensively and voraciously but also selectively (Roberts, 2004). Besides, a literature review is more than just a listing of what other researchers have published on that area of research but a recognition of what has been done with the view of filling the gaps that may exist in the previous works.

The literature reviewed in this chapter covers previous research in the area of usability of digital institutional repositories (DIR) by faculty and postgraduate students. In addition, the literature reviewed covers developed and developing countries in Europe, North America, Asia, Australasia and Africa. The goal of this study was to investigate the usability of Digital Institutional Repositories (DIRs) by PG students and faculty at the Namibia University of Science and Technology. The following research questions were addressed in this study:

1. What are the attitudes and perceptions of PG students and faculty towards DIRs?
2. To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR?
3. What is the perceived usefulness of DIR by PG students and faculty?
4. What is the extent of system usability of the DIR by PG students and faculty?
5. What is the level of satisfaction of PG students and faculty with DIR?

The literature reviewed in this research was obtained from scholarly items, namely: journals, conference proceedings, books, technical reports, as well as published and unpublished bibliographies.

The reviewed literature addresses the key research questions outlined above by covering the following themes: (3.2) attitudes and perceptions towards digital repositories, (3.3) self-

archiving and content usage, (3.4) usability of digital repositories: (3.4.1) perceived usefulness, (3.4.2) perceived ease of use, (3.4.3) domain knowledge, (3.4.4) relevance of search output, (3.4.5) system interoperability, (3.4.6) computer self-efficacy, (3.4.7) screen design, and (3.4.8) level of satisfaction with digital repositories. In addition, literature was reviewed in relation to the following issues around the research questions which are deemed to influence usability of institutional repositories in general and digital repositories in particular: (3.5) open access, (3.6) scholarly communication, (3.7) policy and legal framework; (3.8) awareness, and (3.9) summary of literature review. Figure 3.1 is an illustration to show the focus of the reviewed literature.

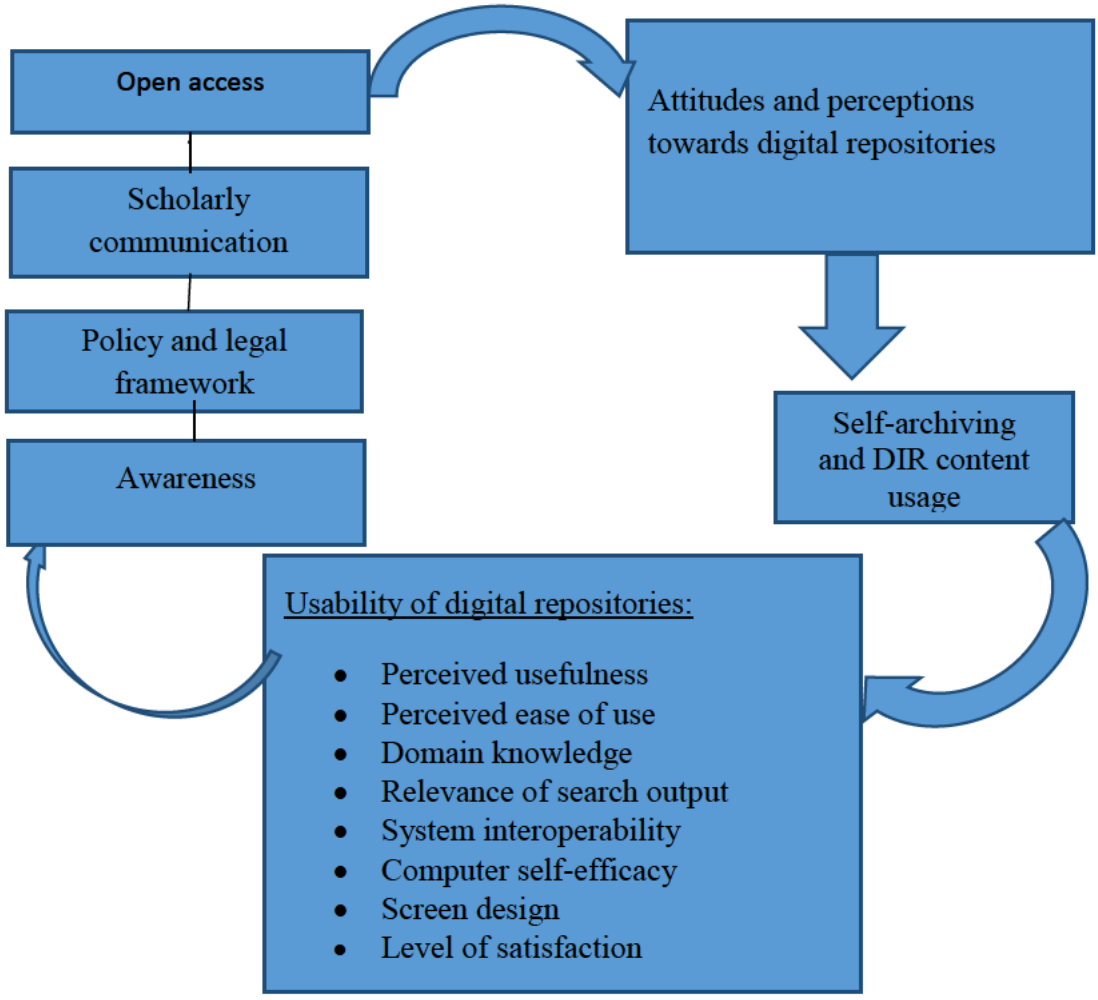

Figure 3.1: Focus of the literature review

Furthermore, related subjects around the research problem that are covered in this literature review include: open access, digital archiving and preservation, scholarly communication, preservation of digital content, dissemination of digital content, institutional and digital repositories, types of objects in the digital repository, research gaps, and summary of literature review.

3.2 Attitudes and perceptions towards DIR

Attitude, according to Blankson (2005:3) means "a complex mental state involving beliefs and feeling and value dispositions to act in certain ways". Therefore, the degree to which researchers are in favour or not in favour of the DIR may have an impact on their contribution towards it, which will then have an impact on the effectiveness of the DIR. Allen (2005) notes that an understanding of academics' perceptions and needs should be put into consideration when institutional repositories are in the early stages of development and implementation, as this can be used to plan repositories more efficiently and encourage their adoption by the academic community more effectively (Nicolas et al., 2004). The attitudes and perceptions are measured by the attitude towards using and the subjective normative beliefs construct of the tTRA model (Fang, Ng, Wang, and Hsu, 2017).

Ankamah, Akussah, and Adams (2018) assert that the use of Information Communication Technology (ICT) in research has become important among postgraduate students. However, available literature illustrates that there is little research on the perceptions and adoption of technology by researchers in developing countries. This situation makes it vital to investigate the perceptions of postgraduate students and faculty towards web-based application systems such as digital institutional repositories. Ankamah, Akussah, and Adams' (2018) study assessed postgraduate students' perceptions towards the use of ICT in a research on Ghanaian Public Universities. The findings discovered that most postgraduate students and faculty observed that the use of ICT applications in research as important. Moreover, most of the participants indicated that the ICT facilities that their institutions provided met their research needs. The findings further showed that postgraduate students used ICT applications for accessing information; they found that ICT is convenient in accessing information, is time saving, and helps finding current information. They strongly recommended that public universities in Ghana ought to uphold the already existing ICT facilities for optimal use.

Halder (2012) investigated user's attitudes towards institutional repositories at Jadavpur University in India. The outcome revealed that 6.68% teaching faculties, 5% staff, and 8.23% student respondents felt that the key motive for developing an institutional digital repository is only for administrative purposes. In contrast, 17.77% teaching faculties, 20.00% staff, and 18.84% students indicated that the purpose for the existence of an IR is to provide open access to materials. Nevertheless, the majority, involving 31.11% of teaching faculties, 27.50% staff members and 29.41% of student respondents were of the view that the main reason for the existence of an IR is to preserve scholarly materials on campus. Another, 15.55% of teaching faculty, 17.50% staff, and 10.59% students were of the understanding that the main purpose

for developing an institutional digital repository is to support the archives, and intensify the visibility of the institution broadly.

Comparatively, Allen (2005) observed that the attitudes and behaviours of academics from different disciplines towards depositing their work in institutional repositories varied. The study (Allen, 2005) revealed that the number of humanities documents in institutional repositories was far lower than that in STEM disciplines. Awareness of Open Access amongst humanities academics was found to below. A review of the literature from across the globe on PG students and faculty found the attitudes and perceptions towards OA and DIRs to be generally positive. Dutta and Paul (2014) shared the results of their survey among selected science and technology faculty members of the University of Calcutta in India. They reported that the faculty members' attitudes regarding IR were also generally positive. However, their awareness of the institutional repository was less than satisfactory. The findings further revealed that most of the respondents came to discover about IR through the Internet. The results revealed that the copyright issue was the most influential factor with regards to the willingness to contribute to the IR.

Oguz and Assefa (2014) studied faculty perceptions towards the institutional repository at a medium sized university in the US. Their study revealed that faculty perceptions of IRs and willingness to contribute to the IRs were diligently related with scholarly productivity rather than previous knowledge of and experience with IRs. The results revealed that seniority in faculty rank contributed negatively to faculty members' perceptions towards the repository.

Yang and Li's (2015) study at Texas A & M University (TAMU) assessed the faculty attitudes towards, and willingness to contribute to an institutional repository. Their study revealed that faculty are more engaged and interested in OA publishing topics in general, and are more eager to embrace new initiatives such as Open Textbooks. Generally, the faculty were found to be willing to deliberate on publishing in OA mediums, and almost half of them believed that OA journal publications are acceptable for consideration of tenure and promotion in their departments. The results further revealed that regardless of their positive attitudes towards OA publishing, they were not so positive towards OA mandates.

Koulouris, Kyriaki-Manessi, Giannakopoulos, and Zervos (2013) in a study in Greece on "institutional repository policies: best practices for encouraging self-archiving", found that faculty were willing to deposit their work in a repository. In addition, more than 89% of respondents were willing to learn about the self-archiving procedures as well as the uses of the DIR.

The study by Manjunatha and Thandavamoorthy (2011) in India explored researchers' attitudes towards depositing to open access institutional repositories as a mode of scholarly publishing. The study revealed that the highest number of scholars from science, technology, and medicine are aware of and are positive towards depositing their research output in institutional repositories. However, low levels of awareness of institutional repositories were found among researchers from the humanities and social sciences but they were willing to contribute their research work to the university's Institutional Repository. In general, scholars were found to have a "positive attitude" towards providing free accessibility of scholarly research within their university.

Moreover, Allen (2005) found that academics from humanities disciplines have a positive attitude about the role that institutional repositories play, and that the majority would at least contribute some of their work in the repository. Whereas the respondents did appreciate several advantages of the IR, they considered the benefits to be mostly for people accessing the information, not necessarily benefiting the authors themselves.

In a study done by Reichman and Okediji (2012) entitled: "When copyright law and science collide: Empowering digitally integrated research methods on a global scale" in the United States of America, it was found that mixed feelings about copyright is one of the obstacles impeding academic authors' participation in IRs. Professors appeared confused about the copyright policies and the level of permits issued by publishers and copyright agencies (Kim, 2007).

Stanton and Liew (2011) examined doctoral students' attitudes to open access forms of publications in New Zealand. They found that although awareness of open access and repository archiving is still low, most of the participants were found to have an understanding of the open access concept. Benefits of maximised exposure through the DIRs were perceived in the study.

A multiple author survey by Davis and Connolly (2007) in the USA demonstrated that most researchers were not willing to contribute their research output in the institutional repository. Similarly, a survey conducted in European by Davis and Connolly (2007) reported low participation by academics in IRs. Participants mostly chose to contribute their research output to departmental websites or online research groups than institutional repositories.

Halder's (2012) exploratory research regarding faculty attitudes towards the Institutional Repository and self-archiving revealed that 22.50% of the faculty and 17.64% of the students did not know what the institutional repository is, thus revealing lack of awareness among these groups of respondents. In a related study, Swan and Brown (2005) found that of the respondents surveyed, self-archiving awareness as a way for open access provision of the author's research output was 29% for open access and Institutional Repositories, and 71% were not aware.

Alemayehu (2010) investigated researchers' attitude towards using IRs at Oslo University in Norway and found that researchers showed an interest in contributing their work into the digital institutional repository. Singeh, Abrizah, and Karim (2013) investigated Malaysian authors' acceptance of self-archiving in institutional repositories using performance expectancy variables in the UTAUT to measure authors' perceptions on performance expectancy. The outcome of the research suggested that the highest number of authors agreed that there are advantages from self-archiving in research performance, hence increasing their personal virtues. Overall, they found that self-archiving makes their research work more visible and useful to disseminate their research output, as well as increasin their prestige as scholars. The literature reviewed thus far in this section goes to emphasise Fishbein and Ajzen's (1975) assertion that "an individual's behavioural intention is the strongest predictor of future behaviour". Similarly, UTAUT perceives "behavioural intention" as "the person's subjective probability that he or she will perform the behaviour in question" (Venkatesh et al., 2003).

These results agree with Murphy's (2016) opinion that scholarly research should be freely accessible. Murphy (2016), highlights that the public is entitled to every scientific paper published by providing free online access on every topic. Murphy (2016) advocates for open access, and sheds more light on how scientific findings that could inform personal and public policy decisions on matters resulting from health care, economics, and the environment are often excessively costly to read and impossible to collect and data-mine. Murphy (2016: para 3) states that:

> Realistically only scientists at really big, well-funded universities in the developed world have full access to published research. The current system slows science by slowing communication of work, limiting the number of people who can access information, and quashes the ability to do the kind

of data analysis that is possible when articles aren't sitting on various databases.

3.3 Self-archiving and usage of DIR

Despite of all efforts worldwide, DIRs are still facing the threat of low contributions from the scholars. Scientists and research scholars are well aware about the gains of open access DIRs; however, they are hesitant to disseminate their scholarly research results through self-archiving (Shukla, 2018). Therefore, the present study attempts to review literature on the extent to which PG students and faculty members archive their research output and use the content deposited in the DIR.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model has been utilised in different surveys, particularly in studies that are intended to understand the acceptance and intention to use information systems. This theoretical model has also been used in numerous studies in LIS (Library and Information Science) and that include Singeh, Abrizah, and Karim (2013) in their study that is entitled "Malaysian authors' acceptance to self-archive in institutional repositories"; and Tibenderana et al. (2010), in their study entitled "Measuring levels of end-users' acceptance and use of hybrid library services at The University of the West Indies". Furthermore, Hedland's (2008) study was on "Researchers' attitudes towards Open Access and institutional repositories as an explanatory model for developing a survey form for a quantitative empirical research on user attitudes and preferences" and Mann et al. (2008) in their study on "Open access publishing among scientists". UTAUT model is thus well-thought-out appropriate for this study since its constructs would have a direct effect on authors' behavioural intentions and usage of digital repositories.

Singeh, Abrizah and Karim (2013) used performance expectancy in UTAUT to measure participants' self-archiving experience. The results show that the majority of respondents 85.2% (92) reported having used digital repositories; however, out of these only 63.9% (69) had experience on self-archiving.

Bamigbola (2014) examined the attitude towards the use of institutional repositories and challenges faced by the faculty members in Agricultural disciplines at the Federal University of Technology, Akure (FUTA) Nigeria. A survey method was employed in the study and data were collected through questionnaire and analysed using descriptive statistics. The study incorporated diffusion of innovation (DOI) and theory of reasoned action (TRA) to understand

the attitude towards the use of IR. The findings suggest a general positive attitude towards IR, though there was low submission of scholarly works by the faculty to the IR.

3.3.1 PG students and faculty self-archiving pattern

Self-archiving is an action of (the author's) depositing a copy of an electronic document on the Internet freely, or more specially on the "World Wide Web" to provide open access to it. The term is commonly known as the self-archiving of peer-reviewed research journals and conference articles, as well as theses and book chapters, submitted in their own institutional repository or open archive for the purpose of increasing its accessibility, usage and citation impact; which is one method of maximising the visibility of research output (Harnad, 2001).

In a study by Xia and Sun (2007) in the USA, self-archiving practice was examined in nine well-known open access institutional repositories using E-prints system. It examined self-archiving practices in nine well-known open access institutional repositories using the E-prints system. The study found that researchers had not extensively accepted the self-arching exercise for institutional repositories. Xia and Sun (2007) also found that full-text availability in those repositories was low; however Australian repositories were exempted. Xia and Sun (2007) reported that using librarians to work with departments in depositing their researchers' works in the repositories on their behalf was one possible reason for the low rate of contribution to the repositories.

Koulouris, Kyriaki-Manessi, Giannakopoulos, and Zervos (2013) in a study in Greece, on "Institutional repository policies: Best practices for encouraging self-archiving" found the need for the promotion of the Technological Educational Institute of Athens' (TEI) IR. The highest number of the faculty members was not familiar with repositories; however, almost all (97.18%) were prepared to submit content to the TEI of Athens' repository. These results prompted the project team to invest in setting up a communication mechanism as a tool for promoting the DIR. Moreover, the willingness for depositing content as observed in the UK repositories indicates that the majority of authors believe in the IR value and visibility regardless of their concerns of plagiarism.

Furthermore, Singeh, Abrizah, and Karim's (2013) study on "Assessing Malaysian authors' acceptance to self-archive in institutional repositories: Towards a unified view" found that "performance expectancy, effort expectancy, social influence and facilitating conditions" did not have any influence on authors' behavioural intention towards archiving of research output.

Although academic researchers tend to concur that institutional repositories are a best option of information dissemination and used them frequently, most of them had not fully considered archiving their research work in institutional repositories.

Foster and Gibbons (2005) conducted a study where 25 professors were interviewed at the University of Rochester to investigate "why faculty members did not submit their content to the institutional repository". The study revealed that "infringement of copyrights" was a concern, and that disciplinary work practices forced them not to make active contributions to the university's DIR. Foster and Gibbons (2005) reported that academics developed their own practice to produce and organise documents by themselves. Furthermore, academics believed that DIR submissions of their research work comes with additional work such as the creation of metadata for submitted items on "open access self-archiving".

Swan (2004), and Swan and Brown (2005) found that most faculty are unaware of the digital institutional repositories concept. Some were confused about making self-archiving a priority and some of those who were aware the concept of digital institutional repositories were still ignorant about the digital institutional repositories implications. Swan (2004) found that the majority of researchers were unaware of the opportunities of archiving of their research work into the institutional repositories.

Despite the factors limiting self-archiving, some universities are already practicing it. For example, the California University of Technology (Caltech) allows faculty, staff and students to deposit items on the repository as shown in Figure 4.1 below.

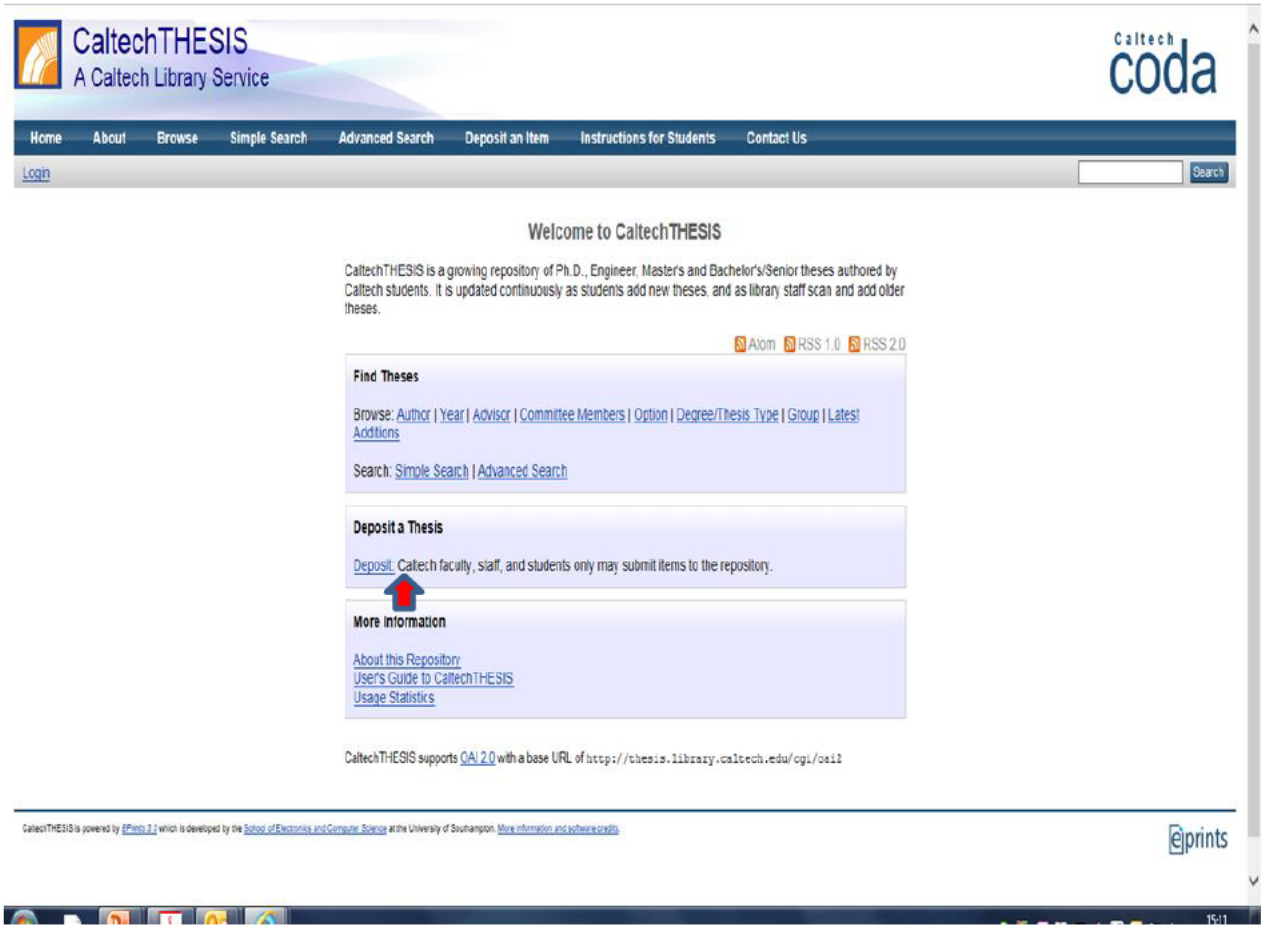

Figure 4.1: Caltech Thesis (Source: http://thesis.library.caltech.edu/10341/)

Rieger (2009) examined "Self-archiving as the alternative means of providing open access to scholarly journal articles". Rieger (2009) found that almost half (49%) of the participants had self-archived a minimum of one item during the last three years in at least one of the three possible ways, that is, "by placing a copy of an article in an institutional or departmental repository, in a subject-based repository, or on a personal or institutional website" (Rieger, 2009:1). Furthermore, 27% had chosen the last method of submitting a copy on a website than utilising institutional (20%) or subject-based (12%) repositories, though the progress of self-archiving activity through the previous years has been a more organised and systematic methods for providing open access. The study also found that post print (peer-reviewed articles) are submitted most often than preprints (articles prior to peer review) (Rieger, 2009).

Rieger (2009) found that while the self-archiving activity is high amongst the most productive authors, there are still a significant number of authors that are unaware of the possibility of providing open access to their research work through "self-archiving". About the authors who had never self-archived any part of their research output, 71% were unaware of this opportunity (Rieger, 2009). Rieger (2009) also found that 20% of authors had experienced trouble with the first attempt of submitting an article in a repository; however, this has reduced to 9% for

repeated submission. Equally, 23% of the authors took longer than one hour to submit their first article, but only 13% took long than that, with the majority of them taking a few minutes. In addition, copyright and intellectual property issues were worrisome to researchers. Another concern regarding self-archiving is the threat of infringing agreed copyright agreements with publishers. Rieger (2009) noted that where permission is understood by the author as required, then authors sought permission. However, where it is not known that permission is required, authors do not seek for it and as such they self-archive their work without permission (Rieger, 2009).

Shukla and Ahmad (2018) assessed the impact of Institutional Repositories on scholarly practices of scientists at the Council of Scientific and Industrial Research (CSIR) laboratories of India. The study revealed that "peer-review scholarly journals" are a favoured medium for publishing research content and the maximised visibility to grey literature was the greatest noteworthy impact of DIR.

Wu's (2015) study at Roger Williams University in Bristol, Rhode Island, examined the causes of low faculty contribution to IR content growth, particularly at small academic institutions. The study identified two major issues, namely, poor adaptation to actual faculty needs and copyright worries as the major bottlenecks in building the case for DIRs. The findings also revealed that academics at Cornell University hardly contribute to the institutional repository, as the IR remained with few contents and hardly used. This was linked to the fact that academics are not motivated to use the institutional repository (Davis and Connolly, 2007).

Stanton and Liew (2011) assessed open access theses in institutional repositories at the New Zealand University and found that only 17.6% (43) of participants submitted part of their research work in the institutional repository and 70.5% (31) of those participants had deposited their master's thesis. Stanton and Liew (2011) further reported that the majority of the participants in the survey were prepared to obey and deposit a copy of their thesis to the repository. However, some participants voiced some worries over the mandatory submission policy. Although they supported contributing their research work in the digital repository and were happy to act in accordance with requirements, the interviewees voiced preference for the voluntary submission of their theses as expressed by one respondent.

Singeh, Abrizah and Karim (2013) carried a study on Malaysian researcher's acceptance of archiving in digital institutional repositories and established that only 69% of academics in a research intensive university understood what open access is. However, awareness of digital and institutional repositories among them was quite significant. Harnad (2006), in a study of

"Open access to peer-reviewed research through author/institution self-archiving in New Zealand", assessed the issues which affect faculty members' contribution decisions to make use of digital institutional repositories. The study found numerous reasons that cause academics' disinclination to contribute their work into the institutional repositories including but not limited to uncertainty on what self-archiving is all about, and the misconception of what open access and institutional repositories really mean.

Similarly, Davis and Connolly (2007) surveyed authors in the USA and their results revealed that many of the respondents were found reluctant to contribute to the institutional repositories. Moreover, researchers displayed limited knowledge of institutional repositories compared to knowledge of open access journals. Another survey at Cornell University found that scholars "were not contributing their research work to the institutional repository". The reasons behind the state of affairs were related to academics having limited knowledge and lack of motivation to use the institutional repository (Singeh, Abrizah, and Karim, 2013).

Scholars generally tend to have misconceptions about archiving research work in DIRs, believing that archiving of research work in DIRs may violate copyright agreements which they have contracted with their publishers (Harnad, 2006). Furthermore, scholars appeared uneducated about copyright issues, considering that some publishers give permission to authors to make contributions into their institutional repositories and they make their articles accessible through their university's institutional repository. A study on "open access initiatives in academic libraries" by Sale (2006) found that of the 10 participants who previously contributed materials in the digital institutional repository, only 1 was confident about issues surrounding copyright when contributing to digital institutional repository articles that had been previously published in journals. The rest were found to "have a slight idea". Authors seemed to have misunderstandings and were overcautious about what is permissible according to publisher agreements.

There are therefore, many issues limiting the deposition of scholarly works into institutional repositories by scholars. Some scholars are much more reluctant to share work that has not gone through peer review and been accepted for formal publication because of the perception that mistakes in the material may be propagated, thus affecting the professional reputation of the scholar (Davis and Connolly, 2007). There is also a feeling among scholars that subject repositories are adequate to meet their needs and as such they don't have reason to use general digital repositories (Davis and Connolly, 2007). In addition, faculty and scholars in general tend to perceive an institutional repository as a single island completely isolated from other

institutional repositories. In this sense, one has to know where to find relevant information. It becomes unrealistic to have material in multiple repositories and require someone to search them separately. Other challenges that affect self-archiving by scholars include lack of time to self-deposit, lack of staffing or a dedicated manager to help with self-archiving, copyright clearance issues, difficulty in obtaining content (especially faculty publications), restrictive policies, limited IT support, and more.

3.3.2 Usage of the DIR

Russell and Day (2010) assert that unsurprisingly there is little detailed information available about the use and usefulness of repositories generally, and particularly for resource discovery. Arndt (2012) reported low direct use of DIRs for conducting research by scholars; instead, the vast majority used Google Scholar. Achieng (2016) analysed the usage of a digital repository in an academic institution in Kenya. The results revealed that the digital repository was underused partly because of lack of access to computers. The research revealed that independent variables such as effectiveness, efficiency, satisfaction, and awareness contributed to the usage of the digital repository and e-resources. Each of these factors influenced the usage of the repository either positively or negatively. The usage drivers were identified as lack of awareness and information, satisfaction and frequency of use, increased information needs, and reduction of barriers to access. The research revealed that effectiveness, efficiency, satisfaction, and awareness constructs have a positive impact on the usage of the repository and the e-resources, and they can be used to increase the usage of a digital repository.

A study by Stanton and Liew (2011) reported that only two participants indicated that they directly used institutional repositories directly for information access. Seven out of the eight participants mentioned that they accessed institutional repositories through Google Scholar or through the Online Public Access Catalogue, but they were not essentially aware that they were using the university's digital institutional repository in the process. One student indicated that he had never used repositories because his research needs are mostly answered though libraries and the Internet. However, it is likely that much of the journal articles the participants had accessed through Google Scholar (and Google) were in fact housed in repository collections, or those articles published in open access journals. In terms of PG students' use of repositories and open journals in their own research, the study revealed that only a few of the respondents had used open access research services, for example "Australasian Digital Theses and Ethos". Nevertheless, the majority of respondents used Google Scholar, so it is possible

that they retrieved open access material from journals and institutional repositories without realising it.

The dominance of search engines is also obvious and popular in the academic sector. A 2005 survey by Online Computer Library Centre (OCLC) established that 89 percent of students from higher learning institutions usually begin their research with Google, and that only 2% start their search at library websites (DeRosa and OCLC, 2005). According to Haglund and Olsson (2008), a repeat of that survey five years later revealed that the condition for libraries had only deteriorated as none of the participants indicated using library websites for their research activities (DeRosa et al., 2010).

According to Haglund and Olsson (2008), the same report revealed a decrease in traditional search engine use. However, the study noted for the first time the use of social media search engines for research. A similar survey in the UK by Griffiths and Bophy (2005) reported that "students preferred to locate information or resources via a search engine above all options, and Google was the search engine of choice" The information researching behaviours of upcoming academic researchers in Sweden displayed an "almost complete dominance of Google as a starting point for searching scientific information".

Rieger (2009) on the other hand reported an extensive use and satisfaction with Google and Google scholar among scholars. Rieger (2009) pointed out that both academics and students preferred search engines over other information retrieval systems in supporting their academic search and learning. Rieger (2009) also reported that there was sufficient awareness of specialised Google tools such as Google scholar and Google books among the faculty members and PG students.

Kroll and Forsman (2010) in the United States of America studied researchers at four active universities and their study revealed that Google and Google scholar were effective for their information needs and participants described these search engines' results as good in many cases. These results give a strong impression that besides efforts of introducing other library information retrieval systems, Google and Google scholar remain the most extensively used by researchers.

Connell (2011) compared the use of digital materials that have been deposited in The Ohio State University (OSU) Knowledge Bank (KB). Results showed that mediated and unmediated content were used, and therefore justified the preservation costs for unmediated content. Results also showed that articles and undergraduate thesis were the most frequently used type

of materials leading to the conclusion that it is important to collect content from all levels of the educational process.

Haglund and Olsson (2008) emphasised that to understand the information needs of young university researchers better, an observational study was carried out at three universities in Stockholm, Sweden. The study found that "most of the researchers used Google for everything, that they were confident that they could manage on their own, and that they relied heavily on immediate access to electronic information" (Haglund and Olsson, 2008:52). The researchers had very little interaction with the library, and their awareness on the value that the librarian's competence could add to their research was very limited and they could recognise it. One significant conclusion of the project is that "librarians have to leave the library building and engage themselves with the research environment, as well as considering the fact that library use is considered complicated, but Google (etc.) is easy. The findings of Haglund and Olsson (2008) project will have an impact on changes in library services for now and in the future

Moreover, Tmava and Alemneh (2013) pointed out that to increase content visibility, search engines are the most popular way that users search for information; they account for 88 percent of users' search time when they are looking for information (Bifet and Castillo, 2005). This is because most users like to search by keywords, and they expect to retrieve useful results. The popularity of Google search engines is attributed to its ease of use, it is free, and it is extremely fast and produces useful results. For the most part, Google generates search results by matching search terms entered with Web page content, usually referred to as full text searching.

3.4 Usability of digital repositories

Usability is a multidimensional construct that is scrutinised from numerous view points; the term has been used extensively and has different meanings to different people. One perspective is to look at usability from the interface effectiveness point of view. This outlook appears to make sense since usability has been grounded on human-computer interaction theoretically (Jeng, 2005). There are many usability studies focusing on interface design. Kim (2002) asserts that interface is one of the utmost vital aspects of usability, since through it users engage and interact with the system. Usability is also related to usefulness and ease of use. According to Matusiak (2012:136), usefulness and usability are interconnected "aspects of applications and information systems that are essential to ensure a system's functionality, to support user needs and tasks, and to provide a satisfactory user experience". Matusiak (2012: 136) emphasises that usability is not a solitary property of a system, but rather a multidimensional concept that

denotes multiple attributes, namely: “ease of learning and use, efficiency, memorability, error recovery, and user satisfaction”. “Ease of use” has been considered as a usability feature which is critical to the user acceptance of the new technology. The best usable system, as Mirel (2004, cited in Matusiak, 2012:136) points out, “is to be ‘useful’ by supporting the right model of people’s work and ‘easy to use’ by revealing an application’s logic and operations”. According to Mirel (2004, cited in Matusiak, 2012), ease of use is a vital attribute at the early encounter with the system as usefulness matters throughout the whole interaction process.

Körber and Suleiman (2008) assessed “Usability of digital repository software: A study of DSpace installation and configuration” in South Africa. The centre of the study was on usability of the administrative functionality of the digital repository software. User evaluations performed on a recent version of DSpace were followed by a participatory design of a tool to increase usability by conceptualising the lower-level details. Furthermore, users agreed that such a tool would be more usable. Therefore, it was found that significant usability problems exist, but these problems could be effortlessly addressed.

Körber and Suleiman (2008) assert that the emerging Open Access movement has in recent years played a defining role in the evolution of digital repository software which is used mainly to archive and disseminate documents that are related to research. In the 90s, such tools were typically custom industrialized to meet the goals of specific organisations or projects. Nevertheless, for Open Access to be widely adopted, it was necessary for repository tools to be effortlessly redistributed in different scenarios. This supported the creation and ongoing development of digital repository tools such as DSpace, E-prints and Fedora. Körber and Suleman (2008) carried a study to identify problems with the administrative usability of digital repository tools focusing on DSpace. The user studies gave evidence of the existence of usability problems in installation and configuration. Specific matters were highlighted and served as a reference for any solutions to this problem. One solution that was suggested is the design of a high level system tool to guide users through the process of installation and configuration.

DSpace has sometimes been criticised for lack of software functionality, inflexible categories, difficulty of deleting, moving objects, or cross-listing objects across categories. The inflexibility of DSpace provided the need to design additional search interfaces to the software. This was not a perfect solution as one cannot directly link to a DSpace object but only to the description page for that document (Davis and Connolly, 2007). Besides, community salience has also been cited for influencing the use of an institutional repository. Most faculty members

tended to associate with an international community of researchers working in a narrow discipline (Davis and Connolly, 2007).

Narayan and Luca (2017) assessed factors affecting the adoption of open access and institutional repositories by researchers at Victoria University in Wellington, New Zealand and established that the "DSpace's community collection structure" was less meaningful to a number of researchers who were already familiar with an organisational hierarchy of faculties and departments. This was linked to the terminologies that emerged from DSpace which were not meaningful within the setting of the university. The respondents narrated that the DIR interface was disorderly and cluttered with too much information, including a lot of metadata and statistics that were not making any sense. Although most of DSpace's browsing categories such as title and author were visible on the homepage of the repository, it was not clear to users what the context of these items within the site is.

Furthermore, Narayan and Luca's (2017) study in New Zealand presented the problems that are encountered in an academic institution when inspiring faculty try to embrace "open access", precisely by paying attention to contributing their research output into a DIR. Their study revealed that researchers were not well informed about the open access and its services and value. Additionally, the misperception about publishers' copyright policies and researcher prestige were observed in their study. Narayan and Luca (2017) stated that the limited accessibility, visibility and usability of the DIR were some of the concerns, and also the necessity for establishing subject repositories. The findings suggested a "redesign" of the DIR and guided the library's promotion programmes for scholarly communication literacy. The study established that although library staff had been advocating for "open access", limited understanding is still observed among researchers; they were also found to have other burdens regarding publishing their research output, and these serve as barriers for open access acceptance among researchers.

Law, Roto, Hassenzahl, Vermeeren and Kort (cited in Narayan and Luca, 2017) emphasise that users' encounter has become a vital basis for assessing the library information systems reinforced and developed from the perception of users while focusing on users' encounters is essential to study more conceptual qualities of the system, including usability, meaning, and affect.

McKay (cited in Narayan and Luca, 2017) notes that digital repositories' usability may be divided into three classes, namely: "content, functionality, and the user interface". Narayan

and Luca (2017) remark that generally more literature has been generated about the "information retrieval systems", however, research focusing on examining the accessibility and usability of the DIRs from the end user's point of view is still limited. This lack of information of the repository from the users' perceptive is likely to be a factor in the inaccessibility and limited acceptance of these systems. Pinfield (2015), in a study at the University of Sheffield, in the UK, entitled "Making open access work: The state of the art in improving open access literature", found several problems with the repository navigability. The research found that the software interface for the repository focused on "searching" than on "browsing", with a search box as the only navigation option. Narayan and Luca (2017) also observed that the way the content is organised in the system and the way it is presented sometimes gave little clue or clear instructions to the user as to where they may begin for information or content search.

3.4.1 Perceived usefulness

Authors such as Cullen and Chawner (2009), Kingsley (2008), and Pickton and McKnight (2006) explain that from the relative advantage perspective of Innovation Diffusion Theory (IDT)an innovation is prone to be adopted when users perceive it to be more advantageous than the one it replaces. Consequently, the digital institutional repository as an innovation would be adopted if it is seen to be beneficial to users, easy to use, known, and easily accessible.

Landauer (1995 cited in Jeng, 2005:48) defines usability as "ease of operation" and usefulness as "serving an intended purpose". According to the TAM, perceived usefulness is the extent to which a user trusts that making use of specific technology (system) would improve his/her job performance. Davis et al. (1992) asserts that "perceived usefulness" refers to the end user's perceptions concerning the outcome of the experience. Davis (1993) defines "perceived usefulness" as when the person believes that using the new system will enhance or improve his/her performance. Similarly, Mathwick et al. (2001) define perceived usefulness as the degree to which an individual believes a particular system would enhance his/her job performance.

The perceived usefulness of DIRs is measured by perceived usefulness, external variables (individual differences), self-efficacy (judgment of one's ability to use a computer), domain knowledge, system characteristics (relevance) and actual use. Usefulness is alluded to as an important determinant of information use. For open access systems that rely on depositing of content, that is DIR, it is believed that there are two key factors that govern their definitive

feasibility, namely: the input activity or submission of content supplied by authors; and usefulness, which is typically assessed via usage statistics (Luce, 2001). These two variables are inextricably related. Scholars are more likely to use (or access the content) and archive it if it has significant performance on output activity on one hand, and deposit their work if an archive is highly used on the other.

With regards to measures of usefulness of the system, bibliometric analyses are some of the most widely used. In the world of research, bibliometric analysis has been considered important over recent years as a tool that enables the DIR to generate statistics of use. Morrill (2015) investigated the role of institutional repositories in open access publishing and studied institutional repositories' potential in defining research impact through the download statistics they provide for their open access material. Institutional and subject repositories provided access and download statistics which gave researchers an earlier indication of the impact of their research.

Lambert (2017) stresses that depositing materials into the institutional repository is not the end of the road, what happens to the materials once they are available (in terms of views and download) is something to contemplate. Tracking, monitoring, and benchmarking the usage of educational resources helps universities to spot emerging trends and to demonstrate value and impact. For example, IRUS-UK (Institutional Repository Usage Statistics) is a usage statistics aggregation service that enables Institutional Repositories to share and compare the usage of resources based on the COUNTER standard. Part of JISC's Open Access offer is the IRUS-UK which provides access to influential and standards-based statistics supporting universities to get a better insight of the breakdown and usage of their institution's research, which they can speedily and effortlessly benchmark against similar organisations and share with key stakeholders.

As seen in figures 3.2 and 3.3 respectively, in some repositories one is able to see download usage statistics.

Figure 3.2: Waikato Research Common (Source: Research Commons, Waikato, nd)

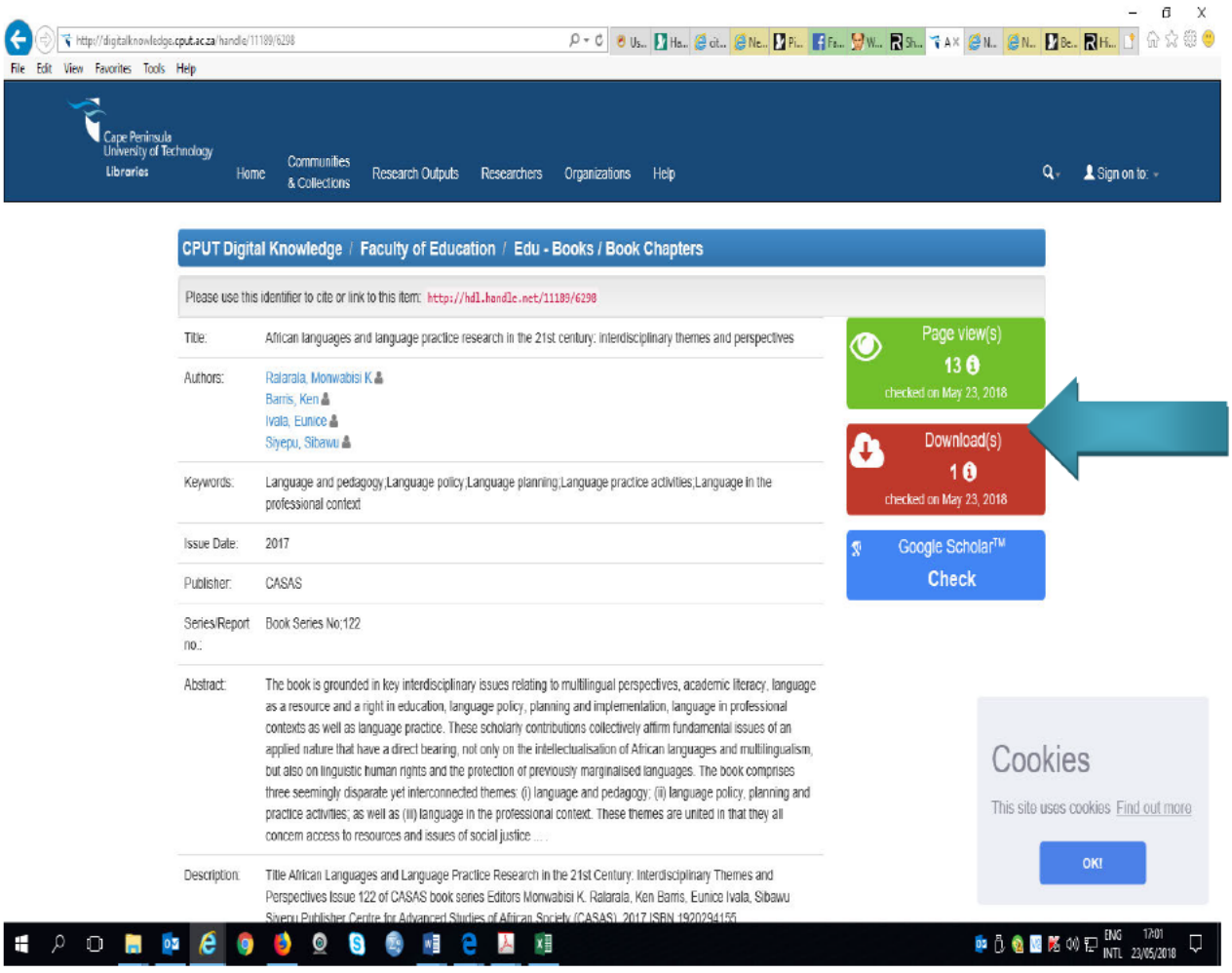

Figure 3.3: CPUT Institutional Repository (Source: Cape Peninsula University of Technology Portal, nd).

3.4.2 Ease of use

System usability is measured based on constructs of perceived ease of use, perceived behavio ur control, and system characteristics such as screen design. Usability is defined as "the study on a product or system to make it easier to use" (Tiryaki, 2004:35). The International Organiz ation for Standardisation (ISO 9241-11, 1998) describes usability as the degree to which a pr oduct can be used by particular users to achieve a specific objective with effectiveness, effici ency, and satisfaction in a specified context of use (Jeng, 2005:48).

Usability in the context of DIRs refers to the ease of use, prolificacy and the degree of satisfaction it provides to users (Joo and Lee, 2011:524). According to Reeves, Apedoe and Woo (2005:28), "usability testing signifies a process of systematic evaluation by using human-computer interactions". Therefore, usability testing is an important tool for the development of virtual systems such as interface design (Ferreira and Pithan, 2005:314). Dalkıran et al. (2014) emphasise that it is not a prerequisite for professional laboratories to conduct usability tests; instead, a convenient environment and sufficient equipment may be adequate for an accurate analysis. Nielsen (1993:26) highlights five characteristics of usability:

1. Learnability (users should be able to learn the system easily)

Learnability is sensibly the utmost central usability attribute. It refers to the fact that the system should be easy to learn so that the user can quickly start getting some work done with it. As Jeng (2005) reports, learnability is particularly vital for beginner users. Learnability in the present study is aimed at examining the learning effort needed to use DIR or for new visitors to orient themselves and get a good overview of what the system offers. Learnability is inferred from the amount of time required to achieve user performance standards and if they can perform the tasks correctly. Grossman, Fitzmaurice and Attar (2009:650) assert that learnability is achieved if the system is easy to learn by the type of users for whom it is intended. Moreover, Nielsen (cited in Grossman, Fitzmaurice and Attar, 2009:650) describes learnability as a beginner user's experience of the early part of the learning experience. Nielsen (1994, cited in Grossman, Fitzmaurice and Attar, 2009:650) further states that a highly learnable system can be categorised as "allowing users to reach a reasonable level of usage proficiency within a short time". Because the computer is a new cognitive tool, learnability has been a concern of interface designers. Designers have been overwhelmed with trying to design "familiar and natural interfaces" that can be learned without reading a manual. Nevertheless, learnability depends on functionality; not all interfaces should be expected to be immediately usable.

2. Efficiency (users should be able to use the system efficiently)

Efficiency is the ability to avoid wasting resources such as time, materials, energy, efforts and money in doing something or in yielding a favourable outcome. In a more general sense, it is the capability to execute and perform better, successfully, and effortlessly. It regularly and specifically encompasses the ability of a specific application to produce a specific result with minimum amount of time, expenses, and or pointless effort (Renger, Foltysova, Renger and Booze, 2017). Efficiency is more similar to usability and can refer to the required time to use the interface and the likelihood of making errors when using the system. Amazon's single button shopping is an example efficiency in design. Resnic and Pastel (2013) consider how much time it will take users to perform their tasks. Basically, the more steps it takes to carry out a task, the less efficient the system is.

3. Memorability (users should be able to remember the system easily)

Memorability refers to how easy a system is to remember and how to use it once learned. Memorability means what kind of interface support have been provided to help users remember when carrying out tasks, especially for systems and operations that are used occasionally (Carbou, Diaz, Exposito, 2013). Resnic and Pastel (2013) explain that memorability is all about reducing the user's memory burden by enabling the visibility of objects, actions, and options. "The user should not have to remember information from one part of the dialogue to another". User instructions of the system should be visible or retrievable with no difficulty or efforts whenever required. Memorability is the extent that the user can easily remember how to use an interface after the user has had an encounter with the system. The interface should be designed in such a way that menus and icons are visible and easy to understand, and menu names and icons or images need to be appropriate for them to be memorable (Resnic and Pastel, 2013).

4. Errors (the system should work as correctly as possible and free of major errors)

The system should be able to provide error messages through a careful design that averts a problem from occurring in the first place. Furthermore, the system can eliminate error prone conditions or check for them and present users with a valid option prior to action commitment (Guerilla HCI, 1994). An effective information system implementation requires operational and sound analysis, logical technical construction, effective design for users and fruitful change management during implementation. Guerilla HCI (1994) asserts that if these conditions are not met then it is likely that the system will be a failure. Guaranteeing a system is successful from a users' perspective is mainly about usability. There are many attributes of information system design that have an influence on usability including online help, the design

of the user interface, system, and error messages (Fisher, 1999). Overall, usability is a fundamental concept in HCI and it is concerned with making systems easy to learn, and easy to use, with limited error frequency and severity. Usability refers to the "quality of the interaction in terms of parameters such as the time taken to perform tasks, number of errors made, and the time to become a competent user" (Benyon et al., 2005:52); how many errors do users make during the task, how serious are these errors, and how easily can they recover from the error. These are questions to be considered when designing the system to avoid errors (Nielsen, 2012).

5. Satisfaction (users should take pleasure in using the system).

Kim and Kim (2008:868) describe one of the attributes of usability as satisfaction. Satisfaction is measured by specific attributes, that is, visual appearance, consistency and standards, and supportiveness (meaning helpful and support). According to Vaezi, Mills and Zafar (2016), user satisfaction within information systems (IS) is considered as a significant indicator of information systems success and it has been the subject of numerous research studies since the field's inception. When it comes to attribute satisfaction, early IS studies focused on users' perceptions of attribute performance and quality and related them to their satisfaction with the IS (Vaezi, Mills and Zafar, 2016). Debons, Ramage, and Orien (cited in Vaezi, Mills and Zafar, 2016), developed a questionnaire to measure user productivity perceptions of 10 different attributes of IS, including timeliness, reliability, assistance, accuracy, access, adequacy, and cost. Similarly, Neumann and Segev (cited in Vaezi, Mills, and Zafar, 2016) designed a survey to measure user satisfaction with IS which considered four attributes: accuracy, recency, content, and frequency.

Delone and Mclean (cited in Maditionos, Mitsinis and Sotiriadou, 2008) state that the system quality can be divided into content (information quality), quality of the system, and quality of services. Information quality denotes the quality of information or quality of the content, whereas, system quality refers to all the topographies which reduce difficulties experiences by users when interacting with the system. Griffith (cited in Madu and Madu, 2002) established that some sort of formats can make information more understandable, satisfactory and attractive. Berry (cited in Matitinos, Mitsinis and Sotiriadou, 2008) indicates some of the quality services which comprise of reliability. Reliability can only be assured when some conditions are met. For instance, information is accurate if it is updated, objective and comes from a credible source. Madu and Madu (2002) as well as Xiaoo and Dasgupata (2002)

established that timelessness and accuracy of information have an impact in the satisfaction that comes with the information.

According to Delone and Mclean (cited in Maditionos, Mitsinis and Sotiriadou, 2008), information system success considers "system quality" as the utmost significant user's satisfaction determinant. This model indicates that "system quality" is divided into different categories, namely: information quality, system quality and services quality. Furthermore, according to Mckiney, Yoon and Zahedi (cited in Maditionos, Mitsinis and Sotiriadou, 2008), information and system quality are some of the fundamentals measures. Matitinos, Mitsinis and Sotiriadou (2008) state that it is clear that the most important aspect that influences satisfaction is quality. However, according to the authors it is extremely difficult to define quality as it depends on each person's view about what quality means to them.

6. Help and documentation

Guerilla HCI (1994) highlights the need for the system to offer support and documentation. The system should be stress-free to search, focused on the user's task, list tangible steps to be carried out, and not too large. This does not imply that the user must be able to ask for help on every single item. User documentation provides "visual information" about how the system works and how to operate it. Documentation may give useful information to the potential users.

Padakuu (2018) highlights that while system documentation is intended mainly for maintenance programmers, user documentation is planned primarily for users. An institution supposedly has ultimate criteria on system documentation. These criteria may comprise the outline for the project dictionary and specific pieces of documentation within it. Padakuu (2018) further adds that the following components that make up the system are normally the main focus of documentation, namely: **s**erver environments, system rules, troubleshooting, system installation and other instruction and guidance and mostly FQA (frequent asked questions) and files. Documentation, training materials and support materials such as online help should be given in accessible formats. When possible, special and standard formats should be available to users who are considerably mildly impaired. Where this may not be possible, and for persons who are rigorously impaired, an alternative format that does not require vision, hearing, or dexterity should be made available, and it should be able to give the same information. Documentation, training, and support materials are a crucial part of any system. Most frequently, the limited access to training and support prevents users from taking advantage of the technologies' functionality. People with impairments that prevent them from viewing all of the information in the interface may have a greater and special need for training and support than other users (Pryor, 2010).

Good documentation is both technically simple to read and understand; for example, it is both good and logical at all levels of the organisation, and works well for readers who won't read more than a few paragraphs. While documentation presents complex ideas and documentation resources are reasonably complex works, they must:

- thoroughly describe how a tool or the system works (i.e. what all of the buttons do and how do they help in interacting with the system),
- how to use the system (i.e. tutorials, installation and configuration guides), and
- define possible use and configuration (i.e. use cases and practical guides).

Pryor (2010) points out some attributes on documentation and emphasises that: documentation is important as reference and standardisation material because it produces value for organisations and products. A good documentation has the ability to reduce the volume of support requests and mistaken issues on reporting. Additionally, good comprehensive documentation makes responding to the remaining support requests easier.

Pryor (2010) further asserts that good documentation acquires knowledge out of people's mind and into a shared format. This maximises trustworthiness because it reduces dependence on people's memories and notes, which may not always be available, or may be unpredictable. Without this requirement, documentation can aid in explaining and regulating the user experience through the innovation. In the absence of documentation, users may be uninformed of the features and behaviours which reduce their value. If users never learn about or take advantage of new features and functionalities, then new innovations are basically wasted (Pryor, 2010).

3.4.3 Knowledge of search domain

"Knowledge of search domain" is one of the internal control factors that may positively influence PEU (Perceived Ease of Use) of the systems. The information retrieval system shows that knowledge of the research domain can aid more effectively the search by supporting users to differentiate between "relevant information" and "irrelevant responses", learning facilitation of the search principles, and formulating more accurate queries (Linde and Bergstrom, 1988; Marchionini et al., 1993; Meadow, 1995). In the computer based environment, DIR as compared to the physical and traditional environment where end-user support or managerial support is generally available, there is usually no one to consult during the search activities. During that time, the background knowledge of the search domain for the user can easily support information system interaction (Hong et al., 2002).

3.4.4 Relevance of search output

Relevance is "the degree to which the system matches tasks as carried out in the current environment and as specified in the task analysis" (Hong et al., 2002:106). In the context of digital information systems, it can be understood as the extent to which the digital repository matches users' information needs (Hong et al., 2002). Normally it involves recall (i.e. the ratio of relevant information retrieved to all relevant documents in the information system) and precision (i.e. the ratio of relevant information retrieved to all retrieved items) which are the key principle measures of the efficiency and effectiveness of information retrieval systems (Hong et al., 2002). All these measures are grounded on the relevance concept.

Researchers in the Library Science discipline are increasingly starting to recognise the importance of relevance based on the user judgment in assessing the information retrieval system effectiveness (Janes, 1994, Park, 1994 and, Spink et al., 1998). Gluck (1996) found that users' satisfaction with retrieved items is related to the relevance of those items in determining their information needs. Yao (1995) matched relevance with usefulness by asserting that the information is only useful when the user perceives it to be relevant. Hence Yao (1995) assumes that the relevance of the content in the system to users' information needs is linked to both the PEU (Perceived Ease of Use) and PU (Perceived Usefulness) of the repository.

The relevance of results obtained in an information retrieval system is dependent also on the appropriate use of terminology or language of the system. The users carry out tasks by submitting their search queries in the information system using phrases that are structured where the information system's terminology that is used in the system becomes critical. Subsequently, it is also vital that users have a clear understanding of the instructions, guidelines, explanations, instructions, and results yielding from any search of the information system clearly and correctly. One main problem with "terminology" for an information system is wrongly used jargons. As recounted by Talja et al. (1998), most often the language that users use to express their information needs most often does not correspond with the terminology of the information system. This difference will not only make it difficult for the users to interact with the system, but also minimises the potential benefits that the system can provide to the users. Caccialupi, Calvi, Cassella, and Conte (2009) researched about the usability evaluation of a repository interface that is based on DSpace in Italy. In their paper, they presented the usability evaluation of a repository interface. The results of Caccialupi, Calvi, Cassella, and

Conte's (2009) evaluation revealed the most important inadequacies of the DSpace interface, namely: problems with the submission interface due to scarcely familiar terminology (metadata) or terms that are not relevant in the specific academic context (community); and confusions caused by terminology.

3.4.5 System interoperability

Interoperability defines the degree to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and consequently present data that can be understood by a user (HIMSS, 2005:2). Open access digital repositories have introduced and implemented the Open Archive Initiative-Protocol for Metadata Harvesting (OAI-PMH) as a mechanism to achieve interoperability in the exchange of meta-information with other systems (Muhammad et al., 2007). With all the different software platforms employed by IRs, their systems are expected to support interoperability in order to provide access via multiple online search engines (Tmava and Alemneh, 2013). Metadata interoperability facilitates the exchange of information between repositories and enables World Wide Web searching. To make items discoverable in the diverse online environment, the database needs to provide standards-compliant database servers and expose the fullness of that metadata to a metasearch client (Dorman, 2008).

McLean and Lynch (2004) agree that library systems interoperability is not easy to achieve and they identify major weaknesses that include: a) dynamic and complex library operation environments that are hard to map between libraries; b) divergent views by the stakeholders about the problems and possible solutions, and c) pressure to solve problems using short-term "quick fixes" rather than long-term solutions. Brown and Swan (2007) assert that through the Open Archives Initiative (OAI), the shared code for metadata tags has made it possible for full-text documents in different formats and locations to be shared.

According to Crow (2002), for institutions to achieve interoperability, they must maintain and expose metadata, giving a chance to other systems to harvest and search for the information. This practice removes the hurdle functioning of the repository in many institutions, as it only requires a file system to hold the content and to enable the creation and sharing of metadata with external systems. However, the concerns of researchers regarding risks of plagiarism and other copyright violations can be addressed by the institution's content accession and access to policies. For example, once the content is submitted, institutional repositories should not allow that content to be removed (Crow, 2002). However, circumstances vary and that might require an institution to limit access to particular content to specific users. These conditions

might consist of copyright restrictions and policies established by a particular research community (e.g. limiting access to departmental working papers to members of that department only) (Crow, 2002).

Interoperable metadata protocols are not new. Hilliker, Wacker and Nurnberger (2013) indicate that in the 1960s, first protocol for linked metadata, the machine-readable cataloguing format, or MARC, as it is normally known, was created and introduced by the Library of Congress. Developments and growth in these standards and search engine analytics are connecting library catalogue systems on the Internet, and using linked data to help users to uncover and research into content that is for all practical purposes concealed in the Deep Web. Semantic searching most frequently applies to scientific inquiries, allowing researchers to gather the profusion of relevant and credible information without using a number of search tools, each with their own precise filters. Additionally, advancements in semantic webs are generating new ways of data contextualisation, resulting in deeper personalisation and more inclusive views of bodies of research (Hilliker, Wacker and Nurnberger, 2013). Merrill, Corlosquet, Ciccarese, Clark and Das (2014) observe that utilising the open-source eXframe software, institutions and laboratories can generate Semantic Web repositories of their experiments, integrate them with heterogeneous resources, and make the interoperable with the vast Semantic Web of knowledge.

3.4.6 Computer self-efficacy

In the library science literature, some scholars have proposed the possible effects of computer literacy on increasing the usage of information retrieval systems literature (Allen, 1995; Davies, 1997; Jacobson and Fusani, 1992). However, the way through which this construct affects intention is unclear, and there has been limited empirical research. Computer self-efficacy is defined as the extent to which the user is able to use a computer (Compeau, and Higgins, 1995). Grounded in social cognitive theory, computer self-efficacy has been found to be an important predictor of IT usage (Compeau and Higgins, 1995; Compeau, and Higgins, 1995; Hill and Smith, 1987).

In IS studies (such as Agarwal, Sambamurthy and Stair, 2000; and Johnson, and Maraka, 2000) the key role that computer self-efficacy plays in understanding individual reaction to computing technology was observed. In the words of Hong et al. (2002), the suggested correlation between computer self-efficacy and perceived ease of use is grounded on the theoretical perspective by Davis (1989) and Mathieson (1991). Davis (1989) established the concept of perceived ease of use and perceived usefulness based on self-efficacy theory. Davis

(1989) recognised that "self-efficacy", which is defined as judgments of how well the user can perform on courses of action required to deal with prospective situations, is related to and can influence the perceived ease of use.

Hong et al. (2002) in Hong Kong, used TAM (Technology Acceptance Model) to assess the impact of individual differences sets (i.e. computer self-efficacy and knowledge of search domain) and characteristics of the system (i.e. relevance, terminology, and screen design) on the intention to use DIRs. Based on a sample of 585 users of the university's repository, the findings intensely reinforced the adoption of Technology Acceptance Model in predicting the intention of users in accepting digital repositories, and to determine the impact of critical external variables on BI (Behaviour Intention) via PEU (Perceived Ease of Use) and PU (Perceived Usefulness). The study indicated that both differences of individuals and characteristics of the system have a significant impact on the PEU of the digital repository. In addition, relevance has the strongest influence on the perceived usefulness of digital repository.

3.4.7 Screen design and user interface (UI) screen design

In an empirical usability study by Broock (2005) at Oregon State University Libraries, DSpace metadata registry and submission screens were customised so that students are prompted to enter fields that pertain to their thesis such as Advisor or College rather than more generic field names such as Description. The instructions on the submission screens were also revised so that they could be more understandable. In Broock (2005), six undergraduate students were recruited to test the usability of the electronic thesis and dissertation submission process. The hypothesis was that if undergraduate students of widely differing experience and age could successfully complete the submission process, then graduate students completing their degrees should also find the process simple. The researcher supplied the students with a sample dissertation as a PDF file and the "Submitting Electronic Theses and Dissertation" instruction form and asked the students to submit the thesis to the DSpace@OSU Electronic Thesis and Dissertation collection. The study revealed minimal problems, but also confirmed the assumption that the process was sound and that the changes they made were helpful. Furthermore, Broock's (2005) results showed that all the six students completed the submission process quickly by following the instructions. They also submitted and uploaded their PDF files and entered the basic metadata within five minutes. This included author, title, advisor, and other pertinent information. However, it was realised that there was also a need for instructions to log off. In terms of complexity, one of the participants found the technology frustrating to use. Stanton and Liew (2011) assert that complexity is likely to be a hurdle in

accessing and using digital repositories directly though this may not be a barrier to accessing digital repository content through "Google Scholar" or "library catalogues" that are understood to be widely used by researchers. These results highlight the significance of optimising repository metadata for discoverability through existing search engines such as Google Scholar and research portals.

Furthermore, Kim (2005) carried out a study on how students find information from the E-print and D-space of the University of Michigan. The research identified the usability problems of two user interfaces of digital institutional repositories, DSpace and E-prints. The problem areas exposed what should be done for the users' search interface and recommended seven approaches for assessing a user search interfaces, specifically that they: "give users a satisfactory number of search options; provide samples of search query; employ users' language; allow users greater control and autonomy; display useful components in result sets; list search results in a useful way; and clearly present links to open digital documents". Implementing these guidelines would improve the user's experiences when using digital institutional repositories.

Kim (2005) further found that the one-box simple search form in DSpace was not considered useful because it doesn't give directions on how to use it. The instructions were provided in "help" documentation in the DSpace; however, no one used it even when users encountered problems. In contrary, E-prints gave some few directions about how to structure search queries above each "search box". Although E-prints users made more errors than DSpace users, they easily recovered from the errors after reading the short instructions. Nevertheless, when DSpace users encountered problems, escaping from those errors was not easy. Therefore, information about how to submit search terms would help users make fewer errors or recover from the errors.

According to Kim (2005), E-prints users also experienced difficulty in understanding some search options such as types. Particularly, respondents were well informed about the different types of scholarly information such as articles, thesis or conference proceedings. One participant expressed that the types of documents would be the least useful search option for him. The participant noted that if he is looking for some information, he would probably focus on "subject" and that "the type of document" would not be important. The importance of the "type of document" option might be different for other subject groups. For instance, a documents type would be considered more important to faculty groups as opposed to post-graduate students.

Furthermore, Alasem (2013) evaluated the usability of the Saudi Digital Library's Interface (SDL) in Saudi Arabia. A set of sixteen items covering four aspects namely: efficiency, effectiveness, aesthetic appearance, and learnability were developed to evaluate the Saudi Digital Library interface (SDL). Twenty-two undergraduate students from the department of Information Studies participated in completing the Likert scales questionnaire. The findings of the research revealed that the SDL's interface level of usability practice was not acceptable, especially concerning aesthetic appearance.

Buchanan and Salako (2009) evaluated the usability and usefulness of a digital library at the University of Strathclyde, UK. The aim of the study was to determine system usability and system usefulness as mutually dependent properties of system interaction and screen design, which in combination, determine system satisfaction and usage. They found that learnability was a key attribute of system usability; and relevance, reliability, and currency, which are key attributes of system usefulness in terms of screen design. The results showed that participants found the interface and scream design easy to learn and useful; and experts tended to perform tasks better and give higher ratings in the questionnaire than the other two user groups.

In terms of functionality, Davis and Connolly (2007) reported that all authors were very grateful for the existence of the DSpace and yet there was a perceived lack of software functionality. Categories identified that it was inflexible, and one could not delete, move objects, or cross-list objects across categories. The inflexibility of the DSpace made it necessary to design an additional search interface to the DSpace documents. However, this was not a perfect solution as one cannot link directly to a DSpace object but only the description page for that document. This resulted in an additional step required by a researcher, and because of it, lots of people possibly get lost at this step.

According to Kocsis, Vanderheiden, Peinado, de Lera, Smirek, Zimmermann and Fendrich (2016), user interface (UI) design focuses on anticipating what users might need to do and ensuring that the interface has features that are easily accessible, understand, and use to facilitate those actions. UI brings together concepts from interaction designs, visual design, and information architecture. Kocsis et al. (2016) explain that user interface is a computer tool that intends to enable interaction between the user and the system. The UI (user interface) demonstrates both physical and communicative features of input and output, or interactive and engagement activity (İlhan, 2005). Jitnupong and Jirachiefpattana (2018:1) state that the "UI entails metaphors, mental models, navigation, interaction, and appearance". The authors add that the "UI metaphors are computer-related features that help users to understand, remember,

and enjoy a UI" (Jitnupong and Jirachiefpattana (2018:1). This implies that the system developer comprehends the needs of users and the objective of the system. Mental models cover data, function, tasks, roles, and people. Navigation supports features such as menus, windows, dialogue, and or icons to aid movement through the mental model. Interactions contain the practice to receive input from the user and bring the output to the user. "Appearance or surface includes all perceptual qualities, such as visual, sound, colours, fonts, and animation" (Jitnupong and Jirachiefpattana, 2018:1).

While dealing with the issue of UI in general, it is imperative to look into the Dspace that the researcher selectively focuses on as software which is where most of DIR is on (Saini, 2018; Rahman and Muhammad, 2014). According to the OpenDOAR database, until today most of the IR in institutions (38.9%) use the DSpace as their IR software (OpenDOAR cited in Rahman and Muhammad, 2014). For this reason, it is imperative to discuss the UI in DSpace.

An increase in Information and Communication Technology (ICT) functionality in everyday living surroundings, from home to public services, presents difficulties among varied devices and services, and therefore, enforces complex burdens with respect to our digital literacy and technical knowledge especially in the use of DIR as a latest technology for information dissemination and access. However, the majority worldwide hardly benefit from these advantages particularly people such as "senior citizens", and those who are digital illiterate are also not enjoying this ICT advantage (Kocsis et al., 2016).

"Digital literacy" includes the skills and abilities needed for accessing the technology. Digital inclusion is the policy established to close the "digital-divide" and promote digital literacy (Jaeger, Bertot, Thompson, Katz and DeCoster, 2012). The DSpace inherits the inclusive policy and provides developers with information, building blocks and resources, for fast and cost-efficient incorporation of convenience basics into new or existing applications and services (Kocsis et al., 2016).

- **Requirements characteristics which enable usability in the DSpace UI section (Kocsis et al., 2016).**

In consideration of UI features, the developers mainly work towards understanding the users' needs, designing a UI that aids them with navigating the Information System to handle their search tasks, exploring how the system communicates with them, and thereby determining the look and feel of the UI. Some of the UI characteristics are discussed below:

- *Metaphors and user needs*

"A metaphor is a relation between language as an abstract (the bottom) system, individual language users, and cultural knowledge" (Jitnupong and Jirachiefpattana, 2018:8). When users come across a user interface metaphor, they bring their own situation to the understanding of that metaphor. These situations include culture, work profession, education, and other traits which classify them as individuals. This is the main responsibility of the designer of a User Interface obviously.

- *Navigation design*

The navigation of the system is guidance that aids a user to attain their research queries. A satisfactory system should be able to direct the users from beginning to end, which means that the designing team needs to understand user tasks involved in the research processes for the purpose of accomplishing it (Jitnupong and Jirachiefpattana, 2018). Navigation is reflected in how the system is designed by looking at the "layout; the template, position of buttons, system hierarchy, content organisation, tabs, menu, and border" in every User Interface. In the DSpace, this gives a simplified navigation and an overview via visible structured segments so that users will not be overstrained and assist in the handling of content (Kocsis et al., 2016). The DSpace also provides communities supported by forums, and question and answer portals organised by content categories.

- *Interaction design*

According to Jitnupong and Jirachiefpattana (2018), interaction is "communication through dialogue between the system and the users". A good UI is the one that helps users fully, to finish their tasks in a short time with no problem. Moreover, "interaction" reveals the provision level of the system and it must be regularly contingent of users encountered. In some systems, the user's needs are fully addressed and the system continuously informs users of any mistakes they make. Additionally, users may need partial support to be built in to the system as they see themselves as skilful about the system. Usually, the design team creates interactions and tries to support users by means of avoiding, correction, and information recovering when they encounter an error. In the DSpace, diverse "gamification" features and strategies are used to encourage users to passively interact with system (e.g. "a reward system where the user can earn points by answering a question in a forum, fixing a bug, providing a certain accessibility feature" etc.). Analysis, critics, and feedback are identified as compulsory features of DSpace design (Kocsis et al., 2016).

According to Botra, Rerselman and Ford (2014), the concept of gamification and the potential to set up gamified applications is perceived as a new way of enquiry for human-computer

interaction and can be considered in the progress of establishing itself as an innovative way for researchers. Deterding, Dixon, Khaled and Nacke (2011) argue that the gameful experience is a specific type of user experience achieved by a strategy of incorporating game design elements into the User Experience. The User involvement, as opposed to experience, is then viewed as a unique manifestation of experience that involves a service, is related to an interaction with the system, and is interactive (Roto, 2014). Roto (2014) further states that the user experience is focused on the user as an individual and is considered a personal experience affected by not only the usability of the technology in use, but also the user's expectations and previous experiences. Botra, Rerselman, and Ford (2014) regards "every aspect of the user's interaction with a product, service, or company" as contributing to the user's perceptions in the whole process of user experience. With interface interaction, gamification would then make the user experience enjoyable and fulfilling.

- ***Must be usable (easy to use)***

According to Bugyei (2017), the system should run for 24 hours without any momentous breaks and is usable in any part of the world with internet coverage. It should enable to provide further corresponding links to different topics using a blog and news page for example. This enables for quick references, information and notifications while still using the application (Bugyei, 2017). The welcome page as the entry point should give support to the user by giving authentic functionalities for interactive usage, together with the content search functionality. The "introduction" is required to give users an understanding of the content and what they can expect (e.g. develop a video) to stimulate attention and motivate the users. In getting started, a tutorial is needed to introduce the system to new users - how the website is working / structured (e.g. video, teaser, infographics, etc.); it should be adaptable to the user's experience level and should be briefly introduced on the first screen. A repository tutorial (e.g. video) can be developed to create awareness, as well as educate and learn from experts or other community members (Kocsis et al., 2016).

3.4.8 Level of satisfaction with DIR

Kim (2005) reported findings from their study on DSpace and E-print in which data about users' satisfaction was collected from post-test questionnaires which contained five sections. These five sections include: overall reaction, web page, terminology and web site information, learning, and web site capabilities. The results revealed that although DSpace users wished for advance search forms, users also noted too much effort in understanding some of the search

parameters such as “series, identifiers or sponsors”. One DSpace user kept using “keywords” for all searching tasks. This user noted that using keywords only for a search parameter was the most reasonable way, and it appeared to be much easier than searching through titles, authors and or years.

Zhang et al. (2013) carried out “a usability evaluation of a research repository and collaboration website”. Evaluation results showed that the general user experience of “Human-Animal Bond Research Initiative (HABRI) Central” was satisfactory; however, the study revealed quite a number of usability problems. Zhang et al. (2013) reported that participants had problems with entering metadata such as “resource type” and authors information during the submission of items into a repository. Participants commented on the process of article submission and that the work flow could be further improved to avoid user confusion. There were also interface design issues regarding layout and consistency.

Kim (2005) carried out a study in the United States of America to examine the usability of the interfaces of two of the most frequently used institutional repository systems: DSpace and E-prints. By applying heuristic evaluation and usability testing, eighteen undergraduate students were tested using experimental design. Time for completing the task, the number of errors encountered and the user’s satisfaction from post-test questionnaires were measured used. The study revealed that DSpace users spent less time completing tasks and made fewer errors than E-prints users. Overall satisfaction of DSpace was also higher than E-prints. Based on this analysis of problem areas, the study suggested guidelines for institutional repository interfaces.

Safdar and Rehman (2015) carried out a study assessing “the users’ perception and satisfaction with the Higher Education Commission Pakistan Research Repository (PRR)”. Scholars also assessed the level of users’ satisfaction with PRR. The study indicated that participants were satisfied with PRR. They agreed with the statements like “PRR is useful; it is important to have PRR; PRR is helpful in staying up-to-date with the latest information and knowledge; the material is usually displayed in a format that is well-suited with my PC; PRR makes it possible to reach knowledge at earliest opportunity; it is easy to use PRR; finding the information that is needed quite quickly; the files are quick to download; and training is necessary to use the PRR” (Safdar and Rehman, 2015:8).

In addition, Jagero et al. (2014) carried out an assessment of the usability of the Africa University Digital Library in Zimbabwe. The results drove the researchers towards the conclusion that there was overall dissatisfaction of users with usability features of the Africa

University digital library, especially in terms of the adequacy of the collection and time response of the system. Jagero et al. (2014) also cited Bandwidth problems, lack of user training, and the lack of cooperation from faculty librarians were also cited as the main factors influencing the attainment of the highest degree of usability for the digital library in terms of satisfying user needs and expectations.

Increasingly, library science researchers have started to acknowledge the importance of user-based relevance judgments in evaluating the usability and effectiveness of information retrieval systems (Janes, 1994; Park, 1994 and Spink et al., 1998). Gluck (1996) found that users' satisfaction with retrieved items is related to the relevance of those items in resolving their information needs. Yao (1995) associated relevance with usefulness by arguing that a document is useful only if the user perceived the document as relevant. Therefore, they assumed that the relevance of the system's content to users' information needs is positively related to both its perceived ease of use and perceived usefulness.

3.5 Open access

According to Jone (2007:31), "Open Access" is defined as a "concept of making publicly-funded research freely available to all at the point of use". The proponents of open access such as Harnad (2010) emphasise that Open Access is freely open and provides everlasting access to the online full text research output for the public worldwide (Bailey, 2007). An essential goal of the open access (OA) movement is the free availability of research outputs on the Internet (Knoth, 2014) at no charge to scientific information. Open access ensures an accelerated scientific communication and fosters new scientific findings. Alemayehu (2010), states that the explosion of digital documents and the rising interest in accessing these documents through the Internet has brought a new way of information disseminating. Alemayehu (2010) adds that mostly the development of internet brought another benefit of availability of digital scholarly content, with a notable speediness irrespective of its format and capacity. This technology innovation motivated the "open access" movement with the idea of sharing information.

Arunachalem (2005) emphasises that open access is only a best option for information dissemination provided that researchers and institutions are prepared and ready to distribute their intellectual outputs. Arunachalem (2005) emphasises that the readiness to share knowledge from scholars and the researcher's end and advances in technology enables free information access.

Open access has become a current discussion topic among different groups such as professionals, information workers, research groups and organisations, researchers, academics, librarians and others. According to Joshi and Vatnal (2012), the discussion of open access mainly focuses on two concepts commonly known as "golden and green road models" to open access. The "golden road" of Open Access journal-publishing is when journals avail their articles through open access, for example by charging the authors or institution for publishing outgoing articles rather than charging the users for incoming articles, accessing, or by simply availing their online edition to the public freely. Additionally, Joshi and Vatnal, (2012:4) state that the "green road" of OA archiving is where authors give OA to their personal published articles by freely availing their personal e-print to the users. The "Hybrid route" is another model, sometimes called "Paid Open Access", and refers to subscription journals with open access to individual articles usually when a fee is paid to the publisher or journal by the author, institution, or funder. "Some universities or libraries avail sufficient funds for hybrid journal publications or sometimes funding is written into grant applications for open access in hybrid journals, although these are not common instances" (Joshi and Vatnal, 2012:4)

According to Kingsley (2008), Open access is a primary tool in reducing the digital divide where access to relevant information is allocated unequally. This unequal distribution has social impacts with those who have access to relevant information, gaining or accumulating better prospects in social, economic or health matters. Akintunde and Anjo (2012) are of the view that the surge in content on the Web will enable more productive researches to be conducted through good access to relevant data and literature. Libraries will also be able to create more professional networking with colleagues all over the world. The best choice and deployment of suitable software will mainly bring contents together and provide a mutual platform for the exchange of information and knowledge in today's knowledge society. According to Fourie and Neale-Shutte (2006), little access to current scientific data and literature is one of the major challenges facing many developing countries. The utmost of research is published in journals that require a subscription fee. University libraries are mostly facing budget constraints, where governments must prioritise the distribution of limited funding to address multiple, equally demanding social needs within the surrounding society.

Particularly, the "open access" movement encountered conflict from some scholars who contended with the idea of providing free access to research output, emphasising that it may have a negative impact on research itself, citing plagiarism of content and infringement into copyrights. However, libraries are said to be the most beneficial entities for achieving objectives via the Open Access movement. The increase of scholarly journals subscription

costs and technology innovation in disseminating and publishing of instinctual outputs has forced academic libraries to adopt open access as one of the methods in disseminating and preserving digital information publications (Alemayehu, 2010).

Buehler and Boateng (cited in Alemayehu, 2010) observe that Open Access opened a modern communication strategy among libraries, publishing agencies and the research communities. The key motive that the open access movement is being extensively adopted by the libraries, according to Harnad et al. (2008) is that the budget for libraries is diminishing. Moreover, most credible "journals" are kept by large "commercial publishers" which make it difficult for knowledge sharing among research communities (Chan cited in Alemayehu, 2010). Thus, Harnad et al. (2008:1024) emphasise that since libraries have a limited budget to obtain most of the published articles through subscription, "most of the potential research impact of those unreachable articles is being lost". Therefore, Open access movements are recognised for research information freedom and it is suggested that "The libraries support the transition, publicize the benefits and highlight open access journals" (Jone, 2007:33) as a strategy for providing intellectual outputs to the libraries.

McCormick (cited in Alemayehu, 2010:22) notes that "the fundamental role of a university library is to provide the intellectual resources to support the research and teaching needs of its faculty and staff". Hence, it is obvious that the academic libraries took the inventiveness to establish DIRs in support of the teaching, learning, and research activities within their institutions with the minimal cost and presenting a dissimilar style in the dissemination and preservation of research outputs. DIRs support the restructuring of the publishing of scholarly information by seconding the free access and online scholarly materials with limited use restrictions.

According to Alemayehu (2010), despite all the benefits that accrue from open access, there is a misconception about this initiative. For example, it is claimed that OA journals are lower in quality than reputable and highly ranked journals. Contrary to this belief, many OA journals are reputable and highly ranked journals and they are a product of often reputable authors, reviewers, editorial staff, and acceptance policies. There is also another misconception that OA repositories will drive journals out of business. Instead it needs to be appreciated that while journals offer a proven, quality controlled method for dissemination, ranked by impact factors, offering tenure/publishing opportunities, the repositories on the other hand complement journals by allowing authors to submit pre and post print versions of published articles and

non-traditional items such as datasets, committee reports, and more. The OA repositories enhance the visibility of the publications.

3.6 Scholarly communications

According to Johnson (2002), "institutional repositories" give strategic reactions to both the opportunity of the online networking environment in today's scholarly journal system. Crow (2002) states that whereas institutional repositories focus on, preserve, and make accessible an institution's intellectual capital, at the same time they are part of the world wide system of distribution and interoperable repositories that give the foundation for a newly disaggregated model of scholarly publishing.

In the long run, by "capturing, preserving, and disseminating" a university's collective intellectual capital, institutional repositories serve as significant indicators of an institution's academic performance and progress (Johnson, 2002). Crow (2002) highlights that under the current system of scholarly communication, most of the intellectual output and value of an institution's intellectual property is distributed through thousands of scholarly journals. Despite the fact that faculty publications in these journals reflect positively on the author's university, an institutional repository focuses on the intellectual output created by a university's researchers, making it easier to demonstrate its scientific, social, and financial value. Therefore, institutional repositories enhance scholarly communication by supplementing existing methods for assessing institutional productivity and prestige.

According to Johnson (2002), more than a decade ago the scholarly communication system limited the readership and availability of most scholarly research (while also complicating its institutional origins) rather that increasing it. Journal price increases and subsequent subscription cancellations have reduced the audience further. In response to this, the role of alternative scholarly communications models such as institutional repositories in breaking the dominations of publishers and increasing the awareness of university intellectual outputs was introduced and it has grown increasingly. Johnson (2002) further states that institutional repositories can aid this function whether they are implemented on individual grounds or in collaborative consortia projects (Crow, 2002).

Scholarly communication is hampered in a number of ways that require solutions. Although many institutions have made efforts to develop digital institutional repositories where content is accessible through the Internet, most of this content is hardly accessible world-wide. This is because Google and Google Scholar platforms that are mostly used have difficulty indexing

the contents of institutional repositories. Arlitsch (2011:60) in this regard asserts that "Google Scholar has a difficulty indexing the contents of institutional repositories because most repositories use Dublin Core, which cannot express bibliographic citation information sufficiently for academic papers". Google Scholar makes specific recommendations for repositories that include the use of publishing industry metadata schemas over Dublin Core. Moreover, DIRs that are functioning over web server technologies, use descriptive metadata, and because their operations are generally directed at open access, they all benefit from successful harvesting and indexing by internet search engines.

Arlitsch and O'Brien (2012) state that the average indexing ratio of IRs in Google Scholar (for example across the USA) is relatively low, and that changing repository metadata to follow one of the publishing industry schemas endorsed by Google Scholar, would drive to a significant improvement in the indexing ratio of the Dspace content. It is imperative to know that "Internet search engines" are taking over overall information searching behaviour of users, and according to Arlitsch and O'Brien (2012), "Google is by far the most popular search engine", consistently grabbing 65 percent share of the "explicit core search market" followed by Bing and Yahoo. The domination of search engines as tools for accessing digital institutional repositories content is also apparent in the academic institutions (DeRosa and OCLC, 2005).

3.6.1 Digital archiving and preservation

There are two major types of archiving, namely traditional and digital archiving. Traditional archiving practices sought to preserve physical objects (e.g. artefacts, samples, paper, photographs, and microfilms) that carry information. Digital archiving on the other hand strives for preserving the electronic information regardless of the media on which that information is stored. Computer disks and other magnetic and optical media degrade, and the information on them is lost unless it has been moved to other media. Software and hardware change quickly such that the physical media on which digital data are stored are impermanent. Action is therefore needed to ensure wide access and long-term preservation of digital data.

The Open Citation Project (2004) noted that academic institutions have been faced with a challenge of managing the "digital intellectual output" that are created including "journal articles, conference papers, reports, theses and dissertation, teaching materials, artwork, research notes, and research data". Nevertheless, the latest technologies enable these institutions to create, preserve, store, and access digital content. Moreover, although there is

the possibility for instant access, most often most of the produced content remains stuck in the authors' computers and they are not made accessible to the public. The Open Citation Project found that about 80-85% of digital intellectual output of universities is never made available to everyone.

In reaction to the above-mentioned challenges, Massachusetts Institute of Technology (MIT) announced a research project titled "to build a stable and sustainable long-term digital storage repository that provides an opportunity to explore issues surrounding access control, rights management, versioning, retrieval, community feedback, and flexible publishing capabilities" (Tiwari & Gandotra, 2018:51).

According to Niven and Thompson (2011), the general objectives of digital archiving are to:

- Authorise easy and extensive accessibility to electronic information for "educational, and scientific purposes".
- Safeguard the robust preservation of electronic information so that it remains accessible for suitable use in the long run.
- Enable intellectual outputs to be preserved in digital formats, enabling easy accessing preparedness for funding or promotion activities (Patterns, Mischewski, and Smyth, 200; Corbett, 2011).

Bhat (2010) suggests a framework for digital preservation comprising of archival stability coupled with organisational processes and technological continuity. Hitchcock, Wendy and Harnad (2007) support distributed preservation services for institutional repositories. Giarlo (2005) stresses the need for libraries to accumulate and integrate the policies, standards, methods, and technologies for digital preservation. Hockx-Yu (2006) suggests implanting digital preservation in the repository's workflow. Muir (2003) discusses the deficiency of the present copyright laws which prohibit librarians to copy items for digital preservation. Reich and Rosenthal (2003) argue that the (Lots of Copies Keep Stuff Safe) LOCKSS Program, funded by the Andrew W. Mellon Foundation may enable institutions to locally collect, store, preserve, and archive web-based journals for long-term preservation with no harm to the publishers' business model.

The LOCKSS project, under the auspices of Stanford University, is a peer-to-peer network that develops and supports open source systems that enable libraries to collect, preserve, and provide their readers with access to material published on the Web. The system attempts to

replicate the way libraries do this for materials published on paper (Reich and Rosenthal, 2003).

According to Akintunde and Anjo (2012), digitisation is an important process and part of preservation. Digitisation enhances access to library resources. By digitising library collections, information will be accessible to all instead of a group of researchers. Digitisation creates visibility for the invisible. Numerous users can access the same material at the same time without a burden. It also removes the problem of distance as users do not have to travel to libraries that possess the hard copies of library materials before they can access and use such materials. Akintunde and Anjo (2012) highlight that digitisation holds great promise for the preservation of materials, the share-ability of resources, and the visibility of libraries and institutions.

3.7 Policy and legal framework

According to Robbio and Coll (2005), a DIR is driven and guided by its policies which determine its "identity, quality, and direction". It is not enough to create a repository simply by placing software on the system. An organisational model for archives is the completeness of its policies, and an archive without policies is like a library without a librarian.

The principal policy concerns of DIR which are important to know are its:

- Content policies about the type of materials to be submitted.
- Submission policies talk about who is authorized and entitled to submit material in the DIR.
- Preservation policies articulate guidelines on maintaining records for future use.

Li (2005) emphasises that no matter how content is deposited in the IR, the quality of the deposited content should be inspected before digital preservation actions are considered as the initial quality of the deposited content can directly impact the success of digital preservation efforts. If the quality of the content cannot be assured, then significant problems may arise. These problems may consist of format obsolescence, poor quality or unreadable images or scans, and insufficient metadata to manage and preserve the materials. Equally, the DIR submission policy is important to explain and give clarity where the responsibility for authorising the submission of material lies, as well as the terms and conditions of the submission of an item. However, within the literature, there is a debate concerning the essential for "mandatory submission policies" for the researcher's intellectual output. Some stakeholders claim that mandatory policies would cause more "harm" than "good" in relation

to researchers preferring a library liaison and advocacy approach, while others (including some of the academics themselves) are not concerned with the mandatory submission policy (Palmer et al., 2008). Other authors argue that a mandatory policy is the only way to achieve appropriate submission rates (Sale cited Stanton and Liew, 2011).

Literature indicates that the mandatory deposit policy is a useful strategy to develop an essential collection of an institutional repository and one that is supported by the majority of the respondents (Stanton and Liew, 2011). Pickton and McKnight, and Swan and Brown (cited in Stanton and Liew, 2011), found that the majority of students and academics (respectively) were found to be willing to comply with a mandatory deposit policy on self-archiving of all peer-reviewed research output in order to maximise its research impact (Harnad, 2003).

Furthermore, preservation policies should be the first step towards guaranteeing preservation actions. All plans and strategies for preserving IR content and the decisions on whether the content requires short, medium, or long term preservation should be driven by preservation policies (Banach and Li, 2011).

Banach and Li (2011) conducted a national survey on digital preservation of institutional repositories in the USA. They examined the current practices of digital preservation of DIR materials. Their study found that 51.5% of respondents indicated that their DIRs had preservation policies. Encouraging enough, this result showed that there has been an increase in digital preservation policy development since the 2003-2005 Cornell survey of institutional readiness by Kennedy (2005), which focused on developing digital preservation programmes. In Banach and Li's (2011) survey, respondents were asked whether the DIR provides long-term preservation to all submitted content. The respondents revealed that many institutions guaranteed preservation only for certain file formats; 90.0% of polices clearly supported or recommended file formats, while the rest of the institutions indicated that they are committed to long-term digital preservation of all materials housed in their IRs (Banach and Li, 2011).

On May 2005 the Coalition for Networked Information (CNI) in the Netherlands hosted an international conference entitled "Making Strategic Case for Institutional Repositories". In preparation for the meeting, the organiser gathered information on Institutional repositories deployed from some 13 countries, namely, Australia, Canada, United States of America, Belgium, France, the United Kingdom, Denmark, Norway, Sweden, Finland, Germany, Italy and the Netherlands. They researched about "the existence of national policies related to institutional repositories for each country". The authors found that while there were only few

national (governmental) policies, there was also a growing number of "reports, declarations, policy directives" and related activities in the government and across major groups of higher education institutions within a country that progressively give support to digital institutional repositories (often in the context of infrastructure to advance open access specifically) (Van Westrienen and Lynch, 2005).

A study done by Nazim and Mukherjee (2011) shows that only 2.36% of IRs has a defined policy for the preservation of documents, whereas 83% of IRs does not make a clear policy for the preservation of documents. Furthermore, 14.19% of IRs does not give any information regarding preservation policy. Nevertheless, there are discernible efforts by some institutions especially in North America and Europe to promulgate such policies despite the fact that the policy of content inclusion, submission, and preservation are not well defined (Nazim and Mukherjee, 2011).

Stanton and Liew (2011) reported that respondents expressed that they prefer a voluntary system or were ambivalent towards archiving their work in an institutional repository. One respondent is quoted to have indicated that submission should not be made compulsory but researchers should be given an option to choose whether to publish their research output in the repository or not. Some students in Stanton and Liew's (2011) study were reportedly against archiving their work in a repository. One participant cited concerns regarding plagiarism and strongly opposed having their research published electronically.

However, in the same study, Stanton and Liew (2011) found a high level of willingness to comply with the mandatory thesis deposit policy. Positive responses ranged between 91.6% from respondents in the College of Sciences to 100% in the College of Creative Arts.

3.7.1 Directive DIR submission policies

Directive DIR submission policies provide guidance intended to be used as a decision-making and planning tool for institutions with digital repositories that are already in existence or in developments that are considered to add research data to their digital collections (Green, 2009). As noted earlier in section 3.2.1, some participants in Stanton and Liew's (2011) study expressed some concerns over the mandatory submission policy. While supportive of placing their work in the repository and happy to comply, these interviewees expressed preference for the voluntary submission. Moreover, the review of literature enlightens that DIR policies are some of the issues that may influence the use and participation of PG students and Faculty on

DIRs. This study made efforts to review literature from different DIR policies from different academic institutions.

Firstly, a closer look at the University of Tasmania's DIR policy on the mandate on depositing for Open Access, the policy clearly stipulates that "University researchers are required to make available for OA digital copies of all research outputs and their related metadata, via deposit in the Institutional OA Repository". The submission of research outputs to the Institutional OA repository on a voluntary basis by other members of the University community and the broader Tasmanian community is encouraged to achieve the benefits of open access where possible (University of Tasmania IR policy, 2017).

Similarly, at the University of Auckland, the policy indicates that where staff members produce any form of intellectual property other than an excluded copyright work in the course of their employment, and using University resources, the University is acknowledged as having rights to that intellectual property (The University of Auckland intellectual property policy, 2013). Furthermore, the University of Cape Town's (in South Arica) IR policy encourages employees and students to make all forms of works of scholarship available through the appropriate platforms and services in digital format and of a type that is consistent with policies and practices. Regarding copyright issues, the policy further states that authors should utilise Sherpa/Romeo or publishers' websites to confirm a publisher's copyright policies and permissions that are normally granted in terms of their copyright transfer agreements.

The policy states that the university recommends that authors evade the handing over of copyright to publishers, where the publisher does not allow archiving, re-use or sharing, as a minimum of a submitted version of a scholarly publication. UCT provides a simple way through which authors can inform publishers of their need to comply with UCT's policy so that it is consistent with the permissions given by the staff member to the University; and encourages authors to publish their scholarly publications in peer-reviewed open access journals. In this case, the author should supply the metadata to the Institutional Repository in order to maximise institutional and personal discoverability (UCT IR policy, 2016). A study done by Sale (2006) in Australia, which assessed the acquisition of open access research articles reported that after the introduction of a mandate policy, authors overwhelmingly deposited their research output, even before six months after publication date. These results show that mandates have in fact an impact on the DIR's content growth.

3.8 Awareness about DIRs

A study by Manjunatha and Thandavamoorthy (2011) in India explored "Researchers' attitude towards deposits to open access institutional repositories as a mode of scholarly publishing". The survey revealed that the majority of science, technology, and medicine scholars understand and are positive towards submitting their research work into institutional repositories. However, the lack of awareness of institutional repositories was observed among the humanities and social sciences. Nevertheless, they were willing to contribute their research work to the University Digital Institutional Repository and they had a positive attitude towards the provision of free access to scholarly research outputs to their university.

Stanton and Liew (2011) examined "Doctoral student's awareness of, and attitudes to open access forms of publication" in New Zealand. They also examined levels of awareness of the open access idea, the model of institutional repositories, and their behaviour of publishing, and views on the benefits and risks of open access publishing. The study found that while awareness of open access and repository archiving is still low, the majority of participants were found to be in favour of the open access idea. The perceived gains of improved disclosure and the possibility of sharing outweighed the perceived risks.

Bamigbola (2014) investigated "The level of awareness, attitude to use of institutional repositories and challenges faced by faculty in Agriculture disciplines in Federal University of Technology, Akure, and (FUTA) Nigeria". Bamigbola (2014) adopted the survey method, and a questionnaire was used to collect data and data were analysed using descriptive statistics. The study integrated diffusion of innovation (DOI) and theory of reasoned action (TRA) to explain and understand the awareness and attitudes to use the DIR. The results revealed that academics' level of awareness about DIRs is increasing; however, there was disparity in the level of awareness across agriculture related disciplines. In addition, there seems to be a general positive attitude towards the DIR, yet there was low submission of scholarly works by faculty. Finally, it was revealed that the use of DIRs is determined by the level of awareness and attitude towards the use of DIRs. Furthermore, an author' survey by Davis and Connolly (2007) in the USA indicated a general low level of awareness of DIRs.

Halder's (2012) exploratory research regarding faculty attitudes towards the IR and self-archiving revealed awareness about the institutional repository hosted by the Jadavpur University Library, which was 93.33% for faculty, 62.50% for staff and 76.47% for students. The study similarly revealed that 22.50% faculty and 17.64% students did not know what the institutional repository is, thus revealing lack of awareness among these groups of respondents.

In a related study, Swan and Brown (2005) found that of the respondent's surveyed, self-archiving awareness as a way of providing open access of author's work was 29% and 71% were not aware. Manjunatha and Thandavamoorthy (2011) noted that the humanities and social science researchers seemed to lack awareness of the DIRs; however, participants were willing to submit their research work to the university's DIR and indicated a positive attitude towards the provision of free access to scholarly research output of their university.

3.9 Summary of literature review

This chapter reviewed theoretical and empirical literature on the usability of digital institutional repositories. The literature review was guided by TAM and other technology acceptance models. The literature reviewed addressed the key research questions covering the following themes: attitudes and perceptions towards digital repositories, self-archiving and content usage, usability of digital repositories - perceived usefulness, perceived ease of use, domain knowledge, relevance of search output, system interoperability, computer self-efficacy, screen design, and level of satisfaction with digital repositories. In addition, literature was reviewed on the following broader issues around the research problem, open access, scholarly communication, policy and legal framework, and awareness.

The researcher noticed that there is limited literature on usability of DIR and self-arching. This observation was also made by Zhang, Maron and Charles (2013:9), who noted that there is limited literature on how the content submission process itself may hinder self-archiving practices. Xia and Sun (2007) examined self-archiving practices in nine well-known open access institutional repositories using the E-Prints system and found that the practice of self-archiving for institutional repositories had not been widely accepted by researchers.

The literature revealed that depositing and the use of IRs were influenced by content submission policies, usability issues such as perceived usefulness and perceived ease of use, self-archiving practices, internet connectivity, and high cost of technological and communication infrastructure. The literature also revealed paucity of studies on IRs that have used heuristic expert evaluation, which is a powerful and robust technique of usability inspection. The literature further revealed that despite growing interest and investment in institutional repositories, little efforts have been geared into improving usability of existing digital repository at NUST. The present study therefore made efforts to try and address these gaps.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter covers the research methodology that was used in conducting the study. Research methodology describes what the research project is all about, procedures of how it is conducted, and how to measure its attainment or failure. Babbie (2011:647) defines research methodology as "the methods, techniques and procedures that are employed in the process of implementing the research design or research plan as well as the underlying principles and assumptions that underline their use". Research design is a strategic plan and a framework for action that functions as a link between research questions and the carrying out of the research project. Research designs guide the arrangement and conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose. Like all plans, research designs ensure that the study fulfills the purpose it is intended for and that the research is completed within the available resources and time.

This chapter covers the following research aspects: research methodology and methods, research paradigms, research approaches, multiple methods approach, research design, population of study and sampling procedure, data collection tools, reliability and validity of data collection tools, data collection methods and procedures, data analysis, approaches to information system evaluation, ethical considerations, and summary.

4.2 Research methodology and methods

Babbie and Mouton (2001:199) define research methodology as "the methods, techniques and procedures that are employed in the process of implementing the research design or research plan as well as the underlying principles and assumptions that underlie their use". The research methodology consists of various aspects such as paradigm, approaches, designs, population, sampling process, data collection, reliability and validity of instruments and ethical considerations.

4.2.1 Research paradigms

Saunders, Lewis and Thornhill (2009:118) define a paradigm as "a way of examining social phenomena from which particular understandings of these phenomena can be gained and explanations attempted". Pickard (2007:7) classifies research paradigms into three

philosophically distinct categories, namely: transformative paradigm, positivism, post-positivism, interpretivism and pragmatism. Positivists prefer "working with an observable social reality and that the end product of such research can be law-like generalizations, similar to those produced by the physical and natural scientists" (Remenyi et al., 1998:10). Interpretive researchers believe that reality consists of people's subjective experiences of the external world. Unlike positivists, interpretive researchers use meaning and relevance, but no measurement-orientated methodologies. They mainly use data generation techniques such as interviews or participants' observations that rely on subjective relationships between the researcher and his/her subjects (Saunders, Lewis and Thornhill, 2009:116). Post-positivism paradigm on the other hand, according to Teddlie and Tashakkori (2009:5), is a "revised form of positivism that addresses several of the more widely known criticisms of quantitative orientation and yet maintains an emphasis on quantitative methods".

4.2.1.1 Interpretivist/constructivist paradigm

Interpretive or constructivist researchers believe that reality consists of people's subjective experiences of the external world. Unlike positivists, interpretive researchers use meaning and relevance, but no measurement-orientated methodologies. They mainly use data generation techniques such as interviews or participants' observations that rely on subjective relationships between the researcher and his/her subjects (Saunders, Lewis and Thornhill, 2009:116).

The interpretivist/constructivist paradigm was developed from Edmund Husserl's phenomenology and Wilhelm Dilthey's and other German philosophers' study of interpretive understanding called hermeneutics (Mertens cited in Eichelberger, 1989). Interpretivist/constructivist approaches to research intend to understand "the world of human experience" (Cohen and Manion, 1994:36). The reality is socially constructed (Mertens, 2005:12). The interpretivist/constructivist researcher has a tendency of relying upon the participant's views of the situation being studied (Creswell, 2003:8). "The constructivist researchers mostly rely on qualitative data collection methods and analysis or a combination of both qualitative and quantitative methods (mixed methods)" (Creswell, 2003:8). Creswell (2003) indicates that quantitative data may be used in a way that can support qualitative data and effectively deepens the description.

4.2.1.2 Transformative paradigm

"Transformative researchers felt that the interpretivist/constructivist approach to research did not adequately address issues of social justice and marginalised people" (Creswell cited in Tshabalala, 2015). A transformative researcher therefore believes that it is necessary for

studies to be combined with politics and include an action agenda for improvements that may better the lives of the participants, the institution in which people work or live, and the researcher's life (Creswell cited in Tshabalala, 2015:190). A transformative researcher can use qualitative and quantitative data collection and analysis methods in the same way as the interpretivist/constructivists. Nonetheless, a "mixed methods approach" gives the transformative researchers a structure for the expansion of more comprehensive and full representations of our social world through the utilisation of multiple viewpoints and a clear understanding of better arrays of values and positions (Somekh and Lewin, cited in Tshabalala, 2015:190).

4.2.1.3 Pragmatic paradigm

"Pragmatism is not committed to any one system of philosophy or reality. Pragmatist researchers focus on the 'what' and 'how' of the research problem" (Creswell, cited in Tshabalala, 2015:190). Tashakkori and Teddlie (cited in Brierley, 2017:3) perceive pragmatism as the paradigm that gives the fundamental theoretical framework for "mixed-methods research". Creswell (cited in Brierley, 2017:3) states that the pragmatic paradigm places the research problem at the centre and applies all the necessary methods to understand the problem by paying attention to the research questions, data collection and analysis approaches which are selected to give clear understanding into the research question. This is a research paradigm that only combines "quantitative and qualitative research methods" and also exploits the integrity of the data analysed (Feilzer, 2010).

4.2.1.4 Positivist and Post-positivism paradigm

Positivism accepted David Hume's theory of the nature of reality (i.e., philosophical ontology). Hume believed that reality consists of atomistic (micro-level) and independent events. He believed in the use of the senses to produce knowledge about reality (i.e., scientific method). Positivism utilised a significant impact on scientific practice in the social sciences for many years in the early 20th century. This was especially true in the natural sciences where laboratory experiments can closely be estimated to the real world environment, thus allowing for precise predictions (Kaboub, 2008). According to Aliyu, Bello, Kasim and Martin (2014), a positivist investigator acknowledges the notion that the universe or world is in agreement with permanent and unchanging laws and rules of causation and happenings; that there exists an intricacy that can be overcome by reductionism; and with the intention of asserting an importance and prominence on impartiality, measurement, objectivity and repeatability. These researchers have similarly a realist and an independent, as well as objective analysis and understanding of the universe. The methodologies frequently undertaken by positivist

investigators and researchers involve confirmatory analysis, nomothetic experiments, quantitative analysis, laboratory experiments and deduction (Olesen, 2004; Ryan and Julia, 2007).

In a positivist view of the world, science was seen as the way to get at truth and to comprehend the world well enough so that we might forecast and control it. The world and the universe are considered deterministic; they operate by laws of cause and effect that we can recognise if we apply the unique technique of the scientific method. Science considered as largely a mechanical affair. We use logical reasoning to hypothesise theories that we can test. Based on the findings of our studies, we may learn that our theory doesn't fit the facts well and so we need to review our theory to foretell reality well. The positivist believes in realism - the impression that observation and measurement is the core of the scientific endeavour. The main approach of the scientific method is the experiment, the attempt to understand natural laws through direct manipulation and observation (Trochim, 2006).

The post-positivism paradigm on the other hand, according to Teddlie and Tashakkori (2009:5), is a revised form of positivism that addresses numerous of the more broadly known criticisms of quantitative orientation and yet maintains an emphasis on quantitative methods.

According to Trochim (2006), one of the most common forms of post-positivism is a philosophy called critical realism. A critical realist considers that there is a reality independent of our thinking. Positivists are also realists. The variance is that the post-positivist critical realist identifies that all observations are imperfect and have errors and that all theory is revisable. In other words, the critical realist is critical of our ability as a way to know reality with inevitability. Where the positivist believes that the goal of science is to expose the truth, the post-positivist critical realist believes that the goal of science is to hold consistently to the goal of getting it right about reality, even though we can never attain that goal. Because all measurements are imperfect, the post-positivist highlights the significance of multiple measures and observations, each of which may possess different types of error, and the need to use triangulation across these multiple error sources to try to get a better consideration of what's happening in reality (Trochim, 2006). The post-positivist also believes that all observations are theory-laden and that scientists (and everyone else, for that matter) "are inherently biased by their cultural experiences, world views, and so on. Post-positivism rejects the relativist idea of the incommensurability of different perspectives; the idea that we can never understand each other because we come from different experiences and cultures. Most post-positivists are constructivists who believe that we each construct our view of the world

based on our perceptions (Essays, UK. (2013).

In order to understand the usability and extent of use of the digital institutional repository by academics and postgraduate students, the post-positivist approach was agreed upon because the post-positivism paradigm has its roots in multiple methods, and this study employed multiple methods. For example, in the evaluation of educational technology, Mason (cited in Cullen, 2004) advocated for the use of both interpretivist and positivist studies. In the post-positivist approach, Mason (cited in Cullen, 2004) explains that "an experimental, quantitative core is supported by critiques from varied analysis, theoretical perspectives, and value frameworks, combining the use of survey and observational data with regression and cluster analyses" (Cullen, 2004:8). Methodologies highlighted by Mason (cited in Cullen (2004) that would fall within the post-positivist framework comprise survey questionnaires, user interviews, laboratory experiments, case studies, user statistics on educational technology and so on. Authors such as Cullen (2004) adopted post-positivism to assess the use of digital libraries in the health sector. Fenech (1998) tested the behavioural constructs of perceived usefulness and perceived ease of use as predictors of usage acceptance of the World Wide Web.

The current study was an analytical study. It is located in the post-positivism paradigm. The study adopted a mixed research approach that included qualitative and quantitative research. The study used data collection techniques that included interviews, participants' observations and experiments. In mixed methods research, investigators use both quantitative and qualitative data because they work together to provide the best understanding of a research problem.

4.3 Research approaches

Research methodology revolves around two major approaches namely: qualitative and quantitative research (Teddlie and Tashakkori, 2009). The difference between the two is that essentially qualitative research comprises methods that collect verbal or textual data, while quantitative research uses numerical data that can be counted (School of Education Training and Development, 2003:59). Using "multiple methods" (triangulation) allows researchers to combine elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, and data analysis) for the purposes of comprehensive understanding. Gathering various types of data by using different methods from different sources (such as post graduate students, library staff and faculty) is established

as an effective way of providing a wide range of coverage that may result in understanding and getting a fuller picture of the study (Bonoma, 1985).

4.3.1 Multiple methods approach

In the literature, it is common to find the terms 'mixed method' design, 'multi-method' design and 'multiple methods' design that are very often used interchangeably, though it is important to differentiate these terms (Esteves and Pastor: n.d.). According to Tashakkori and Teddlie (2003:11), multiple methods are defined as "research in which more than one method or more than one worldview is used". The author also defines multiple methods in three key categories namely: multi-method research, mixed method research, and mixed model research. From the analysis of Tashakkori and Teddlie (2003), it is established that the distinction among these terms is linked to the research stage of the study (definition of research questions, research methods, data collection and analysis, and the inference process) where the mix of methods is used. Morse (2003:190) offers the following definitions for multi-method and mixed method designs as follows: Multi-method design is the conduct of two or more research methods, each conducted thoroughly and complete in itself in one project. The results are then triangulated to form a complete whole. Mixed methods design comprises the incorporation of various qualitative and quantitative strategies within a single project that may have either a qualitative or quantitative theoretical drive. The "imported" strategies are supplemental to the key or core method and serve to inform or provide clues that are followed up within the core method (Morse, 2003:190).

In order to accomplish the research aims of this study, a multi-method research framework that combined various research methods both quantitative and qualitative was used. The use of multiple methods increases the sturdiness of results because findings can be strengthened through triangulation; the cross-validation is achieved when different sources of data converge and are found corresponding (Kaplan and Duchon, 1988).

4.4 Research design

The use of surveys is one of the numerous research designs (others include content analysis, experiments, observation and the historical method) employed by researchers to gather information for a study. Surveys encompass the systematic collecting of data by interview, questionnaire and through observation methods (Gray, 2004:99). The survey is the research design adopted for this study because it involves systematically collecting data by interview and questionnaire. Previous authors who have applied survey in related studies include Veiga e Silva, Gonçalves, and Laender (2007). They used empirical methods by applying direct

involvement and observation of users. Ferreira and Pithan (2005) on their part used task performance measures and interviews; and Jagero et al. (2014) used questionnaires, interviews, and indirect observations in related studies. These two studies investigated the usability of the digital library which is similar to this study.

4.5 Population of study and sampling procedure

Kazerooni (2001) states that the target population is a group of individuals that the researcher would like to apply the conclusions, and select a sample. The target population for this study was faculty (academic staff), postgraduate students (Master's and Doctorate), and librarians (library professionals with Library Science qualifications) at the Namibia University of Science and Technology. The total population at NUST was thus 743 (as determined through institutions databases). Saunders, Lewis and Thornhill (2009:219) indicate that with a total population of 743 a sample size of 217 is adequate to provide representativeness (see table 4.1below).

Margin of error				
Population	**5%**	**3%**	**2%**	**1%**
50	44	48	49	50
100	79	91	96	99
150	108	132	141	148
200	132	168	185	196
250	151	203	226	244
300	168	234	267	291
400	196	291	434	384
500	217	340	414	475
750	254	440	571	696
1 000	278	516	706	906
2 000	322	696	1091	1655
5 000	357	879	1622	3288
10 000	370	964	1936	4899
100 000	383	1056	2345	8762
1 00 00	384	1066	2395	9513
10 000 000	384	1067	2400	9595

Table 4.1: Determining sample sizes (Source: Saunders, Lewis and Thornhill, 2012)

Namibia University of Science and Technology					
Schools	**Faculty**	**Masters**	**PhD**	**Librarians**	**System developers**
School of Natural Resources and Spatial Science	47	46	0	11	2
School of Engineering	35	77	1		
School of Computing and Informatics	39	79	25		
School of Health and Applied Science	35	10	0		
School of Human Science	68	0	0		
School of Management Science	70	136	0		
HPG School of Business	13	49	0		
	307	**397**	**26**	**11**	**2**
Total Population	**743**				

Table 4.2: Relative distribution of the population

The relative distribution of the sample sizes of the population is provided in Table 4.3. The sample sizes are based on the population strengths of each population.

Respondents	**Respondents size**	**Relative sample size computation**	**Relative sample sizes**
Faculty	307	307/743x217=	90
Masters	397	397/743x217=	116
PhD	26	26/743/x217=	7
Librarians	11	11/743x217=	3
System developers	**2**	2/743x217=	1
Total population	743		**743**
Total sample	**217**		**217**

Table 4.3: Relative distribution sample sizes

The study applied a purposive sampling technique to sample postgraduate students (Master's and Doctorate students) and librarians (library staff involved in managing the DIR and faculty involved in publishing from all faculties). Snowballing strategy was used to reach out to the target participants. Babbie and Mouton (2001:167) state that "Snowball refers to the process of accumulation as each located subject suggests other subjects". In order to gain access to faculty and students, the researcher made use of faculty offices and study rooms and various university residences intended for postgraduate students. Faculty members were identified through their faculty offices within their departments, and librarians were identified through the library director.

4.6 Data collection methods and procedures

Various data collection methods including survey questionnaire, interviews, observations, document review and heuristic evaluation were employed. Survey self-questionnaires were used to collect data from postgraduate students and faculty, while interviews were administered to librarians.

Non-participatory observation was used to collect data from the library facility. "Observational methods of evaluations are executed by observing how the actual users interacting with the system" (Dix et al., 2004:343). This may be carried out by observing the users in their normal setting, or by asking them to work on a structured task on the computer (Dix et al., 2004:343). The observation should be conducted in a place specially identified for the experiment, such as a usability laboratory, or in the workplace environment, however, this has to be with minimal interference (Preece cited in Ssemugab, 2006). Preece (cited in Ssemugab, 2006) states that observational methods' objectives are:

1. To provide contextual information needed to surround the evaluation and make sense of data collected using other methods.
2. To develop insights into the environment, events, activities, interactions, language used.
3. To learn about sensitive issues that participants may be unwilling to talk about.

In this study, the researcher visited 2 structured labs (mostly used for trainings), 3 unstructured labs (mostly used for student's general work) and the research common (mostly used by PG students and faculty) and internet café where library technical support comes from. The researcher mostly focused on how the users (PG students and faculty) interact with the computers; the observation was mostly on facilities and the internet connections which are seen as enablers of efficiency.

Document review was used to collect data from written documents. Al Kilani and Kobziev (2016), note that documentation is an important tool to most schemes and social research because of its location in the historical circumstances. The document is a way of collecting data and it can be an essential source of any investigation, and an alternative method of collecting information rather than questionnaire survey, interview and observations. There are three reasons that make the documents one of the most useful methods of data collection. First, it is used as inputs to the interview guide and saves time. Second, it is useful for tracing the history of the organisations. Third, it is helpful in counteracting the biases of the interviews. Documents provide the possibility to supplement needed information from other resources and highlight new ideas and insights that need further investigation by a researcher. Documents that may be used for analysis take a variety of forms such as organisational or institutional reports, survey data, and various public records. Scrapbooks and photo albums can also furnish documentary material for research purposes. In this study, the researcher typically reviewed minutes and reports from library files.

Heuristic evaluation was used to collect data through the inspection of the DIR system. The self-administered questionnaire was distributed to postgraduate students and faculty in order to collect data effectively from the dispersed group of respondents on campus. The study sought to capture the feelings, thoughts, opinions and relationships regarding the use and usability of the digital repository from the respondents. Interviews with librarians and observations were conducted as follow ups to provide an opportunity to clarify any issues arising from postgraduate students and faculty members in order to obtain insights into the use and usability of DIR at NUST. In addition to survey questionnaire, interview, observations and document review, this study used the Heuristic Expert Evaluation technique.

4.6.1 Heuristic expert evaluation

According to Dix et al. (cited in Ssemugab, 2006:111), heuristic evaluation is "a usability examination technique, introduced by Nielsen and his counterparts in 1990" in their study. They were guided by the number of usability principles, and evaluated whether a user interface agrees to these principles or criteria. These criteria are referred to as "heuristics". A heuristic is "a standard or general principle that can guide a design decision, or be used to analyse a decision that has already been made" (Ssemugab, 2006:111). Heuristic evaluation is one of the highly recognised and inexpensive techniques for usability assessment of systems (Paddison and Englefield, 2003:126).

Heuristic evaluation works in such a way that a small group of evaluators is required to inspect the interface of the system and judge its agreement with the heuristics. Normally it is possible for a single evaluator to identify all usability shortcomings in a system, though it has been confirmed that different experts (evaluators) identify different usability problems, which may not be generally exclusive. This implies that once different experts are involved with the evaluation of a specific system, it is likely that more problems are exposed. In considering this, three to five evaluators are recommended to be used (Nielsen, 1994).

In addition to the professional HCI, evaluations can be done by evaluators who are knowledgeable in both HCI and in the domain area. Identifying usability problems in a system is the key goal of HE evaluation (Nielsen, 1992:113).

4.6.1.1 Specific domain heuristics

Heuristics usually comes as a result of "academic and professional research studies" taken from "existing criteria lists", or system observations and previous experience in the given domain. Karoulis and Pombortsis, Barber and Preece et al. (cited in Ssemugabi, 2006) suggested four heuristics, namely:

Navigation:

"The system should provide navigational responses so that the user knows where he/she has b een, where he/she is, and the link options he/she has on where to go next. Information should be organized in a hierarchical way, from general to specific, with interrelated information gat hered together, with clear labels on headings and titles". To make it easy to scan content, the s ize of each page should be suitable for the display in order to minimize scrolling.

Physical constraints:

Each target should be easy to reach and manipulate, hence the distances between the target objects such as icons and the sizes of the objects should be appropriate.

Extraordinary users:

The system should be suitable for people with disabilities, for example, "the colour blind, older users, the blind, and dumb". Specific needs, such "as the social and cultural needs of the target group, whether local, national or international, should be considered and addressed" (Karoulis and Pombortsis, Barber and Preece et al. cited in Ssemugabi, 2006:114).

Heuristic evaluation has a number of advantages (Ssemugabi, 2006:119)

1. It ends up with some major improvements to a particular user interface
2. Identifies a number of usability in a short session; a limited number of experts can identify problems.
3. It is easy for evaluators to propose solutions to the usability problems because of t heir experience with many system interfaces.
4. Less costly than methods that involve user testing

- **Expert evaluation methods applied in this study**

The heuristic evaluation approach used in this study was based on the methodology used by Nielsen (1994:38-49) and can be subdivided into the following phases:

1. **Criteria used for Heuristic Evaluation in this study**

The criteria in Table 4.4 below (Heuristic evaluation criteria for web-based system) were used as the heuristics for this evaluation.

	Category 1: General interface design heuristics
1	**System accessibility** The system should include the features of a possibility of visually impaired people to interact with each other through sharing information.
2	**Match between the system and the real world** "The metaphors used should correspond to real world objects and concepts. The system should speak the user's language by using terms, phrases, symbols and concepts familiar to the user" (Ssemugabi, 2006:115). The system should include features of a possibility of visual impaired people to interact with each other through information sharing.
3	**User control and freedom** Users are able to leave the system at any time when they require acting in such away. When they have made errors, there should clear "emergency exits" to leave the unwanted state without having to go through an extended dialogue (Ssemugabi, 2006:115).
4	**Semantic web and linked data**

	The systems should be linked to various systems within the institution to act as a platform of sharing skills and knowledge within the institution.
5	**Consistency and standards** There should be concomitancy in that the same words, situations, or actions refer to the same thing.
6	**Error prevention** The system should be designed to prevent errors from occurring, apart from giving good error messages
7	**Collaboration features** The system should incorporate the interaction forum between various authors across the globe; hence this will improve the knowledge between authors.
8	**Flexibility and efficiency of use** The objects, actions, options, and instructions on how use the system, how to perform tasks should be visible, for example, "they should be bold and/or in large font sizes".
9	**Help users know, identify, and escape from errors** The system should give "error messages" spoken in a simple language. "The messages should indicate precisely what the problem is and suggest constructive solutions" (Ssemugabi, 2006:115).
	Category 2: system-specific design
10	**Navigation** Users should know where they are coming from, where they are and where they are going within the system and the system should provide navigational feedback. Navigational aids and search facilities should be available.

Table 4.4: Criteria used for Heuristic Evaluation in this study (Ssemugabi, 2006:115)

- **Selection of evaluators**

"The Heuristic evaluation criteria for web-based system" (see Table 4.5) were used as the heuristics in this study (Avouris cited in Ssemugabi, 2006). During the process of selection of evaluators, issues considered included how many evaluators would be involved and their individual backgrounds. Based on arguments from Avouris (cited in Ssemugabi, 2006) who

carried out a study to "determine the usability of a Web portal for staff and students of a university department", the authors used eleven expert evaluators. The authors argued that a number of evaluators who are experts in Human Computer Interaction (HCI) would be able to point out the number of usability problems. In this study, a total number of four evaluators were selected, including experts with expertise in user interface design and system analysis. In the selection of evaluators, factors considered are the number of evaluators and their respective backgrounds. Out of four expert evaluators selected only three expert evaluators with expertise in user interface design and system analysis agreed to participate. Table 4.5 presents the profiles of the evaluators that were used in this study.

	Evaluator 1	**Evaluator 2**	**Evaluator 3**
Highest qualification	Masters in Informatics PhD candidate	Honours in IT and Information Systems Masters student	Masters in System Administration
Professional role	Lecturer (NUST)	Software programmer and information system analyst at Telecom Namibia	Lecturer (NUST)

Table 4.5: The profiles heuristic expert evaluators

Evaluator 1 was a lecturer and PhD candidate in the Department of Informatics (NUST) and was specialised in databases interface design; Evaluator 2 was a software programmer and information system analyst at Telecom Namibia. Evaluator 3 was a Masters student and lecturer in the Department of Information Systems (NUST), and majored in Educational Information Systems. All evaluators were males and both had a background in databases and system design.

- **Briefing the evaluators**

Normally, evaluators should be briefed about the HE method (Levi and Conrad, 1996:54; Nielsen, 1994:39). In this study, evaluators were also briefed about the HE method. As recommended by Nielsen (1994:40), each of the three expert evaluators conducted evaluation independently. All the necessary documents for evaluation were sent to them via e-mail. The expert evaluators were also asked to evaluate other general features of the DIR system. A two-week period was given to the evaluators during which they could access the NUST DIR in order to evaluate the application. The three evaluators completed their assessment within the

specified period of time. Following discussions with the rest of the evaluators, it was decided that the researcher would be present during the evaluation process as an observer and also to answer any questions. This enabled the evaluator to concentrate on identifying and pointing out the usability problems, while the researcher noted them down and the researcher was available to clarify issues as they happen. The evaluators also wrote down their comments of the assessment sheet (appendix 7). At the end of evaluations, the severity rating of the usability problems were identified.

- **Actual evaluation**

HE is often conducted in formative evaluation during development stages. But in this study it was done on an operational application so as to compare the results of evaluation by three different methods applied in this study (interview, questionnaire, observation and heuristic evaluation) on exactly the same system. It was stated in Ssemugabi (2006) that the "severity of each problem during the HE process is rated by expert evaluators who can rate at the later stage when problems from all the evaluators have been aggregated". In this study, the scores from the different evaluators were then averaged to conclude the final severity of a problem. It was discovered in a study by Nielsen (1994:49) that "this approach is dependable, since any given evaluator's severity rating of a usability problem is independent of whether a particular evaluator had identified the problem or not". Table 4.6 below shows the 5-point rating scale that Pierotti (1996) used to assign severity to the problems. In this study the scaling letter N stands for Not Applicable, which means "I don't consider this to be a problem", thus the letter 'N' is entered. This scale is comparable to that used by Albion (1999) in an HE of educational multimedia, where 5 is outstanding and 1 is poor, with an additional rating of NA for "Not Applicable". Each problem was accompanied by a weighting showing how many experts had identified that problem. The problems for each criterion were grouped in descending order according to the number of experts by whom it had been identified.

Description	Score
Cosmetic problem: will not affect the use of the system. Fix it if possible.	1
Minor problem: users can easily work around the problem. Fixing this should be given a low priority.	2
Medium problem: users are likely to encounter this problem but will quickly adapt to it. Fixing this should be given medium priority.	3
Major problem: users will find this problem difficult but may be able to find workarounds. It is important to fix this problem. Fixing it should be given a high priority.	4
Catastrophic problem: users will be unable to do their work because of this problem. Fixing it is mandatory.	5
Not Applicable: I don't consider this to be a problem.	N

Table 4.6: Five-point rating scale for severity of usability problems (Pierotti, cited in Ssemugabi, 2006)

4.7 Data analysis

The Statistical Package for the Social Sciences (SPSS) for Windows™ software was used to analyse quantitative data collected through questionnaires and heuristic evaluation. The exploration, presentation, description and examination of relationships and trends within research data was made possible through quantitative tools such as graphs, figures and tables were used. Qualitative data gathered from interviews, library observation, and documents analyses were analysed using content analysis. Data were transcribed, coded, grouped into categories, and interpreted thematically.

4.8 Validity and reliability of instruments

Reliability of instruments was achieved by adopting survey questionnaires that have been successfully used to investigate usability and the use of electronic information systems such as DIR in several universities, such as Jagero et al.'s (2014), which was used to assess usability of the Africa University Digital Library in Mutare, Zimbabwe. The inspection of the

instruments by experts prior to data collection was also done to achieve reliability. Additionally, validity was achieved via a cautious assortment of a representative sample and data analysis as well as via the usage of triangulation (comparing data from faculty and postgraduate students with data from librarians) in order to encourage multiple ways of truth establishing (Golafshani, 2003). Similarly, the study adopted previously used instruments for reliability and validation of Heuristics evaluation collected data; for example, Ssemugabi (2006), for assessing the usability evaluation of a web-based e-learning application.

The reliability of instruments was also achieved through pretesting to ensure that they are worded correctly in an effort to evade misunderstandings by participants. The researcher carried out a pilot study with 12 respondents that were not part of the study population in order to discover inadequacies in the design of the questionnaire and ensure they were correctly worded. From the pre-test, respondents commented on issues such as the length of the questionnaire and interview instruments; some suggested that the questionnaire should be abridged so that the participants would not be tired in the process. This pilot study and the pre-testing of the data collection instruments were done at the University of Namibia. Eight postgraduate students, three faculty members, and one librarian were involved. After the pretesting, interview questions in the interview schedules were modified to clarify the meaning of concepts. Similarly, using feedback from the pre-testing of the study and observation by the researcher throughout the process, a final questionnaire was compiled before the actual data collection.

4.9 Ethical considerations

With regards to ethical considerations, the study conformed to University of KwaZulu-Natal research ethics protocol. In addition, permission to carry out the study was required from the Vice Chancellor of the Namibia University of Science and Technology. A consent form was also handed out and completed by participants who were informed of what the study was about, their rights and obligations. They were also guaranteed that their confidentiality and anonymity would be assured. Anonymity was ensured by the participants not being asked to give their names. The participants were free to withdraw at any point of the study if they so wished without any reproach.

4.10 Summary

This chapter covered the following research aspects: research methodology and methods, research paradigms, research approaches, multiple methods approach, research design,

population of study and sampling procedure, data collection tools, reliability and validity of data collection tools, data collection methods and procedures, data analysis, approaches to information system evaluation, ethical considerations, and summary. The next chapter presents the findings of the study.

CHAPTER FIVE

PRESENTATION OF RESULTS

5.1 Introduction

This chapter presents the research findings. The findings are drawn from survey questionnaires**,** interviews, observation, and heuristic expert evaluation. The respondents were masters and PhD students and faculty at the Namibia University of Science and Technology. In addition, librarians and system developers were also included.

The aim of this study was to investigate the uusability of Digital Institutional Repositories (DIRs) by PG students and faculty at NUST. The study was underpinned by the Technology Acceptance Model (TAM). Data obtained from the survey questionnaires (see appendices 1 and 2) and Heuristic evaluation (see appendix 5), were coded, analysed, interpreted, and presented using frequency tables, graphs, and charts. Descriptive data gathered through interview schedules (see appendix 3), document analysis and library observations (appendices 6 and 7 respectively) were analysed and presented in the form of tables, figures as well as narratives and verbatim statements from the respondents. Quantitative data collected through questionnaires and heuristic evaluation were analysed using the Statistical Package for the Social Sciences (SPSS) for Windows™ software. The study used graphs, figures and tables to explore, present, describe and examine relationships and trends within research data. Qualitative data gathered from interviews, library observation and document analysis were analysed using content analysis. Data were transcribed, coded, grouped into categories, and interpreted thematically (see section 4.7).

The use of multiple methods (triangulation) of presenting and discussing results is a powerful technique that facilitates validation through cross verification of data collected through two or more sources (Bogdan and Biklen, 2006).

The findings are presented on the following substantive themes: attitudes and perceptions towards digital repositories, self-archiving, usability of digital repositories, perceived usefulness, perceived ease of use, domain knowledge, relevance of search output, system interoperability, computer self-efficacy, screen design, and level of satisfaction with digital repositories. The findings are preceded by presentation of response rates and demographic profile of respondents. Regarding the response rate, of the 217 copies of questionnaires

distributed to Masters and PhD students as well as faculty, 148 were returned giving a response rate of 68.2%. In addition, three librarians and one system developer were interviewed.

5.2 Demographic and academic profiles of respondents

Respondents were asked questions that drew their personal information, such as gender, age, and faculty of affiliation (see appendices 1 and 2 respectively). These biographical and academic data were used to describe the demographic profile of respondents who participated in the study.

5.2.1 Gender

The respondents were asked to specify their gender. The results illustrated in Table 5.1(a) show that there were 58 (52.7%) female and 52 (47.3%) male respondents. Similarly, faculty respondents were asked to specify their gender as well. The results show that there were 20 (52.6%) male and 18 (47.4%) female respondents. The results are presented in Table 5.1(b) respectively.

Table 5.1(a): PG students gender of respondents (n=110)

Students		Percent
Frequency		
Female	58	52.7
Male	52	47.3
Sub total	110	100

Table 5.1(b): Faculty gender of respondents (n=38)

Faculty		Percent
Frequency		
Male	20	52.6
Female	18	47.4
Total	38	100

5.2.2 Age

The PG students were asked to indicate their age range (Table 5.2a). The results revealed that the highest number of student respondents 54(49.1%) were between 31 and 40 years of age.

The lowest number of PG students were between 20 and 30 years as represented by 38 (34.5%) respondents and respondents between 41 and 50 years of age were 18 (16.4%).

Faculty were also polled to determine their age range. The highest number of respondents was 16 (45.6%) between 40 and 50 years of age, while between 51and 60 years and older they were 13(37.6%). The lowest number of respondents was between 31 and 40 years at 5 (14.2%) and between 20 and 30 years there was 1 (2.6%) respectively. The results are reflected in Table 5.2 (a) and 5.2 (b) respectively.

Table 5.2(a): Students Age distribution (n=110)

Students	Frequency	Percent
31-40 Years	54	49.1
20-30 Years	38	34.54
41-50 Years	18	16.36
Sub-Total	110	100

Table 5.2(b): Faculty Age distribution (n=38)

Faculty Frequency		Percent
40-50 years	16	42.1
60 years and older	13	34.2
31-40 years	5	13.2
51-60 years	3	7.9
20-30 years	1	2.6
Total	38	100

5.2.3 Faculty of affiliation

The PG students were asked to specify their faculties. The results illustrated in Table 5.3a show that 32 (29.1%) respondents, or the majority were from the Faculty of Informatics, followed by the HPG School of Business with 24 (21.8%), Faculty of Management Sciences with 16 (14.5%), School of Human Sciences with 16(14.5%), Faculty of Engineering with 12(10.9%), Faculty of Natural Resources and Spatial Sciences with 8(7.3%), and Faculty of Health and Applied Sciences with 2(1.8%).

Moreover, faculty members were asked to specify their faculty of affiliation. The results, illustrated in Table 5.3b show that the majority represent by 13 (34.2%), are from Faculty of Human Sciences, followed by those from the Faculty of Natural Resources and Spatial Science with 10 (26.3%). In addition, the Faculty of Engineering were 4 (10.5%) and 3 (7.9%) were affiliated to the Faculty of Computing and Informatics, while HPG School of Business were 3 (7.9%). Furthermore, the Faculty of Health and Applied Science had 3 (7.9%) and the Faculty of Management Science had 2(5.3%). The results are presented in Tables 5.3 (a) and 5.3 (b) respectively.

Table 5.3(a): Students of affiliation (n=110)

	Students Frequency	**Percent**
Faculty of Computing and Informatics	32	29.1
HPG School of Business	24	21.8
School of Human Sciences	16	14.5
Faculty of Management Sciences	16	14.5
Faculty of Engineering	12	10.9
Faculty of Natural Resources and Spatial Sciences	8	7.3
Faculty of Health and Applied Sciences	2	1.8
Sub Total	110	100

Table 5.3(b): Faculty of affiliation (n=38)

	Frequency Faculty	**Percent**
School of Human Sciences	13	34.2
Faculty of Natural Resources and Spatial Sciences	10	26.3
Faculty of Engineering	4	10.5
Faculty of Computing and Informatics	3	7.9
HPG School of Business	3	7.9
Faculty of Healthy and Applied Sciences	3	7.9
Faculty of Management Sciences	2	5.3
Sub Total	38	100

5.2.4 Programme of study

The PG students were asked to specify their programme of study. The results in Table 5.4, show that the majority at 100 (90.9%) were Masters Students and the minority at 10(91%) were PhD students respectively.

Table 5.4: Programme of study (n=110)

		Frequency	Percent
	Masters	100	90.9
	PhD	10	9.1
	Total	110	100

5.2.5 Job category

The faculty were asked to indicate their job category. The results in Table 5.5 show that 17 (44.7%) were lecturers, followed by Senior Research fellows with 5 (13.1%) and 5 (13.1%) were Research fellows, whereas Professors were 4 (10.5%), Associate Professors 2 (5.3%), deputy director/Lecturer 1(2.6%) and others 4 (10.5%).

Table 5.5: Job category (n=38)

		Frequency	Percent
	Lecturer	17	44.7
	Research fellow	5	13.1
	Senior Research fellow	5	13.1
	Professor	4	10.5
	Others	4	10.5
	Associate Professor	2	5.3
	Deputy Director	1	2.6
	Total	38	100

5.3 Attitudes and perceptions towards digital institutional repositories

According to Vänninen (2009:107), attitude means "a complex mental state involving beliefs and feelings and value dispositions to act in certain ways". Hence, the extent to which researchers favour the DIR may have an impact on their contribution to it. Attitude is one of the constructs of TAM that is understood to have an impact on the behavioural intention of users to use a technology. This study was grounded on the conjecture that attitude towards DIRs will have a positive impact on the intention to use the DIR. The study integrated the theory of reasoned action (TRA), performance expectancy from UTAUT and technology acceptance model (TAM) to understand how attitude influences the use of DIR.

5.3.1 Attitudes of PG students and faculty towards DIR

PG students either agreed or strongly agreed that open access or DIR was beneficial. The results revealed that 67 (60.9%) strongly agreed, 36 (32.7%) agreed that exposure of work via DIR increases work cited and another 7 (6.4%) were neutral. In addition, 63 (57.3%) strongly agreed and 43 (39.1%) agreed that sharing one's work with peers and research community is a benefit, while 3 (2.7%) were neutral, and 1 (0.9%) disagreed. Sixty-one (55.5%) agreed and 45 (40.9%) strongly agreed that open access of research is beneficial, while 4 (3.6%) were neutral. The findings suggest that the majority of PG students agree that there are gains from self-archiving research performance, thus increasing their personal merits. The results are presented in Table 5.6.

Table 5.6: Advantages of DIR to the PG students (n=110)

Advantage	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Sharing the work publicly	51(46.3%)	53(48.2%)	4(3.6%)	0(0.0%)	2(1.8%)
Ease of sharing of work with other students	57(51.8%)	48(43.6%)	3(2.7%)	0(0.0%)	2(1.8%)
Sharing of work with peers and research community	63(57.3%)	43(39.1%)	3(2.7%)	0(0.0%)	1(.9%)
Exposure of work via DIR increase work cited	67(60.9%)	36(32.7%)	7(6.4%)	0(0.0%)	0(0.0%)
Availability of work on Google scholar	47(42.7%)	49(44.5%)	13(11.8%)	0(0.0%)	1(.9%)
Long term perseverance of digital copy of research	51(46.4%)	51(46.4%)	8(7.3%)	0(0.0%)	0(0.0%)
Open access of research	61(55.5%)	45(40.9%)	4(3.6%)	0(0.0%)	0(0.0%)
Professional networking	57(51.8%)	51(46.4%)	2(1.8%)	0(0.0%)	0(0.0%)
Enhancement of university DIR research profile	50(45.5%	43(39.1%)	4(3.6%)	12(10.9%)	1(.9%)
Enhancement of self-research profile	45(40.9%)	47(42.7%)	8(7.3%)	8(7.3%)	2(1.8%)
Track record of research	44(40.0%)	46(41.8%)	17(15.5%)	0(0.0%)	3(2.7%)
Availability of research without website creation	34(30.9%)	54(49.1%)	6(5.5%)	13(11.8%)	0(0.0%)
Availability of types of materials not been available via traditional publishing process	43(39.1%)	58(52.7%)	6(5.5%)	2(1.8%)	1(.9%)
DIR allows searching of most current research findings of the university	61(55.5%)	42(38.2%)	7(6.4%)	0(0.0%)	0(0.0%)

Availability of research is faster than traditional publishing process	54(49.1%)	40(36.4%)	15(13.6%)	0(0.0%)	1(.9%)
Easiness to search and locate the work	47(42.7%)	47(42.7%)	4(3.6%)	12(10.9%)	0(0.0%)

Responses from faculty showed that 17 (44.7%) strongly agreed that they find it easy to share their work with the general public; ten other respondents (26.3%) agreed, while 9 (23.7%) held a neutral position and only 2 (5.3%) disagree that their work could be shared easily with the public through the DIR. Regarding how the DIR aids in enhancing their personal profiles, 18 (47.4%) of the faculty respondents strongly agreed, while 15(39.5%) agreed and 4 (10.5%) were neutral and only 1(2.6%) disagreed on the role of the DIR in enhancing their personal profiles. More so, there was a strong agreement by 17(44.7%) respondents that another equally important benefit of the DIR is that respondents can rely on it for the long-term preservation of their digital materials; 13 (34.2%) agreed, 7 (18.4%) were neutral and only1 (2.6%) disagreed. A couple more questions were posed to the faculty respondents and there was a clear and strong agreement from the respondents that there are numerous positive benefits associated with using the DIR; in some cases, the respondents only agreed and a few of the respondents held a neutral position, while very few disagreed with the supposed benefits of the DIR. A comprehensive expression of responses by participants to the different questions is presented in Table 5.7.

Table 5.7: Attitudes of faculty towards repository archiving (n=38)

Attitudes towards self-archiving	**Strongly agree**	**Agree**	**Neutral**	**Strongly Disagree**	**Disagree**
I can share my work with the public more easily	17(44.7%)	10(26.3%)	9(23.7%)	0 (0.0%)	2 (5.3%)
I can share my work with my peers and the research community	18 (47.4%)	13(34.2%)	6(15.8%)	0(0.0%)	1(2.6%)
It will give my work more exposure	15 (39.5%)	14(36.8%)	9(23.7%)	0(0.0%)	0(0.0%)
It will increase the number of times my work is cited	13 (34.2%)	16(42.1%)	8(21.1%)	0(0.0%)	1(2.6%)

Attitudes towards self-archiving	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
My work will be available on Google Scholar	13 (34.2%)	13(34.2%)	11(28.9%)	0(0.0%)	1(2.6%)
I can get feedback and commentary on my research	13 (34.2%)	15(39.5%)	10(26.3%)	0(0.0%)	0(0.0%)
I can rely on the university to preserve a digital copy of my research for a long term	17 (44.7%)	13(34.2%)	7(18.4%)	**0(0.0%)**	1(2.6%)
DIR removes cost as a barrier to accessing research (and allows public access to research and information).	16(42.1%)	16(42.1%)	5(13.2%)	1(2.6%)	0(0.0%)
Enables professional networking	15(39.5%)	19(50.0%)	4(10.5%)	0(0.0%)	0(0.0%)
Enhancement of research profile of the university	18(47.4%)	15(39.5%)	4(10.5%)	**0(0.0%)**	1(2.6%)
Enhancement of personal profile	17(44.7%)	15(39.5%)	5(13.2%)	**0(0.0%)**	1(2.6%)
Recommendation for research	12(31.6%)	17(44.7%)	8(21.1%)	**0.0%**	1(2.6%)
Track record of research	16(42.1%)	16(42.1%)	5(13.2%)	1(2.6%)	0(0.0%)
Provide long-term preservation of my digital research materials	17(44.7%)	17(44.7%)	4(10.5%)	0(0.0%)	0(0.0%)
Makes my research available with very little effort on my part and without my having to maintain a website of my own	14(36.8%)	19(50.0%)	5(13.2%)	0(0.0%)	0(0.0%)
Makes it easy for other people to search for and locate my work	14(36.8%)	18(47.4%)	5(13.2%)	0(0.0%)	1(2.6%)

Attitudes towards self-archiving	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Allow me to search the DIR for the most current research findings of my institution	14(36.8%)	20(52.6%)	4(10.5%)	0(0.0%)	0(0.0%)
It makes my research available faster than the traditional publishing process	12(31.6%)	19(50.0%)	7(18.4%)	0(0.0%)	0(0.0%)
Makes available types of materials that have not been made available through the traditional publishing process.	10(26.3%)	20(52.6%)	8(21.1%)	0(0.0%)	0(0.0%)

From the interviews, librarians noted that they were motivated that the DIR can be accessed throughout the world. They also further noted that one can come across or encounter new things that were not envisaged but useful. Moreover, the DIR enables one to learn about what is actually going on from conferences.

5.3.2 Motivation for contributing to the DIR

According to the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980), normative beliefs and motivation to comply would affect subjective norms. Subjective norm refers to the perceived social pressure to perform or not to perform certain behaviour. It is also an individual's perception that those who are important to him or her would approve or disapprove the performance of a given behaviour (Ajzen, 1991).

The researcher sought to know from postgraduate students what motivated respondents to contribute their research work to the DIR. The results in Table 5.8 show that 77 (46.4%) noted that they were motivated by the need to increase the accessibility of their work, while 33 (19.8%) mentioned creating research work publicity and research community impact; 32 (19.8%) said that they were motivated to contribute as this would enable them to know how many times their research was viewed or downloaded by others; and 23 (14.5%) noted that they contributed when they were told to do so. The extent or the degree to which a postgraduate

student is motivated to contribute their work to the DIR is further represented in percentages in the following table.

Table 5.8: PG students' motivation for contributing to the DIR (n=166)

Motivations		**Responses**	
		n	Percent
What reasons will motivate you to contribute?	Increase accessibility of work	77	46.4%
	Create publicity for research work and impact on research community	33	19.8%
	If the DIR shows how many times my materials in the IR were viewed and downloaded	32	19.8%
	When told to contribute	23	14.5%
Total		166	100%

Faculty were similarly asked to state what motivated them to contribute their research work to the DIR. The results in Table 5.9 show that the highest number of respondents at 28 (34.1%) indicated that they were motivated by the need to increase accessibility of their research work; 26 (31.7%) indicated that contributing to the institutional repository creates publicity for their research work, 11(13.4%) indicated that the DIR facilitates the coordination of interdisciplinary teaching and research efforts, ten (12.1%) noted that the IR shows how many times materials in the IR were viewed and downloaded; however, the lowest number at 6(7.3%) indicated that they only contributed when told to do so.

Table 5.9: Motivation for faculty to contribute to the DIR (n=82)

		Responses	
		n	Percent
What motivates you to deposit in the DIR?	Increase accessibility of my research work	28	34.1%
	Create publicity for my research work and impact on research community	26	31.7%
	Facilitates the coordination of interdisciplinary teaching and research efforts	11	13.4%
	If the IR shows how many times my materials in the IR were viewed and downloaded	10	12.1%
	When told to contribute	6	7.3%
Total		82	100%

5.3.3 Factors hindering contribution to the DIR

Based on subjective norm constructs from the TRA, respondents were asked to state what demotivates them from using the DIR. The results shown in Table 5.10 reveal the highest number of PG students at 17(19.7%) that feared the misuse of their work, 16 (16.6%) indicated lack of information about the DIR, 11(17.7%) experienced conflict with publisher policies related to archiving, 11(12.7%) indicated extra effort required, 8 (9.3%) stated lack of rewards, 8 (9.3%) noted complexity and difficulties posed in the system; lack of skills was indicated by 8 (9.3%), while some indicated the nature of research which did not allow them to publish in the DIR at 7 (8.1%); and 6 (6.9%) cited that they found the other modes of information dissemination redundant.

Table 5.10: Factors hindering PG students' contribution to the DIR (n=86)

		Responses	
		n	Percent
Reasons for not contributing to DIR?	Fearing for misuse of work	17	19.7%
	Lack of information to submit	16	16.6%
	Conflict with publishers' policies with regards to authors' issues related to archiving	11	17.7%
	Extra time and effort required	11	12.7%
	Lack of rewards	8	9.3%
	Complexity and difficulties	8	9.3%
	Lack of skills	8	9.3%
	Nature of research does not allow to publish on DIR	7	8.1%
	Redundancy with other modes of information dissemination	6	6.9%
Total		86	100%

Similarly, faculty were also asked to state the reasons why they felt demotivated to contribute their work to the DIR. The results in Table 5.11 show that 5 (20.8%) indicated that they feared misuse of their work (copyright, plagiarism, infringement, etc.), 4 (16.4%) noted that depositing in the DIR is in conflict with publisher policies, 4 (16.4%) indicated that they lacked information on how to submit their work to the DIR, 4 (16.7%) indicated lack of information about how to submit research work to the DIR, 3 (12.5%) alluded to redundancy with other modes of disseminating information; lack of rewards on submission to DIR was indicated by 2 (8.3%), lack of skills to use the system was also indicated by 2 (8.3%), whilst another 1(4.2%) thought that the DIR is only for disseminating students' masters theses and dissertations, while complexity and difficulty to use the system was indicated by 1(4.2%) and the additional time and effort required for self-archiving were highlighted by only 1(4.2%).

Table 5.11: Factors hindering faculty contribution to the DIR (n=24)

		Responses	
		n	Percent
Why are you not contributing to the DIR?	Fearing for misuse of my work (for example copyright, plagiarism, infringement, etc.)	5	20.8%
	Conflict with publisher policies with regards to author issues related to archiving	4	16.7%
	Lack of information to submit my research work to the DIR	4	16.7%
	Redundancy with other modes of information dissemination	3	12.5%
	Lack of rewards on submission to the DIR	2	8.3%
	Lack of skills to use the system	2	8.3%
	DIR is only to disseminate students' master's thesis and dissertations	1	4.2%
	Nature of my research work does not allow me to publish on the DIR (ex. co-authoring, versioning)	1	4.2%
	Complexity and difficulty to use the system	1	4.2%
	Additional time and effort required from me to perform self-archiving	1	4.2%
Total		24	100%

To validate the findings obtained through survey questionnaire, the researcher carried out the library observation along with document review, and by using the facilitating condition construct, the study aimed to measure how the institution's administration supports and encourages the PG students and faculty to use the DIR. Facilitating conditions are perceived as enablers or barriers in the environment that influences a person's perceptions of ease or difficulty of performing a task. In this study, facilitating conditions were skills training, information or available materials, and administrative support, which influenced the use of instructional technologies in teaching (Teo, 2010).

During the library observation and document review, it was found that in addition to general user education services, an information literacy programme was introduced in the library in 2007. This programme was launched because library management acknowledged the need to assist the users to use ICTs that are available to them optimally. The literacy programme was carried out in different ways such as group training in an electronic classroom, communication skills classes for 6 weeks during each semester; online searching and retrieval, preparing and executing a search strategy and utilising search tools.

5.3.4 Free access to scholarly research

The construct attitude from TAM was used to measure PG students' and faculty's opinions on free access to scholarly research. All respondents were asked either to agree or to disagree whether research output of NUST should be freely accessible through the Institutional Repository. The results in figure 5.1 below show that 60 (43.5 %) agreed with the statement, whereas 48 (34.8%) strongly agreed, 26 (18.89%) were neutral, and 4(2.97%) disagreed.

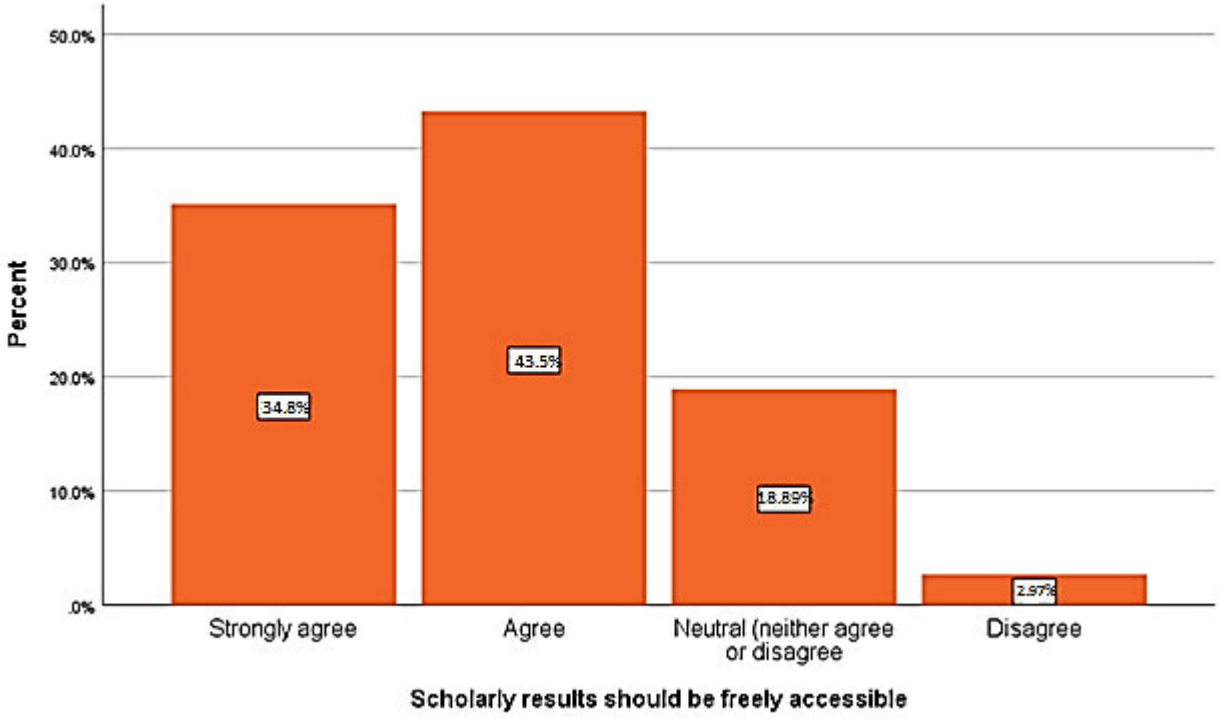

Figure 5.1: PG students' and faculty's opinions on free access to scholarly research (n=138)

5.4 Self-archiving

In this study, self-archiving means how the authors deposit the items in the repository by themselves rather than someone doing it on their behalf. Harnad (2001) describes self-archiving as the act of (the author's) depositing a free copy of an electronic document on the

Internet, or more specifically on the World Wide Web to provide open access to it. The term usually refers to the self-archiving of peer-reviewed research journals and conference articles, as well as theses and book chapters deposited in the author's own institutional repository or open archive for the purpose of maximising its accessibility, usage and citation impact (see also section 1.10.9).

Wirba Singeh, Abrizah, and Harun Abdul Karim (2013) investigated Malaysian authors' acceptance of self-archiving in institutional repositories using the Unified Theory of Acceptance and Use of Technology (UTAUT) and TAM models. Both models focus on performance expectancy, effort expectancy, social influence, and facilitating conditions on using technology. According to the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980), attitudes and subjective norms would affect an individual's intention, and intention has influence on behaviour in sequence. In this study, "facilitating condition" and "behavioural intention" (see UTAUT) were used to measure the extent to which PG students and faculty at NUST are: a) archiving their research output in the DIR, b) using content in the DIR.

5.4.1 Previous experience on DIR contribution

By using behaviour constructs from UTAUT, the PG students were asked if they have in the past submitted their scholarly work to the Digital Institutional Repository at NUST. The results showed that 9 (10.91%) of the students had previously contributed digital materials to the DIR, 73 (89.09%) had never contributed to the DIR. The high number of non-contributors could be attributed to the fact that most of them were master's students who were focusing on completing their theses.

Faculty respondents were similarly asked if they had deposited their scholarly work into the Digital Institutional Repository at NUST. The results showed that 25 (71.4%) had previously deposited into the repository, while 10(28.6%) had not.

During the interview, the librarians were asked how they rated the growth of the DIR in the institution. Librarian A noted the growth as being slow because some researchers were reluctant to submit their scholarly work to the repository. Librarian B concurred that the growth of the repository was slow because this depended on the output of lecturers depositing into it. Librarian B further added:

> "*If the level of research in the institution was high obviously the repository would grow. The DIR growth is predicated on the research activities within the institution. Currently the research in the institution is low, compounded by the fact that not every*

researcher submits their work to the library for uploading into the DIR. Some researchers prefer other platforms for depositing their research work.

5.4.2 Preferences in submitting research work to open repositories

By using the behaviour intention construct from UTAUT, faculty were asked to state their preferences in submitting their research work to institutional repositories. The results in **Table 5.12** below show that the highest number of faculty amounting to 8 (32.0%) deposited their research in the DIR, followed by 7 (28.0%) who submitted their work to the Print Institutional Repository and 3(12.0%) who submitted their research work to professional/ research group open access websites, 5(20.0%) that submitted their work to departmental websites/portals, and those who preferred to submit their research work in subject repository were 2 (8.0%).

Table 5.12: Faculty preference in submitting research work to open repositories (n=25)

		Responses	
		N	Percent
Where do you prefer to submit?	Digital institutional repository	8	32.0%
	Institutional print repository	7	28.0%
	University/department website	5	20.0%
	To professional/ research group open accessed website	3	12.0%
	Subject repository	2	8.0%
	Personal webpage	0	0.0%
Total		25	100%

5.4.3 Intention to contribute scholarly work to DIR

By using the behaviour intention construct from TAM, the PG students who stated that they did not contribute materials to the DIR were asked whether they planned to contribute materials in future. The results in figure 5.2 showed that the majority as represented by 46 (63.1%) respondents said that they are planning to do so, followed by 21(28.7%) who were undecided, while 6(8.2%) were not planning to contribute to the DIR.

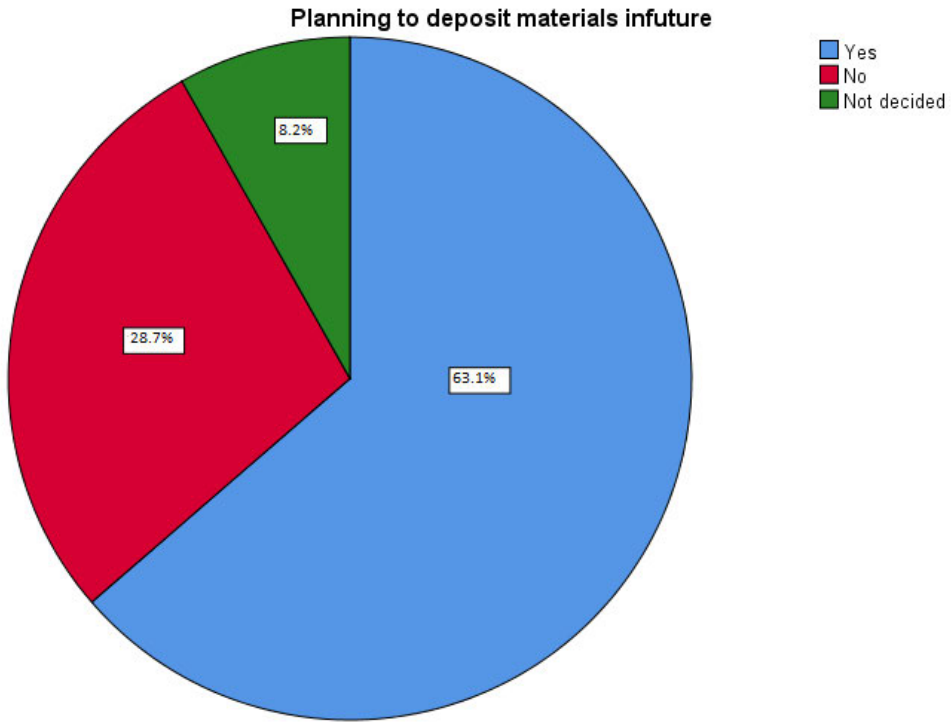

Figure 5.2: PG students' intention to contribute materials to the DIR (n=73)

Faculty were similarly asked if they planned to submit their research output to the institutional repository in the future. The results in figure 5.3 below show that the highest number of respondents at 15 (39.5 %) indicated that they are planning to contribute their publications to the repository, followed by 12 (31.6 %) who were undecided. Nine (23.7 %) indicated that contributing to the repository does not apply to them and only 2 (5.2 %) said they were not planning to contribute their publications to the repository.

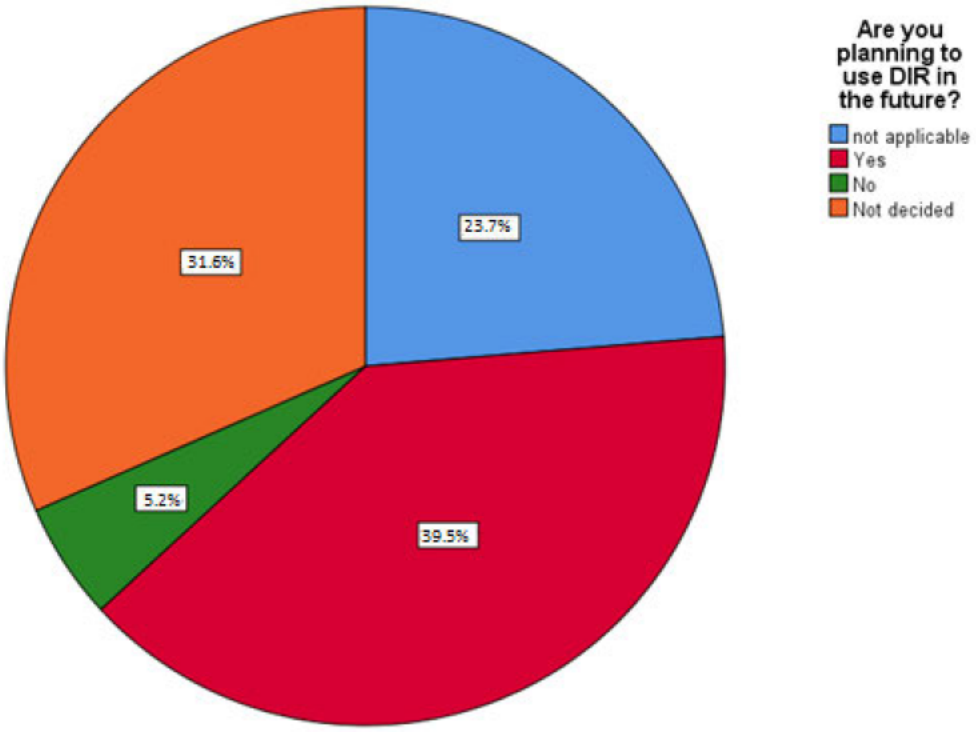

Figure 5.3: Faculty's intention to contribute scholarly work to NUST's DIR (n=38)

5.4.4 Mandatory and voluntary submission policy

There was a high level of willingness to comply with the voluntarily submission policy by respondents. Results as shown in table 5.13 revealed that 53 (48.1%) strongly agreed, 41(37.2%) agreed, 5 (4.5%) were neutral and 10 (9.0%) strongly disagreed, while 1 (1.2%) disagreed with the voluntary submission policy. Forty (36.4%) strongly agreed with the mandatory submission policy, while 39 (35.5%) agreed, 10 (9.1%) were neutral, 19 (17.3%) strongly disagreed, while 2 (1.7%) disagreed.

Table 5.13: PG students' opinion on mandatory and voluntary submission policy (n=110)

	Frequencies and percentage				
	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Prefer Voluntary submission	53(48.1%)	41(37.2%)	5(4.5%)	10(9.0%)	1(.9%)
Prefer a mandatory submission policy	40(36.3%)	39(35.4%)	10(9.0%)	19(17.2%)	2(1.8%)

Twelve (31.7%) of the faculty agreed to comply with the mandatory policy, 10 (26.3%) strongly disagreed, 8 (21.0%) were neutral, 4 (10.5%) disagreed, and 4 (10.5%) strongly disagreed with the mandatory policy. Faculty were asked whether they preferred the mandatory or voluntary submission policy. The results in figure 5.4 show that the highest number of respondents at 19 (50%) strongly agreed with the voluntary submission policy, followed by 9 (23.7%) who agreed and 7 (18.4%) were neutral, 2 (5.3%) disagreed and 1(2.6%) strongly disagreed with the voluntary submission policy (see Figure 5.4 below).

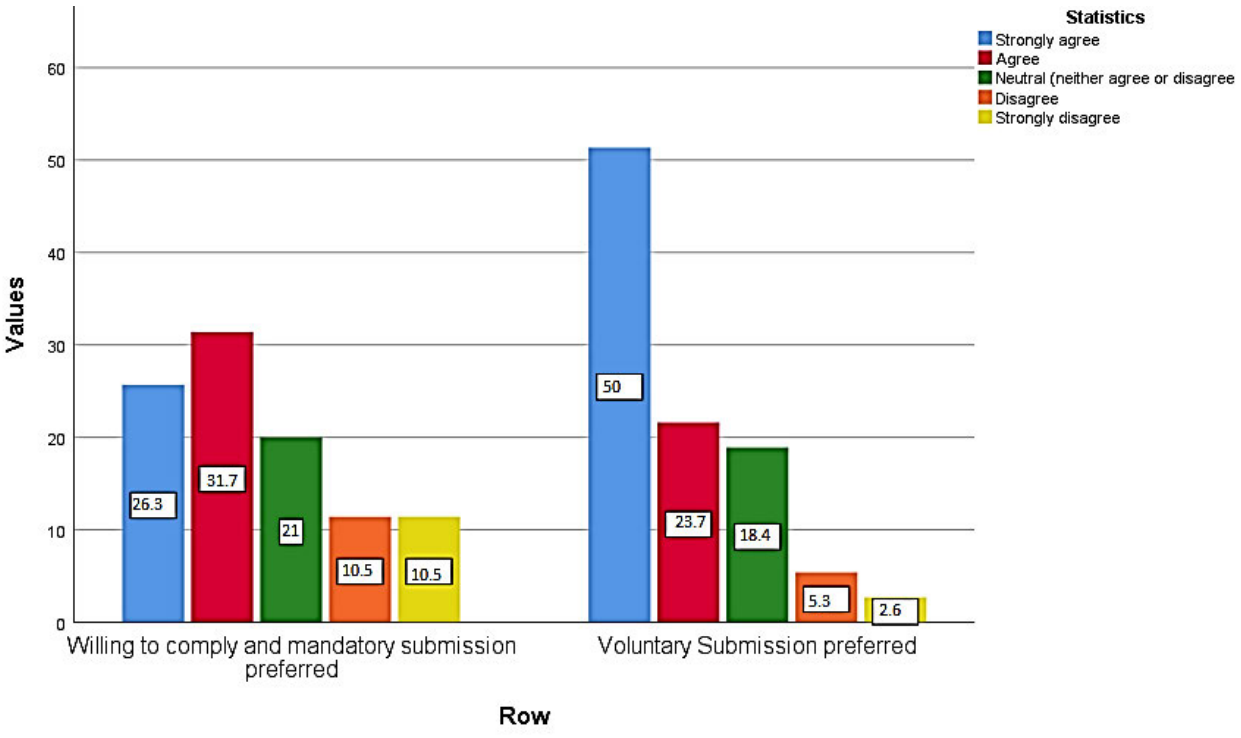

Figure 5.4: Mandatory and voluntary submission policy: Faculty response (n=38)

Moreover, the researcher sought to know whether respondents were aware of the institution having the archiving policy. Librarian A responded that they were not aware if the institution had an archiving policy; however, librarian B responded that she was aware that there is an institutional repository policy in place but was not sure about the archiving policy. Librarian B was also not sure when the policy was implemented. The researcher further sought clarification on how the policy guided the archiving or uploading of the documents into the DIR. The librarian respondent indicated that:

> "*I am aware the archiving policy is pretty clear on what is expected from us when we are uploading documents and archiving documents for the researchers."*

The respondents were further asked to explain how the policy guided the archiving and submission/depositing of the materials into the DIR and whose responsibility it was to upload items. It was revealed that the policy only allowed faculty librarians to upload the materials into the repository. The respondents also indicated that the institution relies on voluntary submissions, where the authors voluntarily submit their research work to the library for uploading in the DIR.

5.4.5 Using DIRs for accessing content

By using use behaviour and actual use constructs from TAM, postgraduate students were asked if they ever used the DIR for accessing information. The results showed that most of them as represented by 67(61%) respondents, have never used the DIR for accessing information, and only 43 (39%) respondents have used it.

- **Tools used to access research output**

PG students were asked what tools they used to access research output in their institution. Results in figure 5.5 indicate that the highest number of respondents (30, 36.6%) used Google scholar, followed by Google (23, 28.0%). Others used library shelves (10, 12.2%), NUST e-resources databases (16, 19.6%), and those who access the DIR indirectly through other modes were only 3 (3.6%).

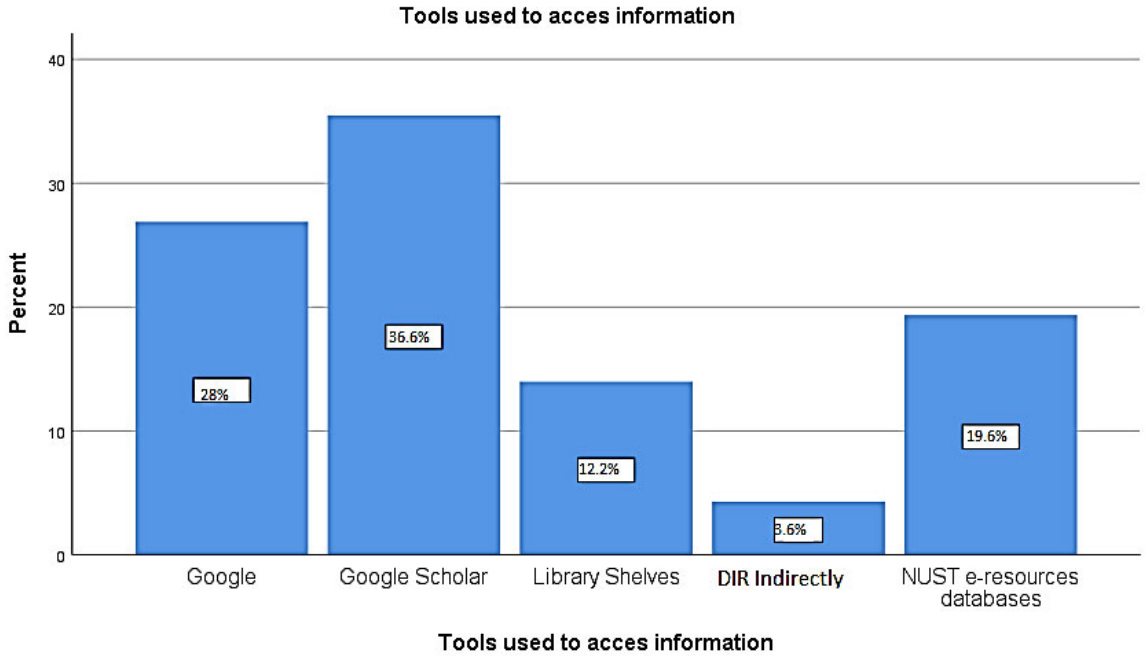

Figure 5.5: Tools used to access research output within NUST (n=82)

The PG student respondents were asked to state the source of information that students mostly access on the DIR. The respondents noted that though the institution subscribes to several databases, such as Proquest, Jstore, NUST Library discovery service, Emerald and many more, the majority of students are inclined to use Google as a primary source of information. Some other students prefer to use print sources as well.

5.5 System usability

One of the major concerns about IRs is related to usability issues. Usability is a process of systematic evaluation of human-computer interaction especially as it relates to the system interface. The researcher investigated the usability of the system in terms of the usage (user system interaction) and the system design. In particular, system efficiency, effectiveness, and learnability were investigated. This section presents results regarding system usability.

Usability is the degree to which software can be used by specified consumers to achieve quantified objectives with effectiveness, efficiency, and satisfaction in a quantified context of use (ISO 9241-11, 1998) (see section 1.11). This study used perceived ease of use (PEU), perceived usefulness (PU), and external variables such as knowledge of research domain, and system characteristics constructs from TAM to measure the usability of the DIR at NUST. The study was based on the assumption that the usability of the DIR will have an effect on the intention to use the DIR.

5.5.1 Perceived usefulness

Perceived usefulness of an information system is understood as the degree to which users perceive that using the system will contribute to meeting their information needs or solving a problem (Matusiak, 2012). Using the perceived usefulness construct from TAM, the respondents were asked about the usefulness of the DIR. The majority of PG students agreed and strongly agreed that the system was useful and easy to use. The results in Table 5.14 also show that the highest number of students (50, 63.2%) agreed and 25 (31.6%) strongly agreed that information retrieved is current, while 3 (3.7%) were neutral and 1(1.2%) strongly disagreed.

Table 5.14: PG students' perceived usefulness of DIRs (n=78)

Perceived usefulness	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Retrieved information from credible source	28 (35.4%)	47(59.4%)	3(3.7%)	1 (1.2%)	0 (0.0%)
Retrieved information is current	25 (31.6%)	50 (63.2%)	3 (3.7%)	1 (1.2%)	0 (0.0%)
Retrieved information was valid	25 (31.6%)	47(59.2%)	4 (5.0%)	2 (2.5%)	1 (1.2%)
DIR resources relate very well to my study	19 (24.3%)	45(57.6%)	10 (12.8%)	1 (1.2%)	3 (3.8%)
Adequate resources for the study	21 (26.9%)	35 (44.8%)	9 (11.5%)	0 (0.0%)	13 (16.6%)

Similarly, the majority of faculty agreed and strongly agreed that the system was useful. Twenty two (57.9%) agreed that retrieved information was from credible sources, 5 (13.1%) strongly agreed, 1(2.6%) strongly disagreed, 9 (23.8%) strongly agreed and 1(2.6%) disagreed. With regards to the currency of information retrieved, 19 (23.7 %) agreed, and 1(2.6 %) strongly disagreed. Seventeen (44.7 %) agreed that retrieved information was valid, 9 (23.8 %) strongly agreed, while 4 (5.0%) and 1(2.6 %) strongly disagreed (see table 5.15).

Table 5.15: Faculty's perceived usefulness of the DIRs (n=29)

Perceived usefulness	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Retrieved information from credible source	5 (17.2%)	22 (76 %)	0 (0.0%)	1 (3.4%)	1 (3.4%)
Retrieved information is current	9 (31.1 %)	19 (65.5%)	0 (0.0%)	1 (3.4%)	0 (0.0%)
Retrieved information was valid	5 (17.2 %)	17 (58.6%)	4 (13.8 %)	2 (7%)	1 (3.4%)

To validate information collected through survey questionnaires, librarians were interviewed and they were asked if they found the system useful in terms of credibility, how current the information retrieved is, and the validity of the information retrieved. Librarian B noted that the system is useful especially to those that are familiar with it such as postgraduate students and staff members. However, Librarian A and C stated that there is no mechanism for testing the credibility of the information since they solely rely on the departments to test the accuracy and the credibility of the information provided.

The researcher further sought to know whether the DIR provided adequate information for the information needs of researchers. Interviewed librarians indicated that the DIR did not adequately meet the researchers' information needs because the content was limited due to lack of active contribution to the DIR by faculty. The researcher also polled respondents on usage statistics. In this regard, the system developer was asked if the system has a usage statistics feature especially for displaying who viewed or downloaded an item. The respondent indicated that statistics of use are not displayed by the system to everyone. Moreover, the system does not have the usage statistics aggregation service that would enable Institutional Repositories to share and compare the usage of resources especially on down loads and citations. However, the system shows only the statistics of top viewed items and this statistics function is only available to administrators when they decide. The respondents were also asked to give their opinion about the accuracy and completeness of the information in the DIR. The responses seemed to indicate that accuracy and completeness is compromised as one respondent noted that, "*sometimes when it comes to referencing in the theses it may not be as accurate".*

5.5.2 Perceived ease of use of the DIR

Perceived ease of use in contrast refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). PG students were asked whether they agreed or disagreed with the statement that the system was easy to use. The ease of use (EU) construct is extracted from TAM.

The results in Table 5.16 show that the highest number of PG students (10, 71.5 %) strongly agreed, 2 (14.3 %) agreed, 1(7.1 %) was neutral and 1(7.1 %) disagreed that the system responds quickly. On the issue of errors and delays 7 (50 %) agreed that no error or delay was experienced, 2 (14.3 %) strongly agreed, while 2 (14.3 %) were neutral and 3 (21.4 %) disagreed. Ten (71.5 %) respondents agreed that few steps were taken to complete a task, 3 (21.4 %) disagreed and 1(7.1 %) strongly agreed. Seven (50.0 %) agreed that the interface is

memorable, while 5 (35.7 %) were neutral, 1(7.1 %) strongly agreed and 1 (7.1 %) disagreed. The results show that users did not experience much difficulty in accessing the system.

Table 5.16: PG students' ease of use experience in using the DIR (n=14)

Experience with system	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
System responds quickly	2 (14.3 %)	10 (71.5 %)	1 (7.1%)	0 (0.0%)	1 (7.1%)
No error or delay	2 (14.3 %)	7 (50.0%)	2 (14.3 %)	0 (0.0%)	3(21.4%)
Few steps to complete a task	1 (7.1%)	10 (71.4%)	0 (0.0%)	0 (0.0%)	3(21.4%)
Memorable interface	1 (7.1%)	7 (50.0%)	5 (35.7%)	0 (0.0%)	1 (7.1%)
Easiness error rectification and navigation	2 (14.3 %)	9 (64.3 %)	2 (14.3 %)	0 (0.0%)	1 (7.1%)
Stable, self-explanatory and consistent links	1 (7.1%)	6 (42.9 %)	6 (42.9 %)	0 (0.0%)	1 (7.1%)
Easiness of DIR usage	3 (21.4%)	5 (35.7%)	2 (14.3 %)	0 (0.0%)	4(28.6 %)

As for the faculty, the results in table 5.17 show that the majority of respondents (16, 55.1%) agreed that the system responds quickly, 5 (17.2%) strongly agreed, 3 (10.3%) were neutral, while 3 (10.3%) disagreed and only 2 (6.8%) strongly disagreed. Eighteen (62.0%) respondents agreed that no error or delay was experienced, 5(17.3%) disagreed, while 3(10.3%) strongly agreed and 3 (10.3%) were neutral. The majority (20, 68.9%) agreed that few steps were needed to complete a task, 5 (17.2%) were neutral 3 (10.3%) disagreed and only 1 (3.4%) strongly agreed. Seventeen (58.6%) agreed that the interface is memorable, 5 (17.2%) were neutral, 5 (17.2%) strongly disagreed, 1(3.4%) strongly agreed, while 1(3.4%) disagreed. The results generally show that users did not experience much of the problem accessing the system.

Table 5.17: Faculty's ease of use experience in using the DIR (n=29)

Experience with system	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
System responds quickly	5 (17.2%)	16 (55.1%)	3 (10.3%)	2 (6.8%)	3(10.3%)
No error or delay	3 (10.3%)	18 (62.0%)	3 (10.3%)	0 (0.0%)	5(17.3%)
Few steps to complete a task	1 (3.4%)	20 (68.9%)	5 (17.2%)	0 (0.0%)	3(10.3%)
Memorable interface	1 (3.4%)	17 (58.6%)	5 (17.2%)	5 (17.2%)	1 (3.4%)
Information is logically organised	2 (6.8%)	5 (17.2%)	4 (13.7%)	18 (62.0%)	0 (0.0%)
Easiness error rectification and navigation	2 (6.8%)	19 (65.5%)	2 (6.8%)	5 (17.2%)	1 (3.4%)
Stable, self-explanatory and consistent links	1 (3.4%)	6 (20.6%)	6 (20.6%)	15 (51.7%)	1 (3.4%)
Easiness of DIR usage	3 (10.3%)	5 (17.2%)	10(34.4%)	7(24.1%)	4(13.7%)

- **Efficiency**

The researcher sought to know the response time of the system. The respondents cited internet connection or low bandwidth as a barrier. Librarian A responded that, *"It all depends on the internet connection sometimes it can be very slow"*.

The respondents were also asked their opinion on the level of errors that users encounter when using the DIR. One respondent noted that, "*The repository is actually quite user friendly and very straight forward to use and I haven't experienced personally any complaints from users*". However, it was noted that the unavailability of the system sometimes occurs due to downtime.

The respondents were asked to state what could be done in order to enhance retrieval from the DIR. Librarian A stated that it is important to ensure that the steps to retrieve information are clear whilst some steps are confusing because some information is archived in the wrong place and extra effort is needed to retrieve it.

However, from the perspective of Librarian B, the steps leading to retrieval from the DIR are quite easy because the system gives options to search such as subject. If that does not work the system gives authors a name option from a list of such authors. One can also search by keywords. The observation by the researcher also revealed that two computer laboratories were reserved for IT classes. Each computer laboratory boasted an average of 40 PCs all of which were linked to the campus Gigabit Ethernet network. There were also wireless services available across the campus with access provided free to all registered students and staff. The wireless coverage was 90% on the campus. There were two types of internet connections - Wired (LAN) and Wireless internet connection.

5.5.3 Domain knowledge

Hong et al. (2002) noted that the users' background knowledge of search domain can support easier interaction with information systems. By using the domain knowledge construct of the system characteristic variable of TAM, the respondents were asked whether they agreed or disagreed that they are familiar with the search domain and are knowledgeable. The results in table 5.18 show that the majority of PG students (43, 55.1%) agreed that they were familiar with the research domain, 22 (28.2%) strongly agreed, 9 (11.5%) respondents were neutral, while 4 (5.1%) disagreed. Forty-one (52.5%) agreed to be knowledgeable with searching options, 22 (28.2%) strongly agreed, 10 (12.8%) were neutral, while 5 (6.4%) disagreed. Results show that although most respondents either agreed or strongly agreed, several others were neutral. The results reveal that the majority of respondents are confident with their knowledge of the searching options, although several others were neutral.

Table 5.18: PG students Domain knowledge (n=78)

Domain knowledge	Strongly agree	Agree	Neutral	Strongly disagree	Disagree
I am familiar with the research domain	22 (28.2%)	43(55.1%)	9(11.5%)	0 (0.0%)	4 (5.1%)
I am knowledgeable with searching options	22(28.2%)	41 (52.5)	10(12.8%)	0 (0.0%)	5 (6.4%)

As for faculty, the results in the table 5.19 show that the majority (15, 51.7%) agreed that they are familiar with the research domain, 7 (24.1%) strongly agreed, 3 (10.3%) were neutral,

while 2 (6.9%) strongly disagreed, and 2 (6.9%) disagreed respectively. Twelve (41.4%) respondents agreed that they are knowledgeable with searching options, while 11 (38%) strongly agreed, 3 (10.3%) strongly disagreed, 2 (6.9%) disagreed and 1 (3.4%) was neutral. The results reveal that the majority of respondents are confident with their knowledge of the searching options.

Table 5.19: Faculty domain knowledge (n=29)

Domain knowledge	Strongly agree	Agree	Neutral	Strongly disagree	Disagree
I am familiar with the research domain	7(24.1%)	15(51.7%)	3(10.3%)	2(6.9%)	2(6.9%)
I am knowledgeable with searching options	11 (38%)	12 (41.4%)	1 (3.4%)	3(10.3%)	2(6.9%)

5.5.4 Relevance of research output

By using the relevance construct of system characteristic variable from TAM, the respondents were asked whether to agree or disagree with the relevance of the research output. The majority of PG students (44, 56.4%) agreed that retrieved information was relevant, 25 (32%) strongly agreed, 7 (9.0%) respondents were neutral, 1 (1.3%) strongly disagreed and 1(1.3%) disagreed respectively. Results show that although most respondents either agreed or strongly agreed, several others were neutral (see table 5.20 below). The results reveal that the majority of respondents perceived the research output housed in the DIR to be relevant.

Table 5.20: PG student's perceive relevance of research output (n=78)

Relevance of research output	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Retrieved information was relevant	25(32%)	44 (56.4%)	7 (9%)	1 (1.3%)	1 (1.3%)

The faculty were similarly asked whether they agreed or disagreed with the quality of relevance of the research output. The majority of respondents (15, 51.7%) agreed that retrieved information was relevant, 11 (37.9%) strongly agreed, 1(3.4%) was neutral, while 1 (3.4%) strongly disagreed and 1(3.4%) disagreed. Results show that although most respondents either agreed or strongly agreed, several others were neutral (see table 5.21 below).

Table 5.21: Faculty's perceived relevance of research output (n=29)

Relevance of research output	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Retrieved information was relevant	11(37.9%)	15 (51.7%)	1(3.4%)	1 (3.4%)	1 (3.4%)

5.5.5 System interoperability

By using the system characteristic variable of TAM, the researcher sought to find out what systems or tools were used at NUST to ensure that the DIR meets the requirements of open access or to make the content openly accessible. The researcher further probed participants if there were any tools integrated in the DIR content so that it can be picked through general internet and other search engines. The respondent who was the system administrator noted that they have integrated AD (active directory). This means that all the system administration tools are integrated such that when logging into the system only one password is used. Secondly, they have a handler server that helps with positioning the institution articles on Google. This helps with rating so that the searcher can immediately pick up the article in the repository through Google.

5.5.6 Screen design

The researcher used screen design from the system variable of TAM to measure the functionality and characteristics of the NUST DIR. The researcher therefore asked the system developer if there were any features and functions of the digital institutional repository that users would like to see improved. The respondent noted that the system is rather complicated and should be made user friendly. The respondent further noted that the system does not have functionality to move an article that is placed erroneously in a particular discipline to the

correct place. This is only possible if deleted and recreated. Besides, if a document is loaded and one wishes to delete it, the link remains even after the document is deleted.

The system developer was asked to explain the challenges they faced in designing the DIR for usability. The results revealed that system administrators lacked training especially in specific software used to develop the Institutional Repository such as D-space. Instead, they were trained as general system developers. The administrators were also frustrated by the slow institutional network as this hampers downloading or uploading of content into the repository. They also pointed out lack of formal training and that they always made efforts to train on the systems. They also explained that the system comes already defined and customised, therefore making it difficult for the administrator to play around with it and designing it in a desired format. They noted that adding different graphics such as logos and pictures is impossible.

5.5.7 Heuristic evaluation of the system

Heuristic evaluation is one of the highly recognised and inexpensive techniques for usability assessment of systems (Paddison and Englefield, 2003:126). Heuristic evaluation works in such a way that a small group of evaluators is required to inspect the interface of the system and judge its agreement with the heuristics. For data collection, this study also used the Heuristic expert evaluation as a tool for usability assessment. This technique in addition to data collection tools was used in an effort to answer (What is the extent of system usability of the DIR by PG students and faculty?) research question.

As for Heuristic evaluation, all the expert evaluators e-mailed back the completed form withi n seven days of receiving it. The exercise took them an average of 30 minutes. The results of the severity rating exercise are captured in table 5.22 below. The total problems column refer s to the total number of problems identified by the evaluators with regards to the associated h euristic in the Heuristic No. column. The evaluator column indicates which expert evaluator/s identified the problems, while f (for frequency) indicates the number of experts who recogniz ed it. For example, Problem 2.1 was identified by Evaluators 3 and 2, giving a frequency of 2 .

	Category 1: General interface design heuristics	***Eval***	***f***

1	**System accessibility** The system should include the features of a possibility of visual impaired people to interact with each other through sharing information.		
1.1	The system does not include the features of a possibility of visual impaired people to interact with each other through sharing information.	3	1
2	**Match between the system and the real world** The metaphors used correspondence to the real world objects and concepts. The system speaks the user's language by using terms, phrases, symbols and concepts familiar to the user and common to the natural domain in which the system is applicable in a logical order. However, the system does not include features of a possibility of visually impaired people to interact with each other through information sharing.		
2.1	Some terminologies are unfamiliar.	2,3	2
3	**User control and freedom** Users are able to exit the system at any time when they need to do so. Even when they have made errors, there are clearly marked 'emergency exits' to leave the unwanted state without having to go through an extended dialogue.		
3.1 3.2 3.3	There are no facilities for Undo and Redo. The system is slow to respond. There is no system exit button.	1,2 1 1	2 1 1
4	**Semantic web and linked data**		

	The systems should be linked to various systems within the institution to act as a platform of sharing skills and knowledge within the institution.		
4.1 4.2	The system is not linked to various systems within the institution to act as a platform of sharing skills and knowledge within the institution and staff members. The system does not include semantic interoperability features between authors to aggregate data for various authors across the globe.	1, 2 2,3	2 2
5	**Consistency and standards** The system should be consistent in that the same words, situations, or actions refer to the same thing. It is advisable to use standard platform conventions.		
5.1	On the content page, the font size and layout of the 'Databases' is not consistent.	3	1
6	**Error prevention** Apart from giving good error messages, the system should be designed to prevent errors from occurring.		
6.1 6.2	Whatever is entered into the system is accepted. There are no ways to avoid erroneous/meaningless entries.	2,3 2,3	2 2
7	**Collaboration features** The system should incorporate the interaction forum between various authors across the globe; hence this will improve the knowledge between authors.		
7.1	The system does not have the interaction forum between various authors across the globe which can improve the knowledge among authors; for example, the system does not have a chatting feature.	1,2,3	2

7.2	The system does not include an sms module between authors which means authors can request information they need and also send messages to one another.	1	1
8	**Flexibility and efficiency of use** Objects, actions, and options should be visible so that the user does not need to recall information from one part of the interaction to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate. Instructions on how to perform tasks should be visible, for example, they should be bold and/or in large font sizes.		
8.1 8.2 8.3 8.4 8.5	The system cannot be customised. There are no shortcuts provided. The system is not flexible; you do what is exactly required and leave it that way. The system does not cater for novice users or new researchers. There is no Help feature.	1,2,3 1,2,3 1 1,2,3	3 3 1 3
9	**Help users recognise, diagnose, and recover from errors** The system should give error messages expressed in plain language. The messages should indicate precisely what the problem is and suggest constructive solutions.		

9.1 9.2 9.3	The error messages given are not helpful, for they do not provide any instructions to fix errors. If a typed command (data) results in an error message, one has got to retype the entire command instead of repairing the faulty part. When the wrong password is entered for submitting and any other interaction activity the error message appearing on the screen where it is entered instead of appearing in a text box.	1,3 1,2, 3 1	2 3
	Category 2: system-specific design		
10	**Navigation** The system should provide navigational feedback so that the user knows where he/she has been, where he/she is, and the link options he/she has on where to go next. Navigational aids such as search facilities should be available.		
10.1 10.2	Theses and dissertations are not placed under any faculty and or department, which make it difficult to identify thesis/dissertation produced per faculty. No option for searching by type which makes documents to be mixed up and difficult to get quickly to specific of type of item you are looking for.	1,2,3 1,3	3 2
Total			38

Table 5.22: Final set of problems identified by expert evaluators (Ssemugabi, 2006)

Three experts participated in the heuristic evaluation of the digital institutional repository for this study. A list of 21 unique problems was initially identified by these experts (given in table 5.23 below). This resulted in a final list of 38 problems emerging from the expert evaluators.

Heuristic No.	Evaluator 1	Evaluator 2	Evaluator 3	Total problems
1	0	0	1	1
2	0	1	1	1
3	3	1	0	3
4	1	2	1	2
5	0	0	1	1
6	0	2	2	2
7	2	1	1	2
8	4	3	3	5
9	3	1	2	3
10	2	1	3	1
Total	12	10	15	21

Table 5.23: Number of problems identified by each evaluator for each heuristic

The results in table 5.23 show that the majority of evaluators identified Heuristics 7, 8, 9 and 10 problems when compared with the rest. For Heuristic 8, five of the problems were each identified by three experts. All three experts identified some problem in relative to Heuristic 8. The major problem identified in Heuristic 8 by three evaluators was that the system could not be customised. This implies that the system had short comings in terms of flexibility and efficiency of use. Correspondingly, all the experts pointed out some problem linked to Heuristic 10. These problems were mostly related to navigation through the system. The fact that numerous problems were identified with regards to Heuristics 10 probably demonstrates navigational and user control difficulties with the system interaction. Problem 9.2 was concerned with typing a command (data) that resulted in an error message, whereby the person had to retype the entire command instead of amending the fault. This was encountered by all three evaluators. The analysis of results showed that evaluators tended to identify several problems with respect to one or two heuristics. For example, of the 12 problems identified by Evaluator 1, four of them were for Heuristic 8. Likewise, for Evaluator 2, three of the ten identified were for Heuristic 7, and for Evaluator 3, five of the 15 problems identified were for Heuristic 9.

5.6 Level of satisfaction in using digital institutional repositories

Kim and Kim (2008:868) described one of the attributes of usability as satisfaction (i.e. visual appearance, consistency and standards; supportiveness, meaning helpful and support) (See section 3.4.2). The actual use (AU) construct from TAM was used to measure the level of

satisfaction with the DIR. The respondents were asked to agree or disagree with the level of system satisfaction. The majority of PG students (16, 31.3%) agreed that the DIR is satisfactory to the users; however, 15(29.4%) were neutral, 11(21.5%) strongly disagreed,6 (11.7%) disagreed, while 3(5.8%) agreed.

In terms of readable and engaging text types and font size, 35 (68.6%) agreed, 8 (15.7%) were neutral, 6 (11.7%) strongly agreed, while 2 (4.0%) disagreed. Seventeen (33.3%) were neutral to logically organising information, 11(21.6%) disagreed, 9 (17.6%) strongly disagreed, while 8 (15.7%) strongly agreed and 6 (11.7%) agreed to the logical organisation of information (See Table 5.24). Results show that although most respondents either agreed or strongly agreed, several others were neutral.

Table 5.23: PG students' level of satisfaction in using DIRs (n=51)

Level of satisfaction	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
DIR is satisfactory to the users	3 (5.9%)	16 (31.4%)	15 (29.4%)	11(21.6%)	6 (11.7%)
Self-explanatory consistent and stable links	2 (3.9%)	33 (64.7%)	11 (21.6%)	1 (2%)	4 (7.8%)
Readable and engaging text types and font size	6 (11.7%)	35 (68.6%)	8 (15.7%)	0 (0.0%)	2 (3.9%)
Appropriately used icons graphics and colours	4 (7.8%)	34 (66.7%)	10 (19.6%)	2 (3.9%)	1 (2%)
Concise terms used to label menu functions	5 (9.8%)	36 (70.6%)	9 (17.6%)	1 (2%)	0 (0.0%)
Logically organising of information	8 (15.7%)	6 (11.7%)	17 (33.3%)	9 (17.6%)	11(21.6%)
Every click leads to the information being searched	6 (11.7%)	27 (53%)	12 (23.5%)	4 (7.8%)	2 (3.9%)
Understandable terms used throughout the DIR	4 (7.8%)	32 (62.7%)	8 (15.7%)	0 (0.0%)	7 (13.7%)
Consistent terms used throughout DIR	5 (9.8%)	35 (68.6%)	9 (17.6%)	0 (0.0%)	2 (3.9%)

The majority of faculty agreed and strongly agreed with the level of satisfaction of the system. The results in table 5.25 below also show that the highest number of respondents (15, 51.7%) strongly agreed to readable and engaging text types and font size of the system;12 (41.3%) respondents agreed, while 2 (6.8%) disagreed. In terms of appropriately used icons, graphics, and colours, the majority (24, 82.7%) agreed, 4 (13.7%) respondents strongly agreed and 1 (3.4%) disagreed. Seventeen (58.6%) respondents agreed to the concise terms used to label menu functions,10 (34.4%) strongly agreed, while1(3.4%) strongly disagreed and 1(3.4%)

disagreed respectively. Eighteen 18 (62.0%) disagreed to logically organising information,8 (27.5%) strongly agreed, while (3, 10.3%) agreed.

Table 5.24: Faculty level of satisfaction in using DIRs (n=29)

Level of satisfaction	Strongly agree	Agree	Neutral	Strongly Disagree	Disagree
Readable and engaging text types and font size	15 (51.7%)	12 (41.3%)	0 (0.0%)	0 (0.0%)	2 (6.8%)
Appropriately used icons graphics and colours	4 (13.7%)	24 (82.7%)	0 (0.0%)	0 (0.0%)	1 (3.4%)
Concise terms used to label menu functions	10 (34.4%)	17 (58.6%)	0 (0.0%)	1 (3.4%)	1(3.4%)
Logically organising of information	8 (27.5%)	3 (10.3%)	0 (0.0%)	0 (0.0%)	18(62.0%)
Self-explanatory consistent and stable links	6 (20.6%)	19 (65.5%)	0 (0.0%)	0 (0.0%)	4 (13.7%)
Every click leads to the information being searched	12 (25.5%)	7 (57.4%)	6 (12.7%)	0 (0.0%)	2 (4.2%)
DIR satisfies the users	3 (6.1%)	17 (73.4%)	4 (8.1%)	0 (0.0%)	5(12.2%)
Understandable terms used throughout the DIR	4 (13.7%)	18(62.0%)	0 (0.0%)	5 (17.2%)	5 (17.2%)
Consistent terms used throughout DIR	10 (34.4%)	14 (48.2%)	3 (10.3%)	0 (0.0%)	2 (6.8%)

During the interview, the researcher posed the question, "what is your opinion with regards to the appearance of the DIR interface?" Librarian A and C responded that the font size and the text are easy to read. Librarian B noted that,

"*The interface design is fine. The texts and font are not too small but large enough to read. The only problem with the system is how to cater for visually impaired users. Currently the system does not have features that can accommodate the visually impaired and the system should be designed to accommodate all users irrespective of their status of ability/disability"*.

The respondents were also asked to describe the organisation of information on the DIR. It was revealed that the system is cluttered with information and it should be simplified with less information on each page. With regards to colours, graphics, and icons on the DIR, the researcher questioned whether the system limit allows for innovation in designing and redesigning. In response, the system administrator noted that the system is limited when it comes to adding extra links or codes. However, it is possible to change colours and add on a logo. Overall, it is not easy to customise the system, especially when one does not have training.

5.7 Summary

This chapter presented findings of the data collected through survey questionnaires, interviews, library observation, document analysis, and heuristic expert evaluation. The findings were presented under thematic headings of the main research questions and broader issues around the research problem on which the study was designed. The themes included: attitudes and perceptions towards digital repositories, self-archiving, usability of digital repositories: perceived usefulness, perceived ease of use, domain knowledge, relevance of search output, system interoperability, computer self-efficacy, screen design, and level of satisfaction with digital repositories. The presentation of the findings on these themes was preceded by the response rate and demographic profile of respondents. The findings were presented in the form of tables, graphs, and text. In the next chapter the findings are discussed.

The findings revealed lack of awareness about the DIR among PG students and faculty. The findings further revealed a weak institutional repository policy which does not clearly stipulate processes and standards on the submission of scholarly works to the repository. The study also revealed the conflict with publisher policies related to archiving. These conflicts of publishing policies which involves authors, academic institutions and publishing companies cause dilemmas among researchers regarding publishing their research work. Moreover, there seemed to be misconceptions on the part of faculty and PG students about DIR and open access.

CHAPTER SIX

DISCUSSION OF FINDINGS

6.1 Introduction

This chapter discusses and interprets the research findings. “The purpose of discussion in any type of research is to frame the findings of the research investigation in light of the previously published research” (Amonette, English and Kraemer, 2016:79). Baedeker (2015) points out that in the discussion chapter, the researcher provides a broader interpretation of findings and the possible implications they might have for practice, thus giving meaning to what has been found. Accordingly, this chapter presents what the results mean, why things turned out the way they are and how the results can be used in practice. The chapter discusses the results in relation to the research questions that were investigated and existing knowledge. As Bavdekar (2015) asserts, the discussion of results provides the researcher with an opportunity to highlight pertinent themes in their research and provide a reflection of how the extant research differs from and extends current knowledge of the area in which they have chosen to carry out research.

Additionally, Şanlı, Erdem and Tefik (2013) stated that the discussion chapter gives the researcher a chance to demonstrate exactly their knowledge on the topic by allowing the researcher to interpret findings and provide a deep insight into the meaning of the findings. In discussing the findings, the researcher takes into account the aim of the research, the research questions, and the implications of the research for the relevant theories informing the study and explaining outcomes. MacCoun (1998) further asserts that the purpose of the discussion is to explain any new understanding or insights about the problem after considering the findings. Essentially, the discussion will always connect to the introduction by way of the research questions posed and the literature reviewed.

This study’s main objective was to investigate the usability of the institutional repository by PG students and faculty at NUST. The study sought to address the following research questions:

1. What are the attitudes and perceptions of PG students and faculty towards DIRs?
2. To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR?
3. What is the perceived usefulness of the DIR by PG students and faculty?
4. What is the extent of system usability of the DIR by PG students and faculty?

5. What is the level of satisfaction of PG students and faculty with the DIR?

The chapter is organised around the following themes: attitudes and perceptions towards digital repositories, self-archiving and content usage, usability of digital repositories: perceived usefulness, perceived ease of use, domain knowledge, relevance of search output, system interoperability, computer self-efficacy, screen design, and level of satisfaction with digital repositories.

6.2 Attitudes and perceptions towards digital institutional repositories

This section presents attitudes and perceptions of faculty and postgraduate students at the Namibia University of Science and Technology towards DIRs.

According to Vänninen (2009:107), attitude means "a complex mental state involving beliefs and feeling and value dispositions to act in certain ways". The implication here is that the degree to which researchers like or dislike DIRs may have an impact on their contribution to them. The preceding view is in tandem with the supposition of TAM that attitude has an effect on the behavioural intention of users to adopt or use technology. This study holds that attitude towards DIRs will have a positive effect on the intention to use the DIR. The study integrated the theory of reasoned action (TRA), performance expectancy from UTAUT and technology acceptance model (TAM) to understand the attitude towards use of DIRs.

6.2.1 Perceptions and attitudes of PG towards DIR

Singeh, Abrizah, and Karim (2013) in a study of Malaysian authors' acceptance to self-archive in institutional repositories used performance expectancy from UTAUT and attitude towards constructs to measure authors' perceptions on performance expectancy. This study also used the performance expectancy contract from UTAUT to measure PG students and faculty perceptions towards the DIR performance expectancy. The respondents were then asked to rate the statements in terms of benefits associated with publishing with the DIR.

PG students either agreed or strongly agreed that open access or DIR was beneficial. The results revealed that 67 (60.9%) strongly agreed, 36 (32.7%) agreed that exposure of work via DIR increases work cited and 7(6.4%) were neutral. In addition, 63(57.3%) strongly agreed and 43(39.1%) agreed that sharing one's work with peers and the research community is a benefit, while 3 (2.7%) were neutral and 1 (0.9%) disagreed. Sixty-one (55.5%) of the respondents agreed and 45(40.9%) strongly agreed that open access of research is beneficial, while 4 (3.6%) were neutral. The findings suggest that a large majority of PG students agree

that there are gains from self-archiving research, thus increasing personal merits. Drawing from responses of PG students, it can be established that their attitude is heavily influenced by their beliefs in the benefits of DIR. It is pertinent to underscore that the supposed benefits of the DIR to the students vary but overall there is a firm affirmation that the use of the DIR is beneficial nonetheless. A plethora of studies (Halder, 2012; Duttah and Paul, 2014; Ankamah et al., 2018) have also established that a varying number of positive benefits is acknowledged by PG students across all academic disciplines with regards to their use of the DIR.

A similar positive attitude or perceived benefit of the DIR was also recorded in the responses from faculty. Results from respondents showed that 17 (44.7%) strongly agreed that they find it easy to share their work with the general public; ten other respondents (26.3%) agreed while 9 (23.7%) held a neutral position and only 2 (5.3%) disagreed that their work could be shared easily with the public through the DIR. Regarding how the DIR aids in enhancing their personal profiles, 18 (47.4%) of the faculty respondents strongly agreed, while 15 (39.5%) agreed and 4 (10.5%) were neutral and only 1(2.6%) disagreed on the role of the DIR in enhancing their personal profiles. There was a strong agreement by 17 (44.7%) of respondents that another important benefit of the DIR is that respondents can rely on it for a long-term preservation of their digital materials; 13 (34.2%) agreed, 7 (18.4%) were neutral and only 1 (2.6%) disagreed. A couple of more questions were posed to the faculty and there was a clear and strong agreement from the respondents that there are numerous positive benefits associated with using the DIR. Research results replicate benefits reported in the literature, especially the public benefit of open access, enhanced exposure of work through Google Scholar and the potential for increased citation, as well as the potential to receive feedback and commentary (Cullen and Chawner, 2009).

Other benefits cited by faculty through questionnaire included: research work, which will be available on Google Scholar, getting feedback and commentary on researchers' research; the DIR preserves a digital copy of the researcher's research for the long term. As per literature review, the benefits of repositories to institutions and individuals are numerous (Barwick and Pickton, 2006). To the University, a DIR promotes the world wide visibility of the university records and reputation. It discloses the output of the institution's intellect to researchers around the globe who would not otherwise have the accessibility to it through traditional channels (Barwick and Pickton, 2006). Crow (2002:4) explains in SPARC (Scholarly Publication and Academic Resources Coalition) that there are two ways that repositories are capable of bringing out an optimistic "paradigm shift" in the process of scholarly communication: firstly,

capability of supplementing the existing way of publishing and motivating modifications to the current scholarly publishing mode (mainly moderating the collective expense of having scholarly publishing access); and secondly, the capability to enable the visibility of an institution's research outputs in order to "demonstrate the relevance of its research activities" and increase the status and public value" of the institutions.

According to Ashworth et al. (2013), an advanced Digital Institutional Repository can be used as a marketing strategy to attract high quality prospects and funding opportunities to the university, as well as support for learning and teaching. Academics and students will have central and equal accessibility to teaching and learning materials, and long-time preservation of the institution's digital output; as well as the ability to keep track of research performance. According to The Open Citation Project (cited Ashworth et al., 2013), a DIR furthermore improves the impact of scholarship and dissemination of information. Literature indicates that articles on open access are likely to be cited more than those that are not open access articles. On average, online files receive 300% more citations than paper based materials in some disciplines. Furthermore, literature indicates that the researchers should take a message that research is incomplete pending the extensive sharing and dissemination of the output. In addition, an extensive set of materials storage and access is guaranteed since many authors might experience lack of resources, time, or expertise to be able to preserve their own scholarly work and a DIR comes in aid for these scholars (Ashworth et al., 2013).

Cullen and Chawner (2009) state that via an organisational based DIR strategy long-standing availability and better security of research work is guaranteed. They further emphasise that archiving enables a greater exposure of research work, for example, via Google Scholar search engine, hence a better possible of "research impact". According to Kingsley (2008), maximised exposure is partially attained through maximised readership by including other researchers that would normally not have access to subscribed journals. Through the DIR, items acquire an everlasting URL compared to personal or departmental web sites. Therefore, users can follow the URL and still access the document after many years. It gives the idea about what others think about the author's work. There are also some extra value services such as "hit counts" on an article or thesis, publication lists that are personalised, and an analysis on the citation is also provided. In addition, the DIR provides a "centralised archive" of researcher's work and profiles of researchers. Institutions benefit in that the institution gets prestige and opportunities for funding (Jain, Bentley and Oladiran, 2009).

In terms of society/community, scholarly content is distributed among people and the whole public at large. Increased online public access to research output in return increases the research visibility, usage and its impact. This also increases the research benefit on itself in terms of information and knowledge distribution, application and growth, research output and development (Kingsley, 2008). In addition, sponsors of sponsored research have obligations now over the researchers to submit their research findings as a condition for funding. Funded research open access is encouraged and promoted through **s**ome policies. These necessities are planned to maximise readership, reuse, and distribution of research outputs (Jain, Bentley and Oladiran, 2009).

In addition to enhancing repository statistics, the inclusion of electronic theses in repositories allows original research undertaken by evolving scholars to be visible, accessible, and able to be used by the wider research community. Statistics indicate that theses and dissertations that are made available in this way are more widely used and cited in on-going research (Troman et al., 2007). Moreover, IRs capture the intellectual capital of the institution; affords better service to contributors; maximise the library's role as a viable partner in the research enterprise; long time preservation of institution's digital output is facilitated; provides a solution to the problem of preserving institution's intellectual output; increases accessibility to knowledge assets; maintains control over institution's intellectual property; contributes to the reform of the entire enterprise of scholarly communication and publishing; provides new services to learning communities beyond what the institution can offer; reduces the amount of time between discovery and dissemination of research findings; and provides maximal access to the results of publicly funded research (Rieh, Markey, Yakel, St Jean and Kim, 2007). Institutional Repositories enhance an increase in citation counts to institution's intellectual output and reduces user dependence on library's print collection (Barton and Waters, 2004). In addition, IR allows preservation of research output into digital formats; enabling easier retrieval (Performance-Based Research Fund Sector Reference Group cited in Barton and Waters, 2004).

In a study by Wirba, Abrizah, and Harun (2013), that aimed at evaluating Malaysian authors' readiness to self-archive in open access repositories, found that the usefulness and effectiveness of open access repositories to support knowledge sharing is highly dependent on the readiness of authors to self-archive their research output. Overall they found that digital archiving makes the author's research more visible and increases their reputation as scholars.

6.2.2 Reasons PG students and faculty submit their research/teaching materials to the DIR

According to the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980), normative beliefs and motivation to comply affect subjective norms. Subjective norm refers to the perceived social pressure to perform or not to perform certain behaviour. It is also an individual's perception that those who are important to him or her would approve or disapprove the performance of a given behaviour (Ajzen, 1991). In this study, subjective norm was construed as the degree to which a person perceives the demands of the 'important' others on him or her to use the computer. This study used normative beliefs and motivation to comply and subjective norm constructs from TRA to measure PG students' and faculty members' motivation to use the DIR.

The researcher sought to find out from postgraduate students what motivated them to contribute their research work to the DIR. The results showed that 77 (46.4%) of the respondents noted they were motivated by the need to increase accessibility of their work, while 33 (19.8%) mentioned creating publicity for research work and impact on research community while 32 (19.8%) said they were motivated to contribute as this would enable them to know how many times their research was viewed or downloaded by others, and (23, (14.5%) noted how they contributed when they were told to do so.

Faculty members were similarly asked to state what motivated them to contribute their research work to the DIR. The results showed majority of respondents (28, 34.1%) indicated that they were motivated by the need to increase accessibility of their research work, while 26 (31.7%) indicated that contributing to institutional repository creates publicity for their research work;11(13.4%) indicated the DIR facilitates the coordination of interdisciplinary teaching and research efforts; ten (12.1%) noted that IR shows the frequency in which materials were viewed and downloaded; however, the lowest 6 (7.3%) indicated that they contributed when they are told to do so.

These findings concur with Kim's (2006) study entitled 'motivating and impeding factors affecting faculty contribution to Institutional Repositories at University of Michigan'. Findings indicated that faculty members who had an interest in contributing to the DIR in the future agreed more strongly with accessibility and publicity of open access materials and possess a greater altruistic intention to make their work publicly accessible. The faculty members who perceived an influence of a grant-awarding body on their decision to self-archive were much less likely than others to contribute to the IR. The most important reason was found to

be preservation of respondents' materials, followed by the DIR capability to show the frequency of viewing and downloading their materials. Institutional recognition was the third most important reason, although its rating was not as high as the first and the second. Retaining copyright did not provide an incentive for future contribution. Respondents also did not connect functions provided by existing publishing systems with the IR. Thus, the peer review process and academic reward were considered least important motivators.

6.2.3 Reasons PG students and faculty are reluctant to contribute to DIRs

This study used normative beliefs, motivation to comply and subjective norm constructs from TRA to measure PG students and Faculty reasons for not using the DIR.

Based on subjective norm constructs from TRA, respondents were asked to state what demotivates them from using the DIR. The results revealed that majority of PG students (17, 19.7%) feared misuse of their work;16 (16.6%) indicated lack of information about the DIR;11(17.7%) experienced conflict with publisher policies related to archiving; 11 (12.7%) indicated extra effort required;8 (9.3%) stated lack of rewards; 8 (9.3%) noted complexity and difficulties posed by the system; lack of skills was indicated by 8 (9.3%); nature of research which did not allow publication in the DIR was noted by 7 (8.1%); and 6 (6.9%) cited that they found the other modes of information dissemination.

Similarly, faculty were asked to state reasons why they were not willing to contribute their work in the DIR. The results showed that 5 (20.8%) indicated they feared misuse of their work (copyright, plagiarism, infringement); 4 (16.4%) noted that depositing in the DIR is in conflict with publisher policies; 4 (16.4%) indicated that they lacked information on how to submit their work to the DIR; 4 (16.7%) indicated lack of information about how to submit research work to the DIR; 3 (12.5%) alluded to redundancy with other modes of disseminating information; lack of rewards on submission to DIR was indicated by 2 (8.3%); lack of skills to use the system was noted 2 (8.3%), another 1(4.2%) thought DIR is only for disseminating students' masters theses and dissertations, while complexity and difficulty to use the system was noted by 1(4.2%) and the additional time and effort required for self-archiving was cited by1(4.2%) of the respondents.

To validate the findings obtained through survey questionnaire, the researcher carried out the library observation along with document review, and by using facilitating condition construct, the study aimed to measure how the institution management supports and encourages the PG students and faculty to use the DIR. Facilitating conditions are perceived enablers or barriers in the environment that influence a person's perception of ease or difficulty in performing a

task. In this study, facilitating conditions were skills training, information or available materials, and administrative support which influenced the use of instructional technologies in teaching (Teo, 2010).

During the library observation and document review, it was found that in addition to general user education services, an information literacy programme was introduced in the Library in 2007. This programme was launched because library management acknowledged the need to assist the users to use ICTs available to them optimally. The literacy programme was carried out in different ways such as Group Training in an Electronic Classroom, Communication Skills classes for 6 weeks during each semester; online searching and retrieval, preparing and executing a search strategy and utilising search tools.

Fear of misuse for their work, copyright, plagiarism and infringement has led to poor motivation of depositing of contents into the DIR, hence the low contents. Davis and Connolly (2007) assert that publisher copyright concerns and policies discourage authors from submitting to the institutional repository. Davis and Connolly (2007) point out that some authors were confused about what authors could do with their papers and stated that the rules were constantly changing. Others had a misconception that it was not to make articles available to platforms outside the publisher's website, fear that their work would be plagiarized or copied without acknowledgement, and lack of any incentive for making one's work available before formal publication. Davis and Connolly (2007) mention that plagiarism was a real concern and reason scholars were reluctant to disseminate their work early in electronic form. In addition, all authors felt that, releasing results before formal publication was tantamount to giving away one's competitive advantage.

Crow (2002) is of the view that the success of archiving movement will depend to a greater extent on the will of the faculty and relationship they have with their institution regarding the copyright issues. Crow (2002) notes that certain questions need answers; for example, who owns the copyrights in the journal articles written by faculty? Is it the faculty themselves, their institution or outside sponsor? Does the faculty know who owns the copyright?

This seems very difficult, where the publication industry is established, and also taking into consideration the services journals and publishers provide to the research community. Such services are for instance screening for significance and peer review. These items would have to be reproduced at the level of OA databases. Another challenge at this point, where OA is not prescribed to all researchers worldwide, is a continuous need and if for the time being, to

publish in the journals for career reasons. Usually, the copyright is transferred to the publisher and with that the author loses the right to avail the product to an open access database.

6.2.4 Opinion on free access to scholarly research

The researcher used attitude (construct from TAM) to measure PG students and faculty members' opinions on free access to scholarly research. The respondents were asked to either agree or to disagree whether scholarly research generated at NUST should be freely accessible through Institutional Repository. The results showed that 60(43.5 %) agreed with the statement whereas 48 (34.8%) strongly agreed; 26 (18.89%) were neutral, while 4 (2.97%) disagreed.

These results agree with the literature; for example, Murphy (2016) is of the opinion that scholarly research should be freely accessible and that the public have a right to know by providing free online access to just about every scientific paper ever published on topics ranging from acoustics to zymology. She campaigns for open access, and has shined a light on how scientific findings that could inform personal and public policy decisions on matters as consequential as health care, economics and the environment are often prohibitively expensive to read and impossible to aggregate and determine.

Generally, the study found that the respondents had positive attitudes and acknowledged the benefits and gains from the DIR. The results in Figure 6.1 provided a detailed description of the relationship between perceptions, beliefs, and attitudes by adult internet users. The respondents were found to have a positive attitude towards internet (DIRs) because they believed that it is good and beneficial to their research needs. This finding suggests that the relationship between normative and behaviour intention by DIR users is significant.

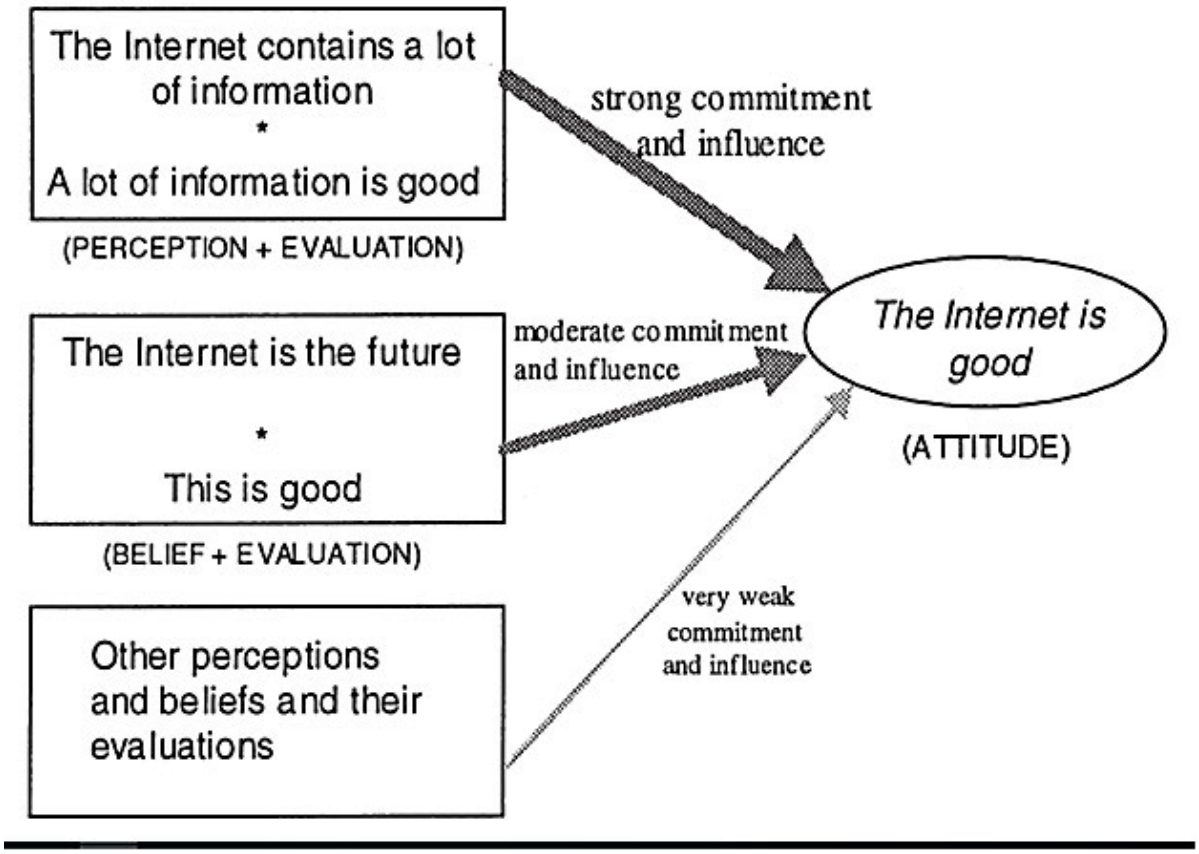

Figure 6.1: Relationship between perceptions, beliefs and attitudes (Source: Klobas and Clyde, 2000:7)

6.3 Self-archiving and Using DIRs for accessing content

In this study, self-archiving means the items in the repository by themselves rather than someone doing it on their behalf. Harnad (2001) describes self-archiving as the act of (the author's) depositing a free copy of an electronic document on the Internet, or more specifically on the World Wide Web, in order to provide open access to it. The term usually refers to the self-archiving of peer-reviewed research journal and conference articles, as well as theses and book chapters, deposited in the author's own institutional repository or open archive for maximising its accessibility, usage and citation impact (see also section 1.11).

Wirba, Singeh, Abrizah, and Harun Abdul Karim (2013) studied Malaysian authors' acceptance to self-archiving in institutional repositories. The authors used the unified theory of acceptance and use of technology (UTAUT) and TAM model. UTAUT postulates that performance expectancy, effort expectancy, social influence and facilitating conditions on using technology, influence technology acceptance. Similarly, the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980) posits that attitudes and subjective norms would affect an individual’s intention to use technology, and intention has influence on behaviour. This study used facilitating condition, behavioural intention, and use behaviour from UTAUT to measure

the extent to which PG students and faculty at NUST were: a) archiving their research output in the DIR, b) using content in the DIR.

6.3.1 Previous experience on DIR contribution

By using use behaviour construct from TAM, PG students were asked if they have submitted their scholarly work to the Digital Institutional Repository at NUST in the past. The results showed that 9 (10.91%) had previously contributed digital materials to DIR, while (73, 89.09%) had never contributed to the DIR. The high number of non-contributors could be attributed to the fact that most of them were Masters Students who were focusing on completing their theses. In addition, it seems students were not aware that they could submit their research work in the DIR. Similarly, faculty respondents were asked if they had deposited their scholarly work into the Digital Institutional Repository at NUST. The results showed that 25 (71.4%) had previously deposited into the repository, while 10 (28.6%) had not. These results reveal that the majority of participants contributed their research work in the DIR. In the opinion of the librarian respondents, there is low level of content submission by both PG students and faculty. These results confirm the findings of Bamigbola (2014) who reported that despite the general positive attitude to DIR by faculty and students, there was low submission of scholarly works by both categories of users. The results revealed that faculty did not submit their research work to DIR because they pointed out that they were not aware of the need to submit their research work to the institutional repository. Other faculty were ignorant of the value of depositing their research work in the repository. In addition, some faculty were wary to deposit in the repository for fear that journals restricted authors to submit their research work elsewhere. This threatens the growth of contents in digital institutional repository. Hence, the archiving efforts in this institution should be enhanced. These results are reflected in literature showing no improvement. Ondari-Okemwa (2007) asserts that in the context of Namibia the deposition by scholars of their publications in the IRs remains very low. For example, by the year 2016 the country had only 1,207 scholarly publications in the DIRs at both UNAM and NUST compared to Mozambique with 3,103 publications in one repository alone, while Zambia had 3,395 in a single repository respectively (Ezema and Onyancha, 2016).

Swan (2004), and Swan and Brown (2005) found that many academic authors were not familiar with the concept of institutional repositories or simply did not understand its importance. Swan (2006) also noted some researchers were not aware of self-archiving. Swan (2004), Swan and Brown (2005), Swan (2006), and Shukla, and Ahmad (2018) agree that there are clear

indications that researchers' participation in contributing research works to DIRs is not improving year-in-year out.

6.3.2 Preferences in submitting research work to open repositories

By using the behavioural intension variable from UTAUT, faculty respondents who stated that they have contributed their scholarly work were asked to state their preferences in submitting their research work to open repositories. The results showed that the majority of faculty (8, 32.0%) deposited their research in the DIR followed by 7 (28.0%) who submitted their work to the Print Institutional Repository; 3 (12.0%) submitted their research work to the professional/research group Open access website; 5 (20.0%) submitted their work to the department website/portals and those who preferred to submit their research work in subject repository were only 2 (8.0%).

The results reveal that, although majority of respondents have contributed to the DIRs, there were still others who preferred to submit their research work elsewhere. These results agree with the findings from Davis and Connolly (2007) who surveyed authors in the USA and results revealed many of respondents were found reluctant to contribute to the institutional repositories. Moreover, researchers displayed a very limited knowledge of institutional repositories compare to knowledge of open access journals. Another survey at Cornell University found that scholars "were not contributing their research work to the institutional repository". The reasons behind the state of affairs was related to academics having limited knowledge and lack of motivation to use the institutional repository (Singeh, Abrizah, and Karim, 2013).

Scholars generally tend to have misconception self-archiving believing that self-archiving violates copyright agreements which they have contracted with their publishers once they contribute their research output into an institutional repository (Harnad, 2006). Furthermore, scholars appeared uneducated about copyright issues, considering that some publishers give permission to authors to make contributions into their institutional repositories though making their articles accessible via their university's institutional repository. A study "on open access initiatives in academic libraries" by Sale (2006) reported that of ten respondents who contributed materials in an institutional repository, only one was confident about issues surrounding copyright when submitting his previously published journal article to the library's institutional repository. The rest were reported to "have a slight idea". Authors seemed to have misunderstandings and were overcautious about what is permissible according to publisher agreements.

There are therefore many issues limiting deposition of scholarly works into institutional repository by scholars**.** Some scholars are much more reluctant to share work that has not gone through peer review and been accepted for formal publication because of the perception that mistakes in the material may be propagated, thus affecting professional reputation of the scholar (Davis and Connolly, 2007). There is also a feeling among scholars that subject repositories are adequate to meet their needs and don't have reason to use general digital repository (Davis and Connolly, 2007). In addition, faculty and scholars in general tend to perceive an institutional repository as a single island completely isolated from other institutional repositories. In this sense, one has to know where to find relevant information. It becomes unrealistic to have material in multiple repositories and require someone to search them separately. Other challenges that affect self-archiving by scholars include lack of time to self-deposit, lack of staffing or a dedicated manager to help with self-archiving, copyright clearance issues, difficulty in obtaining content (especially faculty publications), restrictive policies, limited IT support, and more.

Wu's (2015) study at Roger Williams University in Bristol, Rhode Island, examined causes of low faculty contributions to IR content growth, particularly at small academic institutions. The study identified two major issues, poor adaptation to actual faculty needs and copyright worries as the major bottlenecks in building the case for DIRs. The findings also revealed that academics at Cornell University hardly contribute to the institutional repository as it remained few contents and hardly used. This was linked to the fact that academics are not motivated use the institutional repository (Davis and Connolly, 2007).

Similarly, Shukla and Ahmad (2018) assessed the impact of Institutional Repositories on scholarly practices of scientists at the Council of Scientific and Industrial Research (CSIR) laboratories of India. The study revealed that 'Peer-Review Scholarly Journals' are a favoured medium for publishing research content and the maximised visibility to grey literature was the greatest noteworthy impact of DIR on respondents. This study confirms that researchers are still reluctant in contributing to the repository as this has been reported in previous studies. Hence, their preparedness had not changed.

6.3.3 Intention to contribute scholarly work to DIR in future

By using behaviour intention variable from TAM, PG students who stated they did not contribute materials to the DIR were asked whether they planned to contribute materials in future. The results showed that the majority 46 (63.1%) plan to do so, followed by those 21(28.7%) who were undecided, while some 6 (8.2%) were not planning to contribute to the DIR.

Similarly, faculty respondents were asked if they planned to submit their research output to the institutional repository in the future. The results showed that the highest number of respondents, 15(39.5 %) plan to contribute their publications to the repository, followed by some 12(31.6 %) who were undecided. Nine (23.7 %) indicated that contributing to the repository does not apply to them and only (2, 5.2 %) said they were not planning to contribute their publications to the repository.

These results support the findings of previous studies which reveal that the researchers were willing to contribute their research work in the DIRs. These results concur with Yang and Li's (2015) study at Texas A and M (University (TAMU) which assessed faculty members' attitudes towards, and willingness to contribute to an institutional repository (IR). In addition, they investigated the perceptions of faculty members towards newer OA trends and resources, including Open Educational Resources (OER) and Data Management Plan Tool. They found that tenured faculty are more engaged and interested in OA publishing topics in general, and tenure-track faculty are more willing to adopt new initiatives such as Open Textbooks. Overall, the TAMU faculty are willing to consider publishing in OA publications, and almost half of them believe OA journal publications are acceptable for consideration of tenure and promotion in their departments.

Similarly, Koulouris, Kyriaki-Manessi, Giannakopoulos and Zervos (2013), in a survey which focused on institutional repositories, policies and best practices for encouraging self-arching at a Greek University, found that the faculty members were all willing to deposit their work. More than half of them indicated that they would proceed with self-archiving procedures. In addition, more than 89% were willing to learn self-archiving procedures as well as uses of the DIR.

6.3.4 Mandatory and voluntary submission policy

Facilitating conditions are perceived enablers or barriers influencing a person's perception of ease or difficulty of performing a task. In this study facilitating was considered to include skills

training, information or available materials, and administrative support. These facilitating conditions were also found to influence the use of instructional technologies in teaching (Teo, 2010). Facilitating condition construct from UTAUT was used with the aim to measure how the institution administration encourages the PG students and faculty to submit their research work to the DIR.

There was a high level of willingness to comply with the voluntary submission policy by respondents. Results revealed that 53(48.1%) strongly agreed, 41(37.2%) agreed, 5(4.5%) were neutral, (10, 9.0%) strongly disagreed, while 1(1.2%) disagreed with the voluntary submission policy**.** Forty (36.4%) strongly agreed with mandatory submission policy, while (3, 35.5%) agreed; 10(9.1%) were neutral, 19 (17.3%) strongly disagreed and 2 (1.7%) disagreed.

Faculty were asked whether they preferred the mandatory or voluntary submission policy. Twelve (31.7%) of faculty agreed to comply with the mandatory policy, 10 (26.3%) strongly disagreed, 8 (21.00%) were neutral, 4 (10.5%) disagreed and 4 (10.5%) strongly disagreed with the mandatory policy. Faculty were asked whether they preferred the mandatory or voluntary submission policy. The results in figure16 show that the highest number of respondents 19(50%) strongly agreed with voluntary submission followed by 9 (23.7%) who agreed and 7 (18.4%) were neutral, 2 (5.3%) disagreed, while 1(2.6%) strongly disagreed with voluntary submission policy.

These results affirm the findings of Stanton and Liew (2011) who reported respondents expressed they prefer a voluntary system or were ambivalent toward archiving their work in an institutional repository. One respondent was quoted to have indicated that submission should not be made compulsory but researchers should be given an option to choose whether to publish their research output in the repository or not. Some students in Stanton and Liew's (2011) study were reportedly against archiving their work in a repository. One participant cited concerns regarding plagiarism and strongly opposed having their research published electronically.

However, in the same study, Stanton and Liew (2011) found a high level of willingness to comply with the mandatory thesis deposit policy was observed. Positive responses ranged between 91.6% from respondents in the College of Science to 100% in the College of Creative Arts.

However, within the literature, there is a debate concerning the essential for "mandatory submission policies" for researcher's intellectual output. Some stakeholders claimed that mandatory policies would cause more "harm" than "good" in relation to researcher's accordance, preferring a library liaison and advocacy approach, while others (including some of the academics themselves) are not concerned with mandatory submission policy (Palmer et al., 2008). Other authors argue that mandatory policy is the only way to achieve appropriate submission rates (Sale, cited Stanton and Liew, 2011).

Literature indicates that the mandatory deposit policy is a useful strategy to develop an essential collection of an institutional repository and one that is supported by the majority of the respondents in Stanton and Liew's (2011) survey. Furthermore, during interviews the librarian respondents were also asked whether their institution had an archiving policy. The results reveal that the institution did not have an archiving policy; however, institutional repository policies were in place. The researcher further asked clarity on how the existing policy guided uploading the items and whose responsibility it was to upload items to the repository. The librarians who were responsible for archiving scholarly works on behalf of the authors noted that they were aware of the archiving policy guidelines regarding uploading of documents that were clear despite some technical limitations in archiving materials in the repository. The results suggest that though the institutional repository policy existed, it did not encourage authors to self-archive; instead, responsibility was delegated to the librarians to carry it out on behalf of the authors. The respondents also indicated that the institution relied on voluntary submissions, where the authors voluntarily submit their research work to the library for uploading into the DIR.

These results agree with Xia and Sun (2007) who examined self-archiving practices in nine well-known open access institutional repositories using the E-prints system in USA. They found that an exercise of self-archiving for institutional repositories had not been extensively accepted by researchers. They also found that the availability of full texts in those repositories was relatively low though the Australian repositories were the exception. Xia and Sun (2010) reported that one possible reason for the low rate of author self-archiving was the use of a liaison system where librarians working with departments deposited works on behalf of faculty members

Banach and Li (2011) are of the view that most IRs do not have well-defined policies about the types of records that should be deposited in these repositories. They pointed out that only 2.72% of IRs have a defined policy regarding types of material to be submitted, whereas

around 3.04% policies do not provide guidelines. As to how content is deposited in the DIR, Banach and Li (2011) found that three methods were common namely: author self-archiving by third party on behalf of the author, and by repository staff.

The librarian respondents were asked to explain how the policy guided the archiving and submission/depositing of the materials into the DIR and whose responsibility it was to upload items. It was revealed that the policy only allowed faculty librarians to upload the materials into the repository. The respondents also indicated that the institution relied on voluntary submissions.

As noted earlier in section 3.2.1, some participants in Stanton and Liew's (2011) study expressed concerns over the mandatory submission policy. While supportive of placing their work in the repository and happy to comply, the interviewees expressed preference for the voluntary submission. The review of literature has shown that IR policies are some of the issues that may influence use and the participation of PG students and Faculty in depositing their research work in the Dirs. A brief examination of some IR policies revealed, for example, that the University of Tasmania IR policy mandated researchers to make available OA digital copies of all research outputs and their related metadata via the Institutional OA Repository. Voluntary submission of research outputs to the Institutional OA Repository by other members of the University community and the wider Tasmanian community is encouraged to achieve the benefits of Open Access wherever possible (University of Tasmania IR policy, 2017).

Similarly, at the University of Auckland the IR policy indicates that where staff members create any form of intellectual property other than an excluded copyright work in the course of their employment or using university resources, the university must be acknowledged as having rights to that intellectual property (The University of Auckland intellectual property policy, 2013). Furthermore, at University of Cape Town (in South Africa), the IR policy encourages employees and students to make available all forms of works of scholarship through the appropriate platforms and service in digital format and of a type that is consistent with policies and practices. Regarding copyright issues, the UCT policy further states that, authors should utilise Sherpa/Romeo or publishers' websites to confirm publishers' copyright policies and permissions that are normally granted in terms of their copyright transfer agreements. The policy states that the university recommends that authors should avoid the transfer of copyright to publishers, where the publisher does not permit archiving, re-use or sharing as a minimum of a submitted version of scholarly publication. UCT provides a simple mechanism through which authors can inform publishers of their need to comply with the

institution's policy so it is consistent with the permissions granted by the staff member to the University; the policy also encourages authors to publish their scholarly publications in peer-reviewed open access journals. In this case, the author should supply the metadata to the Institutional Repository in order to maximise institutional and personal discoverability (UCT IR policy, 2016). Previous studies which investigated the impact of mandatory policy towards the growth of DIRs content such as that of Sale (2006) in Australia have shown that mandatory submission has an impact on DIRs' content growth.

The findings from this current study also revealed that performance expectancy (PE), facilitating condition (FC) and attitude towards (AT) did not influence PG students' and faculty's behavioural intention to archive in the DIR. Even though PG students and faculty tended to agree that institutional repositories are a good way of disseminating information and use them frequently (which implies positive attitude), most of them have not fully embraced archiving in digital institutional repositories.

The study found that facilitating condition and policies issues needed to be addressed first as far as promoting open access through DIR is concerned before attitude towards open access, because attitude towards open access publishing is quite positive. Venkatesh et al. (2003) highlight that, "facilitating conditions" and "Intention to use Internet information resources" have significant effects on users (see figure 6.2). Similarly, environment factors such as policies have an influence on users' behaviour and can motivate the PGs and faculty to start using the DIR. As indicated earlier, PGs and faculty were averse to mandatory submission policy which resulted in low content submission. However, Sale (2006) reported that mandatory submission policy has an impact on DIRs content growth.

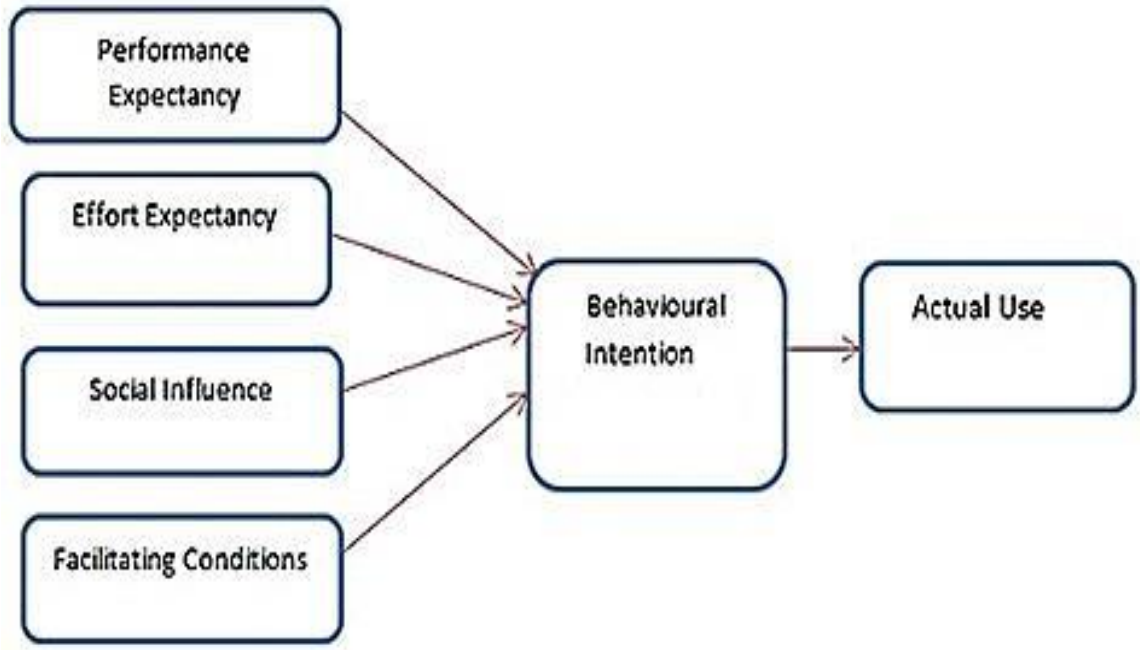

Figure 6.2: Relationship between facilitating conditions and actual usage (Source: Venkatesh et al., 2003).

6.3.5 Using DIRs for accessing content

Using the use behaviour and actual use constructs from TAM, postgraduate students were asked if they ever used the DIR for accessing information. The results showed that 67 (61%) had never used the DIR for accessing information, and only 43 (39%) respondents have used it.

These results suggest that the DIRs were hardly used for information access partially due to the lack of awareness on the existence, benefit and role of DIRs. The low use of DIRs for content access has also been reported in previous studies. Russell and Day's (2010) study at Cornell University reported that most researchers (9 out of 11) believed repositories to be stand-alone services which had to be searched separately (Davis and Connolly, 2007). Consequently, it is unlikely that direct searching of repositories (either local or remote) would occur from researchers. Arndt (2012) assessed doctoral students in New Zealand and found that low awareness of Institutional Repository was responsible for low direct use of IRs in conducting research. The vast majority of respondents reported using Google Scholar, and could unknowingly have accessed open access repository content. Achieng (2016) analysed the usage of a digital repository in an academic institution in Kenya, and found underutilisation of the digital repository content.

6.3.5.1 Tools used to access research output

PG students were asked what tools they used to access research output in their institution. Results in figure 6.3 indicate that the highest number of respondents (30, 36.6%) used Google scholar followed by Google (23, 28%). Others used library shelves (10, 12.2%), NUST e-resources databases (16, 19.6%), and those who access DIR indirectly through other modes (3, 3. 6%).The respondents were to indicate further what resources they mostly used. Majority of the respondents indicated they used databases such as Proquest, Jstore, NUST Library discovery service, Emerald and many more. However, many other students were inclined to use Google as a primary source of information, while others preferred to use print source of information.

The preference of Google Scholar could be attributed to awareness that repository content appears in Google Scholar. This finding suggests the need for attention to enhanced metadata for optimising discoverability of the IR content through general search engines (Arndt, 2012). Russell and Day (2010) assert that one way in which repositories might be useful to researchers would be to integrate deposit and other repository interactions into research practice and workflows (Russell and Day, 2010).

The findings of this study strongly agree with the previous search findings for most researchers. Previous studies had found that researchers mostly use search engines to find information rather than using the libraries. Russell and Day (2010) assert that unsurprisingly there is little detailed information available about the use and usefulness of repositories generally, and particularly for resource discovery. Arndt (2012) reported low direct use of DIRs for conducting research by scholars; instead, the vast majority used Google Scholar.

Achieng (2016) analysed the usage of a digital repository in an academic institution in Kenya. The results revealed that the digital repository was underused partly because of lack of access to computers. The research revealed that independent variables effectiveness, efficiency, satisfaction, and awareness contributed to usage of the digital repository and e-resources. Each of these factors influenced the usage of the repository either positively or negatively. The usage drivers were identified as lack of awareness and information, satisfaction and frequency of use, increased information needs, and reduction of barriers to access. The research revealed that effectiveness, efficiency, satisfaction, and awareness constructs have positive impact on the usage of the repository and the e-resources, and can be used to increase usage of a digital repository.

A study by Stanton and Liew (2011) reported that only two participants indicated that they directly used institutional repositories directly for information access. Seven out of the eight participants mentioned that they accessed institutional repositories through Google Scholar or through the Online Public Access Catalogue, but not essentially aware that they were using the university's digital institutional repository in the process. One student indicated that he never used repositories because his research needs are mostly answered though libraries and the Internet. Although, it is likely that much of the journal articles the participants had accessed through Google Scholar (and Google) were in fact housed in repository collections, or those articles published in open access journals. In terms of PG students' use of repositories and open journals in their own research, the study revealed that only few of the respondents had used open access research services for example "Australasian Digital Theses and Ethos". Nevertheless, the majority of respondents used Google Scholar, so it is possible that they retrieved open access material from journals and institutional repositories without realising it.

The dominance of search engines is also clear in the academic sector. A 2005 survey by Online Computer Library Centre (OCLC) established that 89 percent of students from high learning institutions usually begin their research with Google, and that only 2% starts their search at library websites (DeRosa and OCLC, 2005). According to Haglund and Olsson (2008), a repeat of that survey five years later revealed that that the situation for libraries had only worsened, as no respondents reported visiting library websites at the outset of their research (DeRosa et al., 2010).

That same report revealed a decrease in traditional search engine use, but also noted for the first time the use of social media search engines for their research. Another 2005 survey in the UK found that "students preferred to locate information or resources via a search engine above all options, and Google was the search engine of choice" (Griffiths and Bophy, 2005). The information-seeking behaviours of upcoming academic researchers in Sweden display an "almost complete dominance of Google as a starting point for searching scientific information".

Rieger (2009) on the other hand reported an extensive use and satisfaction with Google and Google Scholars among scholars. Rieger (2009) pointed out both academics and students preferred search engines over other information retrieval systems in supporting their academic search and learning. Rieger (2009) also reported that there was sufficient awareness of specialised Google tools such as Google scholar and Google books among the faculty members and PG students.

Kroll and Forsman (2010) in the United States studied researchers at four active universities and their study revealed that Google and Google scholars was effective their information needs and participants described these search engines results as good in many cases. These results gives a strong impression that besides efforts of introducing other library information retrieval systems, the Google and Google scholars remains mostly and extensively used by researchers.

Connell (2011) compared the use of digital materials that have been deposited in The Ohio State University (OSU) Knowledge Bank (KB). Results showed that mediated and unmediated content were used, and therefore justified the preservation costs for unmediated content. Results also showed articles and undergraduate these were the most frequently used type of materials leading to the conclusion that it is important to collect content from all levels of the educational process.

Haglund and Olsson (2008) emphasised that to understand the information needs of young university researchers better, an observational study was carried out at three universities in Stockholm, Sweden. The study found that "most of the researchers used Google for everything, that they were confident that they could manage on their own, and that they relied heavily on immediate access to electronic information" (Haglund and Olsson, 2008:52). The researchers had very little interaction with the library, and their awareness on the value librarian competence could add to their research was very limited nor recognise it. One significant conclusion of the project is that "librarians have to leave the library building and engage themselves with research environment, as well as considering the fact that library use is considered complicated, but Google (etc.) is easy. The findings of Haglund and Olsson (2008) project will have an impact on changes in library services for now and in future

According to Haglund and Olsson (2008), a repetition of that survey five years later established that the situation for libraries had only worsened, as 0% of respondents reported visiting library websites at the outset of their research (DeRosa et al., 2010). The similar report find a small drop in use of the traditional search engine, but also noted for the first time, the social media search engines use for initial research. Another 2005 survey in the UK found that students favoured to retrieve information or resources though search engines on top of all options, and Google was the best search engine chosen (Griffiths and Brophy, 2005). The information searching behaviours of young academic researchers in Sweden revealed complete dominance of Google as a starting point for searching scientific information by faculty.

Thus, Tmava and Alemneh (2013) pointed out that to increase content visibility search engines are the most popular way users search for information; they account for 88 percent of users' search time when they are looking for information (Bifet and Castillo, 2005). This is because most users like to search by keyword, and they expect to retrieve useful results. The popularity of Google search engines is attributed to its ease of use, it is free, and it is extremely fast and produces useful results. For the most part Google generates search results by matching search terms entered with Web page content, usually referred to as full text searching.

Yin Zhang, Li Jing, Wei (2011) explained how "Subject norm" and "Intention to use Internet information resource" have significant effects on users. Furthermore, they pointed out that environment factors such as the opinions of users, tutors, friends, schoolmates, and colleagues on the usage of Internet information resource are very important to users' behaviour in using the DIRs. Previous studies on the adoption of information systems results have revealed that people often use technology if they find it useful and easy to use (Lu, Yu, Liu and Yao, 2003).

In order to improve the efficiency of the usage of Internet information resource, Yin Zhang, Li Jing, Wei (2011) explored the key factors which affect the actual usage of Internet information resource in China. Structural Equation Modelling (SEM) and Partial Least Squares (PLS) were used to test the conceptual model. Empirical data were collected through questionnaires. From the perspective of users, the results indicated that the key factors including self-efficacy, subjective norm, intention to use have significant effect on users' actual usage of Internet information resource. Figure 6.3 below demonstrates the relationship between subjective norm and actual usage of the Internet information resources.

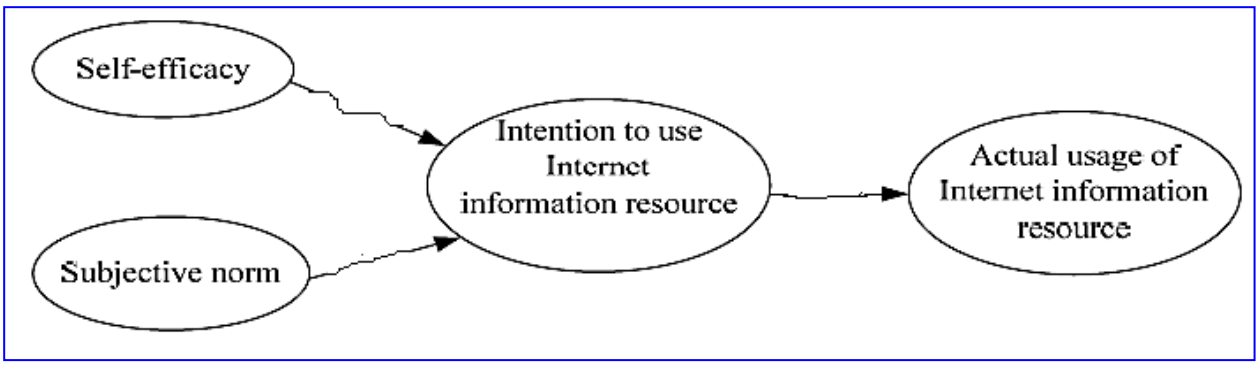

Figure 6.3: Relationship between subjective norm and actual usage (Source: Yin Zhang, Li Jing, Wei (2011)

6.4 System usability

One of the major concerns about IRs is related to usability issues. Usability is a process of systematic evaluation of human-computer interaction especially as it relates to the system

interface. The researcher investigated the usability of the system in terms of the usage (user system interaction) and the system design. In particular, system efficiency, effectiveness, and learnability were investigated. This section presents results regarding the system usability.

- **Usability** is the degree to which a software can be used by specified consumers to

Achieve quantified objectives with effectiveness, efficiency, and satisfaction in a quantified context of use (ISO 9241-11, 1998) (see also section 1.11). This study used perceived ease of use (PEU), perceived usefulness (PU) and external variables such as knowledge of research domain, and system characteristics constructs from TAM to measure the usability of the DIR at NUST. The study was based on the assumption that usability of the DIR will have an effect on the intention to use the DIR.

6.4.1 Perceived usefulness

In this study, perceived usefulness relates to the attributes of digital resources, such as format, type, mode as well as reliability, extent, currency, and quality. These attributes influence users' intention to select the system and can play an important role in adopting it, especially if systems are new and part of emerging technologies. Perceived usefulness of an information system is understood as the extent to which a person believes that using the system will contribute to meeting his/her information needs or solving a problem (Matusiak, 2012). Using Perceived usefulness construct from TAM, the respondents were asked about the usefulness of DIRs at NUST. The majority of PG students agreed and strongly agreed that the system was useful and easy to use. The results also showed that the highest number of students (50, 63.2%) agreed and 25 (31.6%) strongly agreed that information retrieved was current, while 3 (3.7%) were neutral and 1(1.2%) strongly disagreed.

Similarly, the majority of faculty respondents agreed and strongly agreed that the system was useful. Twenty-two (57.9%) agreed that retrieved information was from credible sources, 5(13.1%) strongly agreed, 1(2.6%) strongly disagreed 9 (23.8%) strongly agreed and 1 (2.6%) disagreed. With regards to currency of information retrieved 19 (23.7%) agreed, and 1(2.6 %) strongly disagreed that the information was current. Seventeen (44.7 %) agreed that retrieved information was valid, 9 (23.8 %) strongly agreed, while 4 (5.0%) and 1(2.6 %) strongly disagreed.

Foster, Fried, Gibbons and Susan (2005) carried out an informative study at the University of Rochester to explore the apparent misalignment between the benefits and services of a DIR with the actual needs and desires of research staff. The study revealed that researchers did not

perceive the relevance of the DIR as it was described and promoted by institutional staff running the repository.

To validate information collected through survey questionnaires, librarians were interviewed and asked if they find the system useful in terms of credibility, currency of the information retrieved and the validity of the information retrieved. The study noted the system is useful especially to those that are familiar with it such as postgraduate students and staff members. However, there is no mechanism for testing the credibility of the information; reliance is solely on the departments to test the accuracy and the credibility of the information provided.

The researcher further sought to know whether the DIR provided adequately for research information needs of researchers. Interviewed librarians indicated that the DIR did not adequately meet the researchers' information needs because the content was limited due to lack of active contribution to the DIR by faculty. The researcher also polled respondents on usage statistics. In this regard the System developer was asked if the system has a usage statistics feature especially for displaying who viewed or downloaded an item. The respondent indicated that statistics of use are not displayed by the system to everyone. Moreover, the system does not have usage statistics aggregation service that would enable Institutional Repositories to share and compare usage of resources especially on downloads and citations. However, the system shows only the statistics of top viewed and this statistics function is only available to administrators. The respondents were also asked to give their opinion about the accuracy and completeness of the information in the DIR. The responses indicated that accuracy and completeness is compromised as one respondent noted, "*sometimes when it comes to referencing in the theses it may not be as accurate"*.

For open access systems that rely on depositing of content, it has been said that two major factors govern their ultimate viability: (1) the input activity, or submission of content supplied by authors; and (2) usefulness, which is typically assessed via usage statistics (Luce, 2001). These two variables are inextricably linked. On one hand, scholars are more likely to use or access the content of an archive if it has significant input activity. On the other, they are more likely to deposit their work if an archive is highly used, thus providing greater visibility to their research.

With regards to measures of usefulness of the system, bibliometric analyses are some of the most widely used. In the world of research, bibliometric analysis is considered important as a tool that enables the DIR to generate statistics of use. Morrill (2015) investigated the role of institutional repositories in open access publishing and examined institutional repositories'

potential in describing research impact through downloading statistics of the open access material. Institutional and subject repositories provide access and download statistics which give researchers an earlier indication of the impact of their research.

Lambert (2017) stressed that depositing materials into the institutional repository is not the end of the process, what happens to the materials once they're available (in terms of views and download) is something to consider. Tracking, monitoring and benchmarking usage of educational resources helps universities to spot emerging trends and to demonstrate value and impact. For example, IRUS-UK (Institutional Repository Usage Statistics) is a usage statistics aggregation service that enables Institutional Repositories to share and compare usage of resources based on the COUNTER standard. As part of JISC's Open Access offer, IRUS-UK provides access to authoritative, standard-based statistics supporting universities to gain a better understanding of the breakdown and usage of their institution's research, which they can quickly and easily benchmark against comparable organisations and share with key stakeholders.

As seen in figure 6.4 and 6.5 below, there are repositories that are designed in such a way that one would be able to see the download and usage statistics.

Figure 6.4: Waikato Research Common (Source: Research Commons, Waikato, n.d.)

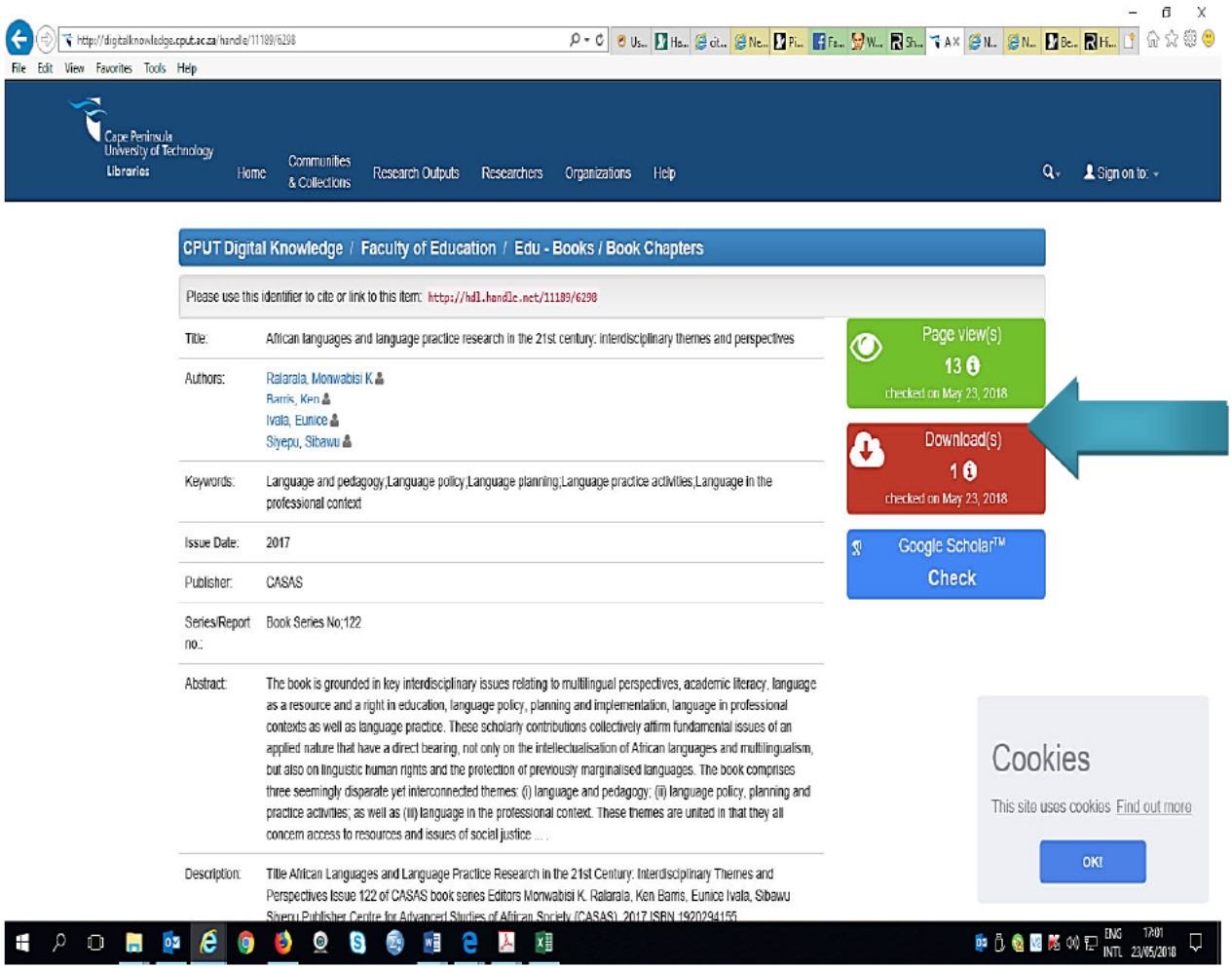

Figure 6.5: CPUT Institutional Repository (Source: Cape Peninsula University of Technology Portal, n.d.)

The respondents were asked what needs to be done to the DIR to improve its features and performance. The respondents noted that more papers of good quality should be added. Librarians were also of the view that the visually impaired should be catered for. They also expressed the need for the system redesign to avoid cluttering of information on a page.

Tao (2009) in figure 6.6 below clearly demonstrates the relationship between the quality of information, quality of the system, perceived usefulness, and intention to use. System Quality and ease of use, System Quality (SQ) and Information Quality (IQ) were found to be significant and that both Information Quality (IQ) and System Quality (SQ) impacted Behaviour Intention (BI). However this study revealed that the perceived usefulness by PG students and faculty did influence the intention to use, which then leads to actual use of the DIR for archiving although depositing of the materials in the DIR was low.

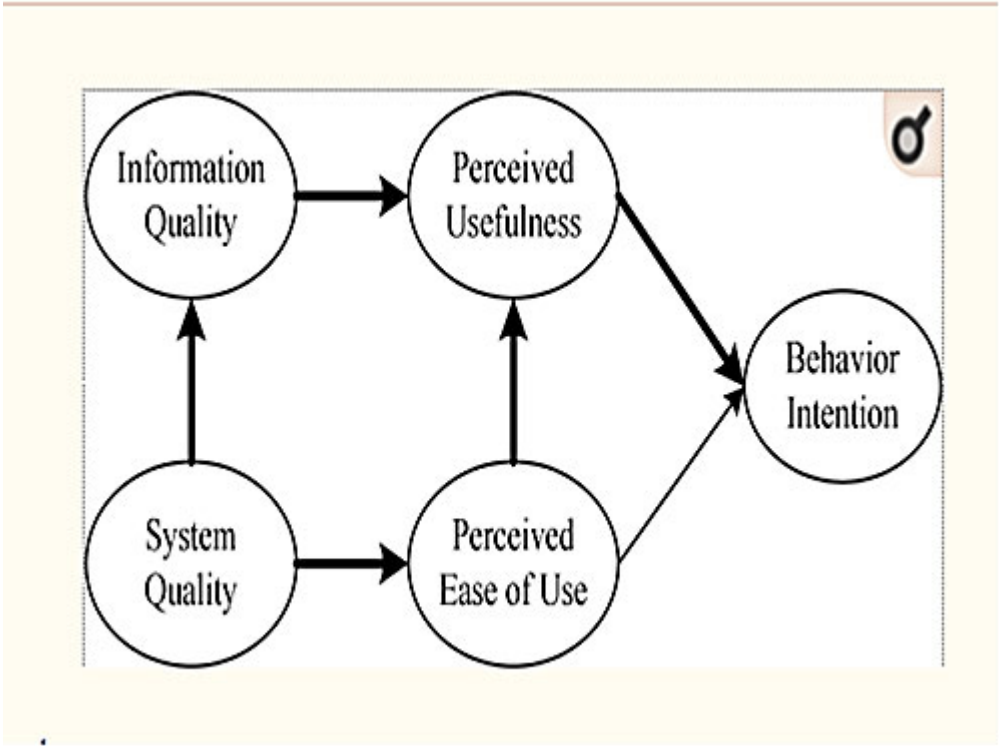

Figure 6.6: Relationship between the quality of information, quality of the system, perceived usefulness and intention to use (Source: Tao, 2009)

6.4.2 Ease of use of NUST DIR

Perceived ease of use, in contrast, refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989:320). This follows from the definition of "ease": "freedom from difficulty or great effort". The PG students were askedabout the ease of using the DIR. The ease of use (EU) is a construct from TAM which is used to measure the degree to which the PG students and faculty found the use of DIR free from difficulty or great effort. The results showed that the highest number of PG students, 10 (71.5 %) strongly agreed, 2 (14.3 %) agreed, 1 (7.1 %) was neutral and 1(7.1 %) disagreed. On the issue of errors and delays, 7 (50 %) agreed that no error or delay was experienced, 2 (14.3 %) strongly agreed, while 2 (14.3 %) were neutral and 3(21.4 %) disagreed. Ten (71.5 %) respondents agreed that few steps were taken to complete a task, 3 (21.4 %) disagreed and 1(7.1 %) strongly agreed. Seven (50 %) agreed that the interface is memorable, while 5 (35.7 %) were neutral, 1(7.1 %) strongly agreed and 1(7.1 %) disagreed.

As for faculty, the results showed that the majority of respondents 16 (55.1%) agreed that the system was easy to use, 5 (17.2%) strongly agreed, 3 (10.3%) were neutral, while 3 (10.3%) disagreed and only 2 (6.8%) strongly disagreed. Eighteen (62.0%) respondents agreed that no error or delay was experienced, 5(17.3%) disagreed, while 3 (10.3%) strongly agreed and (3,

910.3%) were neutral. The majority 20 (68.9%) agreed that few steps were needed to complete a task, 5 (17.2%) were neutral, 3 (10.3%) disagreed and only 1(3.4%) strongly agreed. Seventeen (58.6%) agreed that the interface is memorable, 5 (17.2%) were neutral, 5(17.2%) strongly disagreed, 1(3.4%) strongly agreed, while 1(3.4%) disagreed. The results generally show that users did not experience problem accessing the system.

Stanton and Liew (2011), in a study, reported that four of the six students completed the submission process in Dspace quickly by following the instructions. In addition, all students submitted and uploaded their PDF file and entered the basic metadata within five minutes. This included author, title, advisor, and other pertinent information. However, they noted that there should be instructions for logging off. System usability is one of the major issues in depositing and using DIRs. System interfaces that are poorly designed constrain access and use of institutional repositories. Usability is concerned with process of evaluation using human-computer interaction of system interface. Several authors have described attributes of usability. Kim and Kim (2008:868) described the attributes of usability as satisfaction meaning visual appearance, consistency, and standards; supportiveness meaning being helpful and providing support; usefulness meaning flexibility of function or functionality; effectiveness meaning ease of use. Tsakonas and Papatheodorou (2008) identified ease of use and learnability as important attributes of open access digital repositories. Hariri and Norouzi (2011:14) developed some abridged evaluation criteria for digital user interfaces that included "feedback, ease of use, match between system and the real world, customization, user support, user workload, interaction, compatibility, visibility of system status, user experience, flexibility, and accessibility".

Similarly, Kim and Kim (2008:868) assert that system usability should facilitate learnability-users should be able to learn the system easily, use the system efficiently, experience system memorability (users should be able to remember the system easily), the system should work as correctly as possible and be free of major errors, and users should take pleasure in using the system.

6.4.3 Efficiency

To establish the efficiency of the system, the researcher asked the question: How do you find the response time of the system? The respondents cited internet connection or low bandwidth as a barrier. Librarians responded that, *"It all depends on the internet connection sometimes it can be very slow".*

The respondents were also asked their opinion about the level of errors that users encounter when using the DIR. One respondent noted, *"The repository is actually quite user friendly and very straight forward and I haven't experienced personally any complaints from users*". However, it was noted that unavailability of the system sometimes due to downtime happens.

In addition, the respondents were asked to state what needed to be done in order to enhance retrieval from the DIR. Librarians stated the importance of ensuring that steps taken to retrieve information are clear and not confusing as some information is archived in the wrong place and extra effort is needed to retrieve it. This shows that the possibility of the DIR contented accessibility is narrow, which suggests that users may hardly get what they want from the system. Rai, Lan, and Welker (2002) urged that the system quality is highly represented by ease of use. Thus, moving around within the system should be easy and spontaneous for the users. This is accomplished when the system meets all requirements of navigation. The navigation restructured is vital for the system. Maditinos, Mitsinis, and Sotiriadou (2008) found that clear and short navigation paths with quick page loading enhance navigation. Therefore, detailed and clear links that facilitate users moving to other pages of the same site contributes to browsing and finally have a positive effect on user satisfaction.

However, the steps leading to retrieval from the DIR are quite easy since the system gives options to search such as subject, author, and keywords. In terms of research support from the library, the observation also revealed two computer laboratories were reserved for IT classes. Each computer laboratory boasted on average 40 PCs which were linked to the campus Gigabit Ethernet network. There were wireless services available across the campus; access was free of charge for all registered students and staff members. In addition, wireless coverage was 90% on campus. There are two types of internet connections; staff internet is connected to the wired (LAN) connection, whereas students were connected to wireless internet connection.

6.4.4 Domain knowledge

Hong et al. (2002) noted that the users' background knowledge of search domain can support easier interaction with information systems immensely. By using the domain knowledge construct of system characteristic external variable of TAM, the respondents were asked whether they agree or disagree that they are familiar with the search domain and knowledgeable about searching options.

The results showed that the majority of PG students 43 (55.1%) agreed that they were familiar with the research domain, 22 (28.2%) strongly agreed, 9 (11.5%) were neutral, while 4 (5.1%) disagreed. Forty-one (52.5%) agreed to be knowledgeable with searching options, 22 (28.2%)

strongly agreed, 10 (12.8%) were neutral, while 5 (6.4%) disagreed. Results further showed that although most respondents either agreed or strongly agreed several others were neutral. The results reveal that majority of respondents were confident with their knowledge of the searching options although several others were neutral.

As for faculty, the results showed that the majority (15, 51.7%) agreed that they were familiar with the research domain, 7 (24.1%) strongly agreed, 3 (10.3%) were neutral, while 2 (6.9%) strongly disagreed and 2 (6.9%) disagreed. Twelve (41.4%) respondents agreed that they were knowledgeable with searching options, while 11(38%) strongly agreed, 3(10.3%) strongly disagreed, 2 (6.9%) disagreed and 1 (3.4%) was neutral. The results revealed that majority of respondents were confident with their knowledge of the searching options, although several others were neutral.

"Knowledge of search domain" is one of the internal control factors that may influence PEU (Perceived Ease of Use) of use of the systems positively. Information retrieval system shows that knowledge of the research domain can aid more effectively the search by supporting users differentiate between "relevant information" and "irrelevant responses", learning facilitation of search principles, and formulating more accurate queries (Linde and Bergstrom, 1988; Marchionini et al., 1993; Meadow, 1995). In the computer based environment, the DIR as compared to physical and traditional environment where end-user support or managerial support is generally available, there is usually no one to consult during the search activities. During that time, the background knowledge of search domain for the user can support information system interaction easier (Hong et al., 2002).

The study findings seem to agree with Hong et al. (2002) who extended TAM and found that knowledge of research domain influenced the ease of use. In this study the respondents had confidence with their knowledge of the DIR. Moreover, majority of respondents did not have a problem with the system, hence agreed that the system was easy to use and useful.

6.4.5 Relevance of research output

By using relevance construct of system characteristic external variable from TAM, the respondents were asked whether they agree or disagree with the relevance of the research output. The majority of PG students 44 (56.4%) agreed that retrieved information was relevant, 25(32%) strongly agreed, 7 (9%) respondents were neutral, 1 (1.3%) strongly disagreed and 1(1.3%) disagreed. Results show that although most of respondents either agreed or strongly

agreed, several others were neutral. The results revealed that the majority of respondents perceived the research output housed in the DIR to be relevant.

Similarly, faculty members were asked whether they agreed or disagreed with the quality of relevance of the research output. The results showed that majority 15 (51.7%) agreed that retrieved information was relevant, 11(37.9%) strongly agreed, 1(3.4%) was neutral, while 1(3.4%) strongly disagreed and 1(3.4%) disagreed. This study revealed that participants find the system to be relevant to their research needs. They also agreed that the information held in the repository is relevant to their needs.

Relevance is "the degree to which the system matches tasks as carried out in the current environment and as specified in the task analysis" (Hong et al., 2002:106). In the context of digital information system, it can be understood as the extent to which the digital repository matches users' information needs (Hong et al., 2002). Normally it involves, recall (i.e. the ratio of relevant information retrieved to all relevant documents in the information system) and precision (i.e. the ratio of relevant information retrieved to all retrieved items) have been the key principle measure of the efficiency and effectiveness of information retrieval systems (Hong et al., 2002). All of these measures grounded on the relevance concept.

Increasingly researchers in the Library Sciences discipline are starting to recognise the importance of relevance based on the user judgment in assessing the information retrieval system effectiveness (Janes, 1994, Park, 1994 and, Spink et al., 1998). Gluck (1996) found that users' satisfaction with retrieved items is related to the relevance of those items in determining their information needs. Yao (1995) have matched relevance with usefulness buy asserting that the information is only useful when the user perceived it to be relevant. Hence he assumes that the relevance of the content in the system to users' information needs is linked to both PEU (Perceived Ease of Use) and PU (Perceived Usefulness) of the repository.

Relevance of results obtained in an information retrieval system is dependent also on the appropriate use of terminology or language of the system. The users carry out tasks by submitting their search queries the information system using phrases that are structured where information system' terminology used in the system became critical. Subsequently, it is also vital that users have clear understanding of instructions, guideline, explanations, instructions, and results yielding from any search of the information system clearly and correctly. One main problem with "terminology" for an information system is wrongly used jargons or jargons. As recounted by Talja et al. (1998), most often use the language that users are using to use to express their information needs most often it does not correspond with the terminology of the

information system. This difference will not only make it difficult for the users to interact with the system, but also minimise the potential beneficial that the system can provide to the users. Caccialupi, Calvi, Cassella, and Conte (2009) stated that a usability evaluation of repository interface based on DSpace in Italy. In their paper, they presented the usability evaluation of a repository interface. The results of Caccialupi, Calvi, Cassella, and Conte (2009) evaluation revealed the most important inadequacies of the DSpace interface namely: problems with the submission interface due to scarcely familiar terminology (metadata) or terms that are not relevant in the specific academic context (community); and confusions caused by terminology.

6.4.6 System interoperability

By using system characteristic external variable of TAM, the researcher sought to find out what systems or tools were used at NUST to ensure that the DIR meets the requirements of open access or to make the content openly accessible. The researcher further probed if there were any tools integrated in the DIR content so that it can be picked through general internet and other searching engines. The respondent who was the system administrator responded that they have integrated AD (active directory). This means all the system administration tools are integrated such that only one password is used when logging into the system. Secondly, they have a handler server that helps with positioning the institution articles on Google. This helps with rating so that the searcher can immediately pick up the article in the repository through Google.

In the 1960s, the Library of Congress developed and released the first protocol for linked metadata, the machine-readable cataloguing format, or MARC. These standards and search engine analytics are used to connect library catalogue systems on the Internet using linked data to help users uncover and delve into content that is, for all practical purposes, hidden in the Deep Web (Hilliker, Wacker and Nurnberger, 2013). Merrill, Corlosquet, Ciccarese, Clark and Das (2014) observed that using the open-source eXframe software, institutions and laboratories can create Semantic Web repositories of their experiments, integrate it with heterogeneous resources, and make it interoperable with the vast semantic web of knowledge.

Interoperability describes the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user (HIMSS, 2005:2). Historically, research libraries used to operate in isolation; users who needed to access services and resources in other research libraries visited the libraries in their individual capacities. The purpose of an Institutional repository (IR) is to manage their scholarly work in

ways that facilitate interdisciplinary collaboration and accelerate the pace of discovery and innovation with all the different software platforms via multiple online search engines (Tmava and Alemneh, 2013).

Open access digital repositories have implemented the Open Archive Initiative-Protocol for Metadata Harvesting (OAI-PMH) as a mechanism to achieve interoperability in the exchange of meta-information with other systems (Muhammad et al., 2007). With all the different software platforms employed by IRs, their systems are expected to support interoperability in order to provide access via multiple online search engines (Tmava and Alemneh, 2013). Metadata interoperability facilitates the exchange of information between repositories and enables World Wide Web searching. To make items discoverable in the diverse online environment, the database needs to provide standards-compliant database servers and expose the fullness of that metadata to a metasearch client (Dorman, 2008).

McLean and Lynch (2004) agree that library interoperability is not easy to achieve; they identified its major weaknesses as a) dynamic and complex library operation environments that are hard to map between libraries; b) divergent views by the stakeholders about the problems and possible solutions; and c) pressure to solve problems using short-term "quick fixes" rather than long-term solutions. This situation is however changing and research libraries currently maintain wide networks with other libraries and relevant professional bodies (Brown and Swan, 2007). Through the Open Archives Initiative (OAI), shared code for metadata tags has made it possible for full-text documents in different formats and locations to be shared.

According to Crow (2002), for institutions to achieve interoperability, they simply need to maintain and expose metadata, allowing other services to harvest and search the content. This simplicity lowers the barrier to repository operation for many institutions, as it only requires a file system to hold the content and the ability to create and share metadata with external systems (Crow, 2002). However, concerns of researchers regarding risks of open access such as plagiarism and other copyright violations can be addressed by institution's content accession and access policies. For example, Institutional repositories typically should not permit content to be removed once submitted (Crow, 2002). However, a variety of legitimate circumstances might require an institution to limit access to particular content to a specific set of users. These circumstances might include copyright restrictions, policies established by a particular research community (e.g. limiting access to departmental working papers to members of that department). Implementing these policy-based restrictions requires robust access and rights

management mechanisms to allow or restrict access to content, and conceivably, to parts of digital objects by a variety of criteria, including user type, institutional affiliation, user community, and others (Crow, 2002).

Interoperable metadata protocols are not new. In the 1960s, the Library of Congress developed and released the first protocol for linked metadata, the machine-readable cataloguing format, or MARC, as it is commonly known. Advances in these standards and search engine analytics are connecting library catalogue systems on the Internet, and using linked data to help users uncover and delve into content that is, for all practical purposes, hidden in the Deep Web. Semantic searching most frequently applies to scientific inquiries, allowing researchers to gather an abundance of relevant, credible information without using a dozen search tools, each with their own precise filters. Furthermore, advancements in semantic web are generating new ways of data contextualisation, resulting in deeper personalisation and more comprehensive views of bodies of research (Hilliker, Wacker and Nurnberger, 2013). Merrill, Corlosquet, Ciccarese, Clark and Das (2014) observed that using the open-source eXframe software, institutions and laboratories can create Semantic Web repositories of their experiments and integrate it with heterogeneous resources and make it interoperable with the vast Semantic Web of biomedical knowledge.

6.4.7 Screen design

The researcher used screen design from system characteristic external variables of TAM to measure functionality and characteristics of NUST DIR. The researcher therefore asked the system developer if there were any features and functions of the digital institutional repository that users would like to see improved. The respondents noted that the system is rather complicated and should be made user friendly. The respondents further noted that the system does not have functionality to move an article that is placed erroneously in a particular discipline to the correct place. This is only possible if you delete and recreate it. Besides, if a document is loaded and one wishes to delete it, the link remains even after the document is deleted. These findings concur with Davis and Connolly's (2007) reported that all authors were very grateful for the existence of the DSpace; there was a perceived lack of software functionality. Categories are inflexible, and one could not delete, move objects, or cross-list objects across categories. The inflexibility of the DSpace made it necessary to design an additional search interface to the DSpace documents. This was not a perfect solution, as one cannot link directly to a DSpace object, only the description page for that document. This

resulted in an additional step required by a researcher, and because of it, lots of people possibly get lost at this step.

The system developers were asked to explain challenges faced in designing the DIR for usability. The results revealed that system administrators lacked training especially in specific software used to develop the Institutional Repository such as DSpace, instead they were trained as general system developers. The administrators were also frustrated by the slow institution network and this hampered downloading or uploading of content into the repository. They also indicated that learning and mastering the system and software on which DIR is constructed was cumbersome. They also pointed out lack of formal training and that they always made no efforts to train on the systems. Furthermore, they explained that the system comes already defined and customised; therefore, it makes it difficult for the administrator to play around with it and design it in whichever way they want. They noted for example that adding different graphics such as logos and pictures is impossible.

As from the Heuristic evaluation, the results showed that more problems arose from Heuristics 7, 8, 9 and 10 when compared with the rest. For Heuristic 8, five of the problems were each identified by three experts. All three experts identified some problem in relative to Heuristic 8. The major problem identified in Heuristic 8, by three evaluators was that the system could not be customised. This advises that the system had short comings in terms of flexibility and efficiency of use**.** Correspondingly, all the experts pointed out some problem linked to Heuristic 10. These problems were mostly related to navigation through the system. The fact that numerous problems were identified with regard to Heuristics 10, this probably demonstrating navigational and user control difficulties with the system interaction. Problem 9.2 was concerned with typing a command (data) that resulted in an error message, whereby the person had to retype the entire command instead of amending the fault. This was encountered by all three evaluators. Analysis of results showed that evaluators tended to identify several problems with respect to one or two heuristics. For example, of the 12 problems identified by Evaluator 1, four of them were for Heuristic 8. Likewise, for Evaluator 2, three of the ten identified were for Heuristic 7, and for Evaluator 3, five of the 15 problems identified were for Heuristic 9.

The shortcomings on screen design and user interface revealed in this study are in support of Kim's (2005) research findings. Kim (2005) carried out a study on how students find information from the E-print and D-space of University of Michigan. The research identified the usability problems of two user interfaces of digital institutional repositories, DSpace and

Eprints. Kim (2005) further found that the one-box simple search form in DSpace was not considered useful because it doesn't give direction on how to use it. Therefore, information about how to submit search terms would help users make fewer errors or recover from the errors.

Similarly, Narayan and Luca (2017) also experienced the screen design short comings on DSpace. When they assessed factors affecting in adoption of open access and institutional repositories by researcher at Victoria University of Wellington, New Zealand, they established that "DSpace's community's collection structure" was less meaningful to a number of researchers, who were already familiar with organisational hierarchy of faculties and departments. This was linked to the terminologies that emerged from DSpace which were not meaningful within the setting of the university. The respondents narrated that the DIR interface was disorderly and cluttered with too much information, including a lot of metadata and statistics that were not making any sense. Although most of the DSpace's browsing categories such as title and author were visible on the homepage of the repository; it was not clear to users what the context of these items within the site is.

Regarding the short coming of the screen design which also reported in this study, Narayan and Luca (2017) study stated that the limited accessibility, visibility and usability of the DIR were some of the concern, and also the necessity for establishing subject repositories. The findings suggested a "redesign" of the DIR and guided the library's promotion programs for scholarly communication literacy.

Law, Roto, Hassenzahl, Vermeeren and Kort (cited in Narayan and Luca, 2017) emphasise that users encounters have become a vital basis for assessing the library information systems reinforced and developed from the perception of users, while focusing on the user's encounters is essential to study more conceptual qualities of the system, including usability, meaning, and affect.

McKay (cited in Narayan and Luca, 2017) notes that digital repositories usability may be divided into 3 classes, namely: "content, functionality, and the user interface". Narayan and Narayan and Luca (2017) remarked that, generally more literature had been generated about the "information retrieval systems", however, research focusing on examining the accessibility and usability of the DIRs from the end user's point of view is still limited. This lack of information of repository from users perceptive is likely to be factor in the inaccessibility and limited acceptance of these systems.

Pinfield (2015) in a study at the University of Sheffield in the UK, entitled “making open access work: the state of the art in improving open access literature” found several problems with the repository navigability. Research found that the software interface for the repository focused on “searching” than on “browsing”, with a search box as the only navigation option. Narayan and Luca (2017) also observed the way the content is organised in the system and the way it is presented sometimes gave little clue or clear instruction to the user as to where they may begin for information or content search.

The screen design or user interface observed in this study is due to the lack of training, especially job training of the System Developers and this is a threat to the usability of the DIR with regards to the ease of use (EU) and eventually satisfaction. The fact that there has been a shortcoming of the DSpace discovered in this study while there are several research papers reported on successfulness of DSpace customisation to suit institutions’ needs this study emphasises the issue of training DIR among system developers and administrators.

Narayan and Luca’s (2017) study at Victoria University of Wellington, New Zealand which assessed issues and challenges in researcher’s adoption of open access and institutional repositories specifically for university repository, reported that there was no global site hierarchy or logical organisation of content on the repository. It was a confusing system for the users to navigate. Upon clicking on a community, for example, the site showcased a new form of hierarchy, and the community categories that were on the home page were no longer accessible to the user unless they went back to the home page.

Many of these user experience issues were easily fixed through library initiatives such as customising the DSpace interface and building a more Web-like interface. They further reported that the site was now more visual and organised to match the faculties, schools, and research centres at the university (under a more disciplinary structure), and hence is much easier for researchers to navigate and search (Narayan and Luca, 2017).

In an empirical usability test by Broock (2005) at Oregon State University Libraries, the study reported that DSpace metadata registry and submission screens was customised so that students are prompted to enter fields that pertain to their thesis such as Advisor or College rather than more generic field names such as Description. The instructions on the submission screens were also revised so that they are more understandable. Broock (2005) and Luca (2017) suggest that other future studies investigate the possibilities of customisation in DSpace software.

Furthermore, regarding strengthening the usability of the DIR in terms of User interface (UI) design, the literature highlights focus on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand and use to facilitate those actions (Kocsis et al., 2016).

Kocsis et al. (2016) has advised on requirement characteristics which enable usability in DSpace UI section

In consideration of UI features, the developers mainly work towards understanding the needs of users and design a User Interface that aid them with navigating the Information System handle their search tasks, exploring how the application communicates with them, and determining the characteristics User Interface. Some of these characteristics are discussed below:

- ***Metaphors and user needs***

"A metaphor is a relation between language as an abstract (the bottom) system, individual language users, and cultural knowledge", (Jitnupong and Jirachiefpattana, 2018:8). When users come across a user interface metaphor, they bring their own situation to the understanding of that metaphor. These situations include culture, work profession, education, and other traits which classify them as individuals. This is the main responsibility of the designer of a User Interface obviously

- ***Navigation design***

Navigation of the system is guidance that aids a user to attain their research queries. A satisfactory system should be able to direct the users from beginning to end, which means that the designing team needs to understand user task involved in the research processes for the purpose of accomplishing it (Jitnupong and Jirachiefpattana, 2018). Navigation is reflected in how the system is designed by looking at "layout; the template, position of buttons, system hierarchy, content organisation, tabs, menu, and border" in every User Interface. In DSpace, this gives a simplified navigation and an overview, via visible structured segments so that users will not be overstrained and assist in the handling of content (Kocsis et al., 2016). DSpace also provides communities supported by forums, and question and answer portals organised by content categories.

- ***Must be usable (easy to use)***

According to Bugyei (2017), the system should run for 24 hours without any momentous breaks and it is usable in any part of the world with internet coverage. It should enable to

provide further corresponding links to different topics using a blog and news page for example. This enables for quick references, information and notifications, while still using the application (Bugyei, 2017). The welcome page as the entry point should give support to user by giving authentic functionalities for interactive usage, together with content search functionality. The "introduction" is required to give users an understanding of the content and what they can expect (e.g. develop a video) to stimulate attention and motivate the users. In getting started, a tutorial is needed to introduce the system to new users - how the website is working/ structured (e.g. video, teaser, infographics, etc.); it should be adaptable to user experience level and briefly introduced on first screen. A repository tutorial (e.g. video) can be developed to create awareness, educate and learn from experts or other community members (Kocsis et al., 2016).

Although there has been short coming on screen design and user interface revealed in this study which supports the findings of other authors such as Kim (2005); Pinfield (2015); and Narayan and Luca (2017), other authors had reported that respondents in their studies had not experienced problems in using the Dspace for especially for depositing of items. In accordance with this, in an empirical usability study by Broock (2005) at Oregon State University Libraries, DSpace metadata registry and submission screens was customised so that students are prompted to enter fields that pertain to their thesis such as Advisor or College rather than more generic field names such as Description. The instructions on the submission screens were also revised so that they are more understandable. In Broock (2005), six undergraduate students were recruited to test the usability of the electronic thesis and dissertation submission process. The hypothesis was that if undergraduate students of widely differing experience and age could successfully complete the submission process, then graduate students completing their degrees should also find the process simple. The researcher supplied the students with a sample dissertation as a PDF file and the "Submitting Electronic Theses and Dissertation" instruction form and asked the students to submit the thesis to the DSpace@OSU Electronic Thesis and Dissertation collection. The study revealed minimal problems, but also confirmed the assumption that the process was sound and that the changes they made were helpful. Furthermore, Broock's (2005) results showed that all the six students completed the submission process quickly by following the instructions. They also submitted and uploaded their PDF file and entered the basic metadata within five minutes. This included author, title, advisor, and other pertinent information. However, it was realised that there was also a need for instructions to log off. In terms of complexity, one of the participants found the technology frustrating to use. In terms of complexity, Stanton and Liew (2011) assert that it is likely to be a hurdle in accessing and using digital repositories directly though this may not be a barrier to

accessing digital repository content through “Google Scholar” or “library catalogues” that are understood to be widely used by researchers. These results highlight the significance of optimising repository metadata for discoverability through existing search engines such as Google Scholar and research portals.

6.5 Level of satisfaction in using digital institutional repositories

Kim and Kim (2008:868) describe one of the attributes of usability as satisfaction (i.e. visual appearance, consistency and standards; supportiveness meaning helpful and support) (See section 3.4.2). Actual use (AU) construct from TAM was used to measure the level of satisfaction of respondents with the NUST DIR. The respondents were asked to agree or disagree with the level of system satisfaction.

The majority of PG students (16, 31.3%) agreed that the DIR is satisfactory to the users; however, 15 (29.4%) were neutral, 11(21.5%) strongly disagreed, 6 (11.7%) disagreed, while 3 (5.8%) agreed. In terms of readable and engaging text types and font size, 35 (68.6%) agreed, 8 (15.7%) were neutral, 6 (11.7%) strongly agreed, while 2 (4%) disagreed. Seventeen (33.3%) were neutral to logically organising information, 1(21.6%) disagreed, 9(17.6%) strongly disagreed, while 8 (15.7%) strongly agreed and 6 (11.7%) agreed to logical organisation of information. Results showed that although most respondents either agreed or strongly agreed, several others were neutral.

The majority of faculty agreed and strongly agreed with the level of satisfaction with the system. The results showed that the highest number of respondents 15(51.7%) strongly agreed to readable and engaging text types and font size of the system, 12 (41.3%) respondents agreed while 2 (6.8%) disagreed. In terms of appropriately used icons, graphics and colours, the majority 24 (82.7%) agreed, 4 (13.7%) respondents strongly agreed and 1(3.4%) disagreed. Seventeen (58.6%) respondents agreed to concise terms used to label menu functions, 10 (34.4%) strongly agreed, while 1(3.4%) strongly disagreed and 1(3.4%) disagreed respectively. Eighteen (62.0%) disagreed to logically organising information, 8 (27.5%) strongly agreed, while 3 (10.3%) agreed. Results show that although most respondents either agreed or strongly agreed, several others were neutral.

During the interview, the researcher posed the question, what is your opinion with regards to the appearance of the DIR interface? Librarians responded that the interface design is fine and the texts and font are not too small but large enough to read. The only problem with the system

is that it does not have features that can accommodate the visually impaired and the system should be designed to accommodate all users irrespective of their status of ability/disability.

The respondents were also asked to describe the organisation of information on the DIR. It was revealed that the system is cluttered with information and should be simplified with less information on each page. Another additional question posed was whether the system was limited in allowing innovation. In response, the system administrator noted that the system is limited when it comes to adding extra links or codes. However, it is possible to change colours and add on a logo. Overall, it is challenging to customise the system especially when one does not have training.

The Librarians were asked to describe the organization of information on the DIR. All participants found that the repository interface was cluttered with far too much information, including a lot of metadata and statistics that were not meaningful to them. While all of DSpace's communities and browsing categories (title, author, etc.) were visible on the homepage of the repository, it was not clear to users what the context of these items was within the site. This was an issue which was part of the navigation and information architecture of the software and the lack of DSpace customisation which can cater for the universities' specific needs (Narayan and Luca, 2017). Zhang, Maron and Charles (2013:4) asserted that the usability factors in research repositories affected user motivation and engagement.

Kim and Kim (2008:868) describe one of the attributes of usability as satisfaction. Satisfaction is measured by attributes i.e. visual appearance, consistency and standards; supportiveness meaning helpful and support). According to Vaezi, Mills and Zafar (2016) User satisfaction within information systems (IS) is considered as a significant indicator of information systems success and has been the subject of numerous research studies since the field's inception. When it comes to attribute satisfaction, early IS studies focused on users' perceptions of attribute performance and quality and related those to their satisfaction with the IS (Vaezi, Mills and Zafar, 2016). Debons, Ramage, and Orien (cited in Vaezi, Mills and Zafar, 2016) developed a questionnaire to measure user productivity perceptions of 10 different attributes of IS, including timeliness, reliability, assistance, accuracy, access, adequacy, and cost. Similarly, Neumann and Segev (cited in Vaezi, Mills, and Zafar, 2016) designed a survey to measure user satisfaction with IS, which considered four attributes: accuracy, recency, content, and frequency.

Delone and Mclean (cited in Maditionos, Mitsinis and Sotiriadou, 2008) stated that the system quality can be divided content (information quality), quality of the system, and quality of services. Information quality denotes the quality of information or quality of the content, whereas, system quality refers to all the topographies which reduces difficulties experience by users when interacting with the system. Griffith (cited in Madu and Madu, 2002) establish that some sort of formats can make information more understandable, satisfactory and attractive. Berry (cited in Matitinos, Mitsinis and Sotiriadou, 2008) indicated some of extend of quality of services which comprises of reliability. Reliability can only be assured when some conditions are met. For instance, information is accurate, updated, objectively and are comes from a credible source. Madu and Madu, (2002) as well as Xiaoo and Dasgupata (2002) established timelessness and accuracy of information have an impact in satisfaction of information.

According to Delone and Mclean (cited in Maditionos, Mitsinis and Sotiriadou, 2008) information system success consider "system quality" as the utmost significant user's satisfaction determinant. This model indicated that 'system quality" is divided into different categories, namely: information quality, system quality and services quality. Furthermore, Mckiney, Yoon and Zahedi (cited in Maditionos, Mitsinis and Sotiriadou, 2008), information and system quality were some of the fundamentals measures identified by these authors. Matitinos, Mitsinis and Sotiriadou (2008) stated that it is clear that the most important aspect that influences satisfaction is quality. However, the authors it is extremely hard define quality as it depended on each person's view about what quality means to them.

The construct of system quality mainly focuses on the components of the system which influences its ease of use, flexibility, and efficiency. In particular, access includes the procedure followed by a user to access different components of the system. The time and efforts spent by users during this process determines the quality of access for the system. Cheung and Lee (2005) found that user satisfaction is largely dependent on the quality of the access that is determined by speed of access. Usability represents how easily a user can use the features of the system. Furthermore, it shows the attitude of the system towards its users. In other words, a user-friendly interface environment enhances usability and eventually satisfaction (Khalifa and Liu, 2002). For example, a well organised site that is easy to use and provides simple and clear instructions, avoiding confusion can be considered user friendly.

6.6 Summary

This chapter discussed the research findings using a theory that underpinned the study and extant literature. In general, participants found that digital archiving makes their research work more visible, increasing their reputation as scholars. Furthermore, the study found that the respondents had positive attitudes and acknowledged the benefits and gains from the DIR. The respondents were found to have a positive attitude towards internet (DIRs) because they believed that it is good and beneficial to their research needs. This finding suggest that the relationship between normative and behaviour intention by DIR users is significant.

These results further revealed that there was low level of content submission by both PG students and faculty. These results confirm the findings of Bamigbola (2014) who also reported low submission of scholarly works by faculty to the repository. The current study found that though faculty engaged in research they did not contribute their research output to DIR because they were not informed on the need to contribute their research output to the digital repository of their institution. Other faculty members were ignorant of the value of depositing their research work in the repository. In addition, some faculty were wary to deposit in the repository for fear that journals restricted authors to submit their research work elsewhere. The results revealed that although the majority of respondents have contributed to the DIRs, there were others who preferred to submit their research work elsewhere rather than the repository. The results suggest that the policy did not encourage authors to self-archive as it gave the responsibility to the librarians to do it on behalf of the authors.

The findings also revealed that performance expectancy (PE), facilitating condition (FC) (noted from trainings offered) and attitude towards (AT) did not influence PG students and faculty behavioural intention to archive in the DIR. Even though PG students and faculty tended to approve that DIRs are best means of information dissemination (which implies positive attitude), most participants had not wholly adopted archiving in DIRs

The study also found a need for facilitating conditions and policies issues to be addressed as a way of promoting open access through DIR.The results suggested that the NUST DIRs were hardly used for information access. This was attributed to the lack of awareness about the existence, benefit, and role of DIRs. However, the findings revealed that NUST subscribed to several databases such as Proquest, Jstore, NUST Library discovery service, Emerald and many more. The study results revealed that majority of students were inclined to use Google as a primary source of information, while other students preferred to use print source of information.

The findings revealed that perceived usefulness influenced users' intention to adopt and use the system. The majority of faculty agreed and strongly agreed that the system was useful. From the interviews it was established that the NUST DIR was useful especially to those that are familiar with the system, for example postgraduate students and staff members. However, they stated that it was difficult to test the credibility of the information other than relying on the departments to test the accuracy and the credibility of the information provided. The results revealed that there was lack of guidance on how to determine the quality and credibility of the documents submitted in the DIR.

The study established that statistics of use were not displayed by the system to everyone. Moreover, the system does not have usage statistics aggregation service that would enable Institutional Repositories to share and compare usage of resources. Statistics can only be seen by administrators. The study found that accuracy and completeness of content in the NUST DIR was compromised. However, users did not experience much of the problem accessing the system. Consequently, the respondents had confidence with their knowledge of the DIR and found it easy to use and useful. The respondents also found research output housed in the DIR to be relevant. Hong et al. (2002) stressed that relevance influenced the ease of use and usefulness of the IR.

The study revealed that the NUST DIR use was hampered by lack of training especially in specific software used to develop the Institutional Repository such as D-space and the slow institution network that frustrated downloading or uploading of content into the repository. The study revealed that NUST DIR had issues as revealed by Heuristics assessment for example having to retype the entire command. The NUST DIR was also found to be cluttered with the information and needed to be simplified; it was difficult to customise the system.
The study revealed key issues as follow, the findings revealed lack of the awareness about DIR among PG students and faculty. The findings further revealed weak institutional repository policy which does not clearly stipulate processes and standards on the submission of scholarly works to the repository. Moreover, there seemed to be misconception on the part of faculty and PG students about DIR and open access. Contrary to the literature, for example Westell (2006) who points out that the deposit of material in the repositories around the world remain low because of various reasons of which include usability factors particularly poorly designed interfaces, results from this study indicate that PG students and faculty attitudes played a significant role in influencing their behaviour towards the use of DIRs. Other variables found to influence participants' use of DIRs were subjective norms and facilitating conditions. The

findings therefore, illustrate that PG students generally perceived DIRs as useful but still reluctantly use them.

Their intention to use DIRs was also affected by external factors such as the publisher's policies related to copy right issues which prohibit authors to publish anywhere else.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS ANDRECOMMENDATIONS

7.1 Introduction

This study investigated the usability of institutional repositories by faculty and postgraduate students at NUST. The study addressed the major research question: What system usability factors influence the depositing and use of scholarly content in the DIRs by faculty and postgraduate students at the Namibia University of Science and Technology?

The following specific research questions were addressed:

1. What are the attitudes and perceptions of PG students and faculty towards DIRs?
2. To what extent are PG students and faculty at NUST: a) archiving their research output in the DIR, b) using content in the DIR?
3. What is the perceived usefulness of the DIR by PG students and faculty?
4. What is the extent of system usability of the DIR by PG students and faculty?
5. What is the level of satisfaction of PG students and faculty with the DIR?

The Technology Acceptance Model (TAM) model was used to underpin the study because of its robustness and parsimoniousness. A post-positivist paradigm was used, with a predominantly quantitative and lesser qualitative approach. Interviews, survey questionnaire, document review, system observation, and expert's evaluation methods were used in data collection. The study population was made up of faculty, post-graduate students, librarians and a system developer/administrator. Quantitative data was analysed using SPSS to generate descriptive statistics, while qualitative data was analysed thematically. Reliability and validity were ensured by methodological triangulation, pretesting the questionnaires, and careful transcription of the data.

This concluding chapter contains four main focus areas: summary of findings, conclusion, and recommendations areas of further study are suggested. As part of the conclusion, the originality of the study is given. The following section presents the summary of the findings.

7.2.1 Attitudes and perceptions of PG students and faculty towards DIRs

The study found generally that the respondents have positive attitudes towards DIR and acknowledged the benefits and gains of the DIR. The study found that 77 (46.4%) of PG student's respondents were motivated by the need to increase accessibility of their work, while 33 (19.8%) mentioned that the DIR provided publicity for research work and impacts on research community; 32 (19.8%) responded that they were motivated to contribute to the DIR as this would enable them know how many times their research was viewed or downloaded by others; and 23 (14.5%) noted that their contribution to the DIR was based on request. The results similarly indicated that, majority of respondents (28, 34.1%) were motivated by the need to increase accessibility of their research work, 26 (31.7%) indicated that contributing to institutional repository creates publicity for their research work, 11 (13.4%) indicated that the DIR facilitated the coordination of interdisciplinary teaching and research efforts, 10 (12.1%) noted that the DIR provides them with the statistics of the number of times their materials were viewed and downloaded.

7.2.2 Extent to which PG students and faculty at NUST are: a) archiving their research output in the DIR, b) using content in the DIR

By applying the use behaviour construct from TAM in this study, PG students were asked if they had previously submitted their scholarly output to the DIR at NUST. The study revealed that 9 (10.91%) had previously contributed digital materials to DIR, and 73 (89.09%) had never contributed to the DIR. The high number of non-contributors could be attributed to the fact that most of them were masters' students who were focusing on completing their dissertation. Faculty respondents were similarly asked if they had deposited their scholarly work into the Digital Institutional Repository at NUST. The results showed that 25 (71.4%) had previously deposited into the repository, while 10 (28.6%) had not.

Using the behavioural intension construct from UTAUT, faculty who stated that they had contributed their scholarly work were asked to state their preferences in submitting their research work to institutional repositories. The results showed that the highest number of faculty 8 (32.0%) deposited their research in the DIR followed by 7 (28.0%) who submitted their work to the Print Institutional Repository and 3 (12.0%) who submitted their research work to professional/research group open access website; 5 (20.0%) submitted their work to department website/portals and those who preferred to submit their research work in subject repository were only 2 (8.0%).

Though the results indicated faculty engaged in research, the majority did not submit their research work to DIR for various reasons including the fact that they were not aware of the need to contribute their work to the DIR. Other faculty members were ignorant of the value of depositing their research work in the repository. In addition, some faculties were wary of depositing in the repository for fear that journals restricted authors from submitting their research work elsewhere.

Using behaviour intention construct from TAM, PG students who stated that they did not contribute materials to the DIR were asked whether they planned to contribute materials to DIR in future. The results showed that the majority 46 (63.1%) said yes they are planning to do so, followed by 21(28.7%) who were undecided, while 6 (8.2%) were not planning to contribute to DIR.

The study discovered that the majority of respondents are planning to contribute to the DIR; however, there were still those that are not planning to do so; the study assumes that it is due to lack of awareness and full understanding of the benefits of the DIR. Other factors such as copyright issues and lack of incentives have been seen to be contributing factors.

The study found that the participants highly prefer voluntary submission and that through policy the institution encourages this practice. With these results the study assumes that voluntary submission policy also contributes to low level of submission, or to the DIR, as the researchers do this at their own expense when they want. Although some shareholders argue that mandatory policies could cause more damage than good in relative to researchers comply with submission of their research work (Palmer et al., 2008), some other researchers indicated that a mandatory policy is the only approach to attain suitable contribution rate (Sale cited in Stanton and Liew, 2011).

The findings further revealed that performance expectancy (PE), facilitating condition (FC) and attitude towards AT did not influence PG students and faculty's behavioural intentions to archive in the DIR. Even though PG students and faculty tended to agree that institutional repositories are best option of information disseminating (which implies positive attitude), most of them have not completely adopted archiving in DIRs.

The study found that the DIR is hardly used for content access. The low use of the DIR for content access is assumed to be connected to the low level of awareness of the DIR within the institution, on where to find it (among PG knowledge) and skill on how to use it coupled with the shortage of contents that would fully benefit the PG students in their research needs. The

low use of the DIR is also connected to the massive use of Google which most students tend to rely on for information needs. Therefore, the marketing of the DIR within the institution is important and highly required. The study found that the library engages itself in programs for promoting e-resources within the institution which also includes the e-resources obtainable through the DIR. However, the study found that more effort should be made. In addition, since the students massively make use of Google, it is high time that the institutions make use of semantic webs to enable the accessibility of DIR though other sites or enabling Google to pick up the NUST DIR contents.

7.2.3 Perceived usefulness of DIR by PG students and faculty

The respondents were asked about the usefulness of NUST's DIR. The majority of PG students agreed and strongly agreed respectively that the system was useful and easy to use. The study reveals that the highest number of students 50 (63.2%) agreed and 25(31.6%) strongly agreed that information retrieved was current, while 3 (3.7%) were neutral and 1 (1.2%) strongly disagreed. Similarly, the majority of faculty agreed and strongly agreed respectively that the system was useful. Twenty-two (57.9%) agreed that retrieved information was from credible sources, 5(13.1%) strongly agreed, 1(2.6%) strongly disagreed 9, (23.8%) strongly agreed and 1 (2.6%) disagreed. With regards to currency of information retrieved, 19 (23.7 %) agreed, while 1 (2.6 %) strongly disagreed that the information was current. Seventeen (44.7 %) agreed retrieved information was valid, 9(23.8 %) strongly agreed, while 4(5.0%) disagreed and 1(2.6 %) strongly disagreed. The study found that there were no issues related to the usefulness of the DIR and that the participants found it to be beneficial.

The researcher further sought to know whether the DIR was adequate for research information needs of researchers. Interviewed librarians indicated that the DIR did not adequately meet the researcher's information needs because the content was limited due to lack of active contribution to the DIR by faculty. The researcher also polled respondents on usage statistics. The System developer was asked if the system has a usage statistics feature especially for displaying who viewed or downloaded an item. The respondent indicated that, statistics of use are not displayed by the system to everyone. Moreover, the system does not have usage statistics aggregation service that would enable Institutional Repositories to share and compare usage of resources especially on downloads and citation. The respondents were also asked to give their opinion about the accuracy and completeness of the information in the DIR. The responses seemed to indicate that accuracy and completeness is compromised.

The respondents were also asked what needs to be done to the DIR to improve its features and performance. The respondents noted that more papers of good quality should be added. Librarians were also of the view that the visually impaired should be catered for. They also expressed the need for the system redesign to avoid cluttering of information on a page.

7.2.4 Extent of system usability of the DIR by PG students and faculty

This study used ease of use (EU) construct from TAM to measure the degree to which the PG students and faculty find the DIR free from difficulty or great effort. The results generally showed that users did not experience much of the problem accessing the system. The results also showed that internet connection or low bandwidth were barriers in searching NUST DIR. As to the level of errors that users encounter when using the DIR, the results indicated 'the repository was quite user friendly and very straight forward to use. However, it was noted that unavailability of the system due to downtime was a problem.

Hong et al. (2002) noted that the background knowledge of search domain of the users may enhance interaction with information systems enormously (Hong et al., 2002). By using domain knowledge construct of system characteristic external variable of TAM the respondents were asked whether they agree or disagree they are familiar with the search domain and knowledgeable with searching options. The results showed that the majority of PG students (43, 55.1%) agreed that they were familiar with the research domain, 22 (28.2%) strongly agree, 9 (11.5%) respondents were neutral, while 4 (5.1%) disagreed. As for faculty, the results show that the majority (15, 51.7%) agreed that they are familiar with the research domain,7 (24.1%) strongly agreed, 3 (10.3%) were neutral, while 2 (6.9%) strongly disagreed and 2(6.9%) disagreed. Hong et al. (2002) stressed that knowledge of research domain influence the ease of use of an information system.

Using relevance construct of system characteristic external variable from TAM the participants were asked whether to agree or either disagree with the relevance of the research output. The majority of PG students (44, 56.4%) agreed that retrieved information was relevant, 25 (32%) strongly agreed, 7 (9.0%) respondents were neutral; 1(1.3%) strongly disagreed and 1(1.3%) disagreed respectively. Results showed although most of respondents either agreed or strongly agreed several others were neutral. The faculty were similarly asked whether they agreed or disagreed with the quality of relevance of the research output. A number of respondents 15(51.7%) agreed that retrieved information was relevant, 11(37.9%) strongly agreed, 1(3.4%) was neutral, while 1(3.4%) strongly disagreed and 1 (3.4%) disagreed. These results reveal that there were participants that were sceptical about the relevance of the retrieved information.

By using the system characteristic external variable of TAM, the researcher sought to find out what systems or tools were used at NUST to ensure that the DIR meets the requirements of open access or to make the content openly accessible. The results showed that the system has an integrated AD (active directory). This means all the system administration tools are integrated such that when you log into the system you don't have to use different passwords. They instead use the same password for logging on. Secondly they have a handler server that helps with positioning the institution articles on Google. This helps with rating so that the searcher can immediately pick up the article in the repository through Google.

The researcher used the screen design from the system characteristic external variable of TAM to measure functionality and characteristics of NUST's DIR. The researcher therefore asked the system developer if there were any features and functions of the digital institutional repository that users would like to see improved. The respondent noted the system is rather complicated and should be made user friendly. The respondent further noted that the system does not have functionality to move an article that is placed erroneously in a particular discipline to the correct place. The system developer was also asked to explain challenges faced in designing the DIR for usability. The results revealed that system administrators lacked training especially in specific software used to develop the Institutional Repository such as D-space. The administrator was also frustrated by the slow institution network as this hampered downloading or uploading of content into the repository. It was also revealed that the system comes already defined and customised; therefore, it makes it difficult for the administrator to manipulate it and design it in a desired format.

During the Heuristic evaluation of the NUST DIR, all three experts identified some problems in relation to Heuristic 8. For Heuristic 8, the three evaluators identified the main problem identified which was that the system could not be customised. This suggests that the system was lacking in terms of flexibility and efficiency of use. Correspondingly, all the experts identified some problems related to Heuristic 10. These problems were mostly related to navigation through the system. The fact that many problems were found with regard to Heuristics 10, this possibly revealing navigational and user control difficulties with the system interaction. The screen design or user interface observed in this are due to the lack of training especially job training of the System Developers and this is a threat to the usability of the DIR with regards to the ease of use (EU) and eventually satisfaction.

7.2.5 Level of satisfaction of PG students and faculty with DIR

Kim and Kim (2008:868) described one of the attributes of usability as: satisfaction (i.e. visual appearance, consistency and standards; supportiveness meaning helpful and support) (See section 3.4.2). Actual use (AU) construct from TAM was used to measure the level of satisfaction with the DIR. The majority of PG students (16, 31.3%) agreed that the DIR is satisfactory to the users; however, 15 (29.4%) were neutral, 11(21.5%) strongly disagreed, 6 (11.7%) disagreed, while 3 (5.8%) agreed. In terms of readable and engaging text types and font size, 35(68.6%) agreed, 8 (15.7%) were neutral, 6 (11.7%) strongly agreed, while 2 (4.0%) disagreed. The study also revealed that the font size and the text are easy to read. However, the system does not have features that can accommodate the visually impaired; therefore, the system should be designed to accommodate all users irrespective of their status of ability/disability.

The respondents were also asked to describe the organisation of information on the DIR. It was revealed that the system is cluttered with the information and should be simplified with less information on each page. With regards to Colours, graphics, and icons on the DIR, the administrator noted that the system is limited when it comes to adding extra links or codes though it is possible to change colours and add on a logo.

7.2 Conclusion

This study investigated systems usability factors influencing the depositing and use of scholarly content in the DIRs by faculty and postgraduate students at the Namibia University of Science and Technology by investigating the extent to which factors such as intention, perceived usefulness, perceived ease of use, self-efficacy and subjective norms influenced PG students and faculty Information and Communication Technology adoption and use. Based on the summary of findings, several conclusions are drawn. Similarly, other studies in literature, respondents in this study acknowledged the benefits of Digital institutional repositories such as sharing the work publicly, ease of sharing of work with other students, sharing of work with peers and research community, exposure of work via DIR increase work cited, and availability of work on Google scholar. However, other faculty were ignorant of the value of depositing their research work in the repository, hence did not contribute to the DIR.

Several studies cited earlier have shown that a positive attitude is an important factor that significantly contributes towards technology adoption and use by users of technology. It is therefore concluded that with all other factors i.e. ease of use, usefulness, relevance, facilitating condition and skills, usability of the DIRs among PG students and faculty would be enhanced.

The effective use of DIRs depends largely on a number of factors such as level of awareness, publishing policies and, training, ICT skills of students, faculty, and usefulness, and ease of use. Results of this study indicate that there are trainings offered on Library and information training skills offered on a regular basis.

Contrary to the literature, for example Westell (2006) who points out that the deposit of material in the repositories around the world remain low because of various reasons of which include usability factors particularly poorly designed interfaces, results from this study indicate that PG students and faculty attitudes played a significant role in influencing their behaviour towards the use of DIRs. Other variables found to influence participants' use of DIRs were subjective norms and facilitating conditions. The findings therefore, illustrate that PG students generally perceived DIRs as useful but still reluctantly use them.

Their intention to use DIRs was also affected by external factors such as publisher's policies related to copy right issues which prohibit authors to publish anywhere else. Although participants illustrated no problems with ease of use, the study revealed issues which are part of the navigation and information architecture of the software plus the lack of DSpace customisation which can cater for the universities' specific needs (Narayan and Luca, 2017). Kim and Kim (2008) found that an effective provision of directions on how to register and search for documents, improving visual appearance, and clustering and displaying related materials were factors that enhanced usability of DIRs.

Some of the shortcomings in the use of the DIR as reported by faculty were redundancy of information with other information dissemination modes. Findings on the inquiry into the use of DIR content at NUST confirmed the content in the DIR is hardly used for reasons connected to shortage of research in the DIR coupled with awareness by PG students. Awareness is a powerful determinant of users' behavioural intention towards the use of electronic resources. Literature review confirms that there is a lack of awareness about the DIR among PG students and faculty; this study suggests that this creates negative attitudes that may impact on the usage of the Digital Institutional Repository. Although librarians promoted and marketed the DIR, it can be concluded that the awareness and promotional activities done were ineffective.

This study also revealed the overall use of the TAM and DTPB in the usability of the DIRs was useful. However, the results from this research also indicates that performance expectancy (PE), facilitating condition (FC) and attitude towards (AT) did not influence PG students and faculty behavioural intention to archive in the DIR. Even though PG students and faculty

tended to agree that DIRs are best option of information dissemination (which implies positive attitude), most of them have not completely embraced archiving in DIRs.

The study found that facilitating condition and policies issues needed to be resolved first as far as promoting open access through DIRs is concerned before attitude towards open access, because attitude towards open access publishing is quite positive.

However, this study revealed that the perceived usefulness by PG students and faculty influence the intention to use which then leads to actual use of the DIR for archiving; although depositing of the materials in the DIR was low.

The study findings seem to agree with Hong et al. (2002) who extended TAM and found that knowledge of research domain influenced the ease of use. In this study the respondents had confidence with their knowledge of the DIR. Moreover, the majority of respondents did not have the problem with the system, hence agreed that the system was easy to use and useful.

From the perspective of users, the results indicated that the key factors including self-efficacy, subjective norm, intention to use have significant effect on users' actual usage of Internet information resource.

The outcome of this study is expected to make an important contribution in the area of policy formulation, theory, practical interventions, capacity building, skills development, and infrastructure development to enhance the usability of the DIRs by PG students and faculty at the Namibia University of Science and Technology.

Usability of DIR and timely access to information through DIRs is a critically important topic, globally, and in Africa, where achieving informed and knowledge society is a prime goal. The provision of such access is predicated on well-designed DIR platforms and effective disseminated information through these systems.

This study investigated systems usability factors influencing the depositing and use of scholarly content in the DIRs by faculty and postgraduate students at the Namibia University of Science and Technology. Although Namibia University of Science and Technology has established the digital institutional repository, there has not been a study carried out to investigate and evaluate the use and the usability of the system, to mitigate and adapt to latest technology trends and variability as well as improve the DIR functionality.

The outcome of the study is expected to provide evidence based data upon which relevant academic library institutional repositories policies can be formulated. The study also provides

data that would inform budget allocation for ICT infrastructure development for libraries, human resource development, and staffing academic public libraries in Namibia. Using the TAM model, the study contributes to literature on the factors that influence the self-archiving and use of information systems such as DIRs in academic libraries from a developing country context. This study also intends to fill the gap in literature especially in regard to self-archiving policies and training required to fulfil the DIRs usability.

The models (TRA and UTAUT) were selected to supplement TAM given that they use behavioural intention to predict usage of a system by a user by focusing on determinants such as, voluntary use, perceived behaviour control, efficacy, normative beliefs, and motivation to comply, and facilitating conditions, which are not in the TAM. These constructs were useful in determining students and faculty's behavioural intention to use the information system in addition to the TAM constructs of PU and PEOU including external variables. The study broadly adopted the TAM model.

Methodologically, extant studies have used diversity of methods to study usability of DIRs; however, a few of these studies have used Heuristic Expert evaluation as a usability inspection technique involving expert evaluators and assessment of the system (Nielsen, 1994:26). "Heuristic evaluation (HE) is the most widely used usability evaluation method for computer system interfaces and can result in major improvements to user interfaces" (Lindgaard cited in Ssemugabi, 2006:2). This study used Heuristic Expert evaluation with the aim of improving usability of DIRs at the Namibia University of Science and Technology. "Heuristic evaluation is a usability inspection technique where a small set of expert evaluators, guided by a set of recognised usability principles known as heuristics, determine whether a user interface conforms to these principles" (Nielsen, 1994:26).

7.3 Recommendations

From the main findings and conclusions of the present study, various recommendations emerge that are listed below. The recommendations are discussed according to the model which underpins the study (Technology Acceptance Model). Regarding the effective usability and usage of the DIRs, Figure 6.7 below illustrates a recommended guide for academic institutions in Namibia.

1. Facilitating condition

- From policy perspective, NUST should make provisions for faculty and postgraduate students to personally self-archive their research work in the DIR instead of the current policy that requires only librarians to archive on behalf of researchers. This may help to increase the rate of depositing in the repository.
- Academic institutions in Namibia should get more information revolving the conflict with publisher's policies in regards to author's issues related to archiving.
- Since scholars appeared uneducated about copyright issues, considering that some publishers give permission to authors to make contributions into their institutional repositories though making their articles accessible via their university's institutional repository.
- Costs: for a successful institutional repository the academic institution should provide financial as well as staffing and resources per strategic plans the institutions with Digi tal Institutional Repositories in Namibia should consider cost in the following areas:
  - Software costs: as most of the repository software is available freely as Open Source, software cost is not a problem. But some repository software such as DSpace, Fedora, and Greenstone require additional third-party software to be installed on hardware in o rder to render effective service. There may be some expenditure for purchasing additi onal software which must be highly considered.
  - Hardware cost: The concerned institutions should provide adequate hardware such as server PCs, work stations, network tools, and other necessary equipment for proper m aintenance of the system.
  - Staff costs: qualified human resources are a pre-requisite to make a successful Institut ional Repository system. Technically qualified staff must be hired to carry out IR-rela ted work. Additionally, The Library and Information Science (LIS) schools in Namibia should work with libraries to introduce system development programmes in their curriculum; this will help create a critical mass of support in the University libraries which currently depend on ICT departments for support, management, administration and development of the systems.
  - Start-up costs: appointing a skilled repository administrator; establishing a steering gr oup or advisory panel; training support staff, researchers, and other end users.

2. Subjective norms

- Marketing*:* other studies, for example Alnaser et al. (2017), have found that there is a significant positive relationship marketing of product or services and subjective norm

which leads to user's satisfaction. Therefore NUST should provide strong advocacy and marketing about benefits of institutional repositories and depositing materials thereof to encourage faculty and PG students to contribute their research to the Digital Institutional repository to enhance visibility of the University and that of the authors.

3 Behavioural intention

- The NUST must ensure that the DIR content is easily discoverable and ensure the usage of content within the institution. This can be either done through the library discovery service, to make it clear how DIR content can be discovered.

4 Perceived usefulness and perceived ease of use

- The academic institutions should regularly carry out the usability test of DIRS to ensure the usefulness and ease of use the systems.

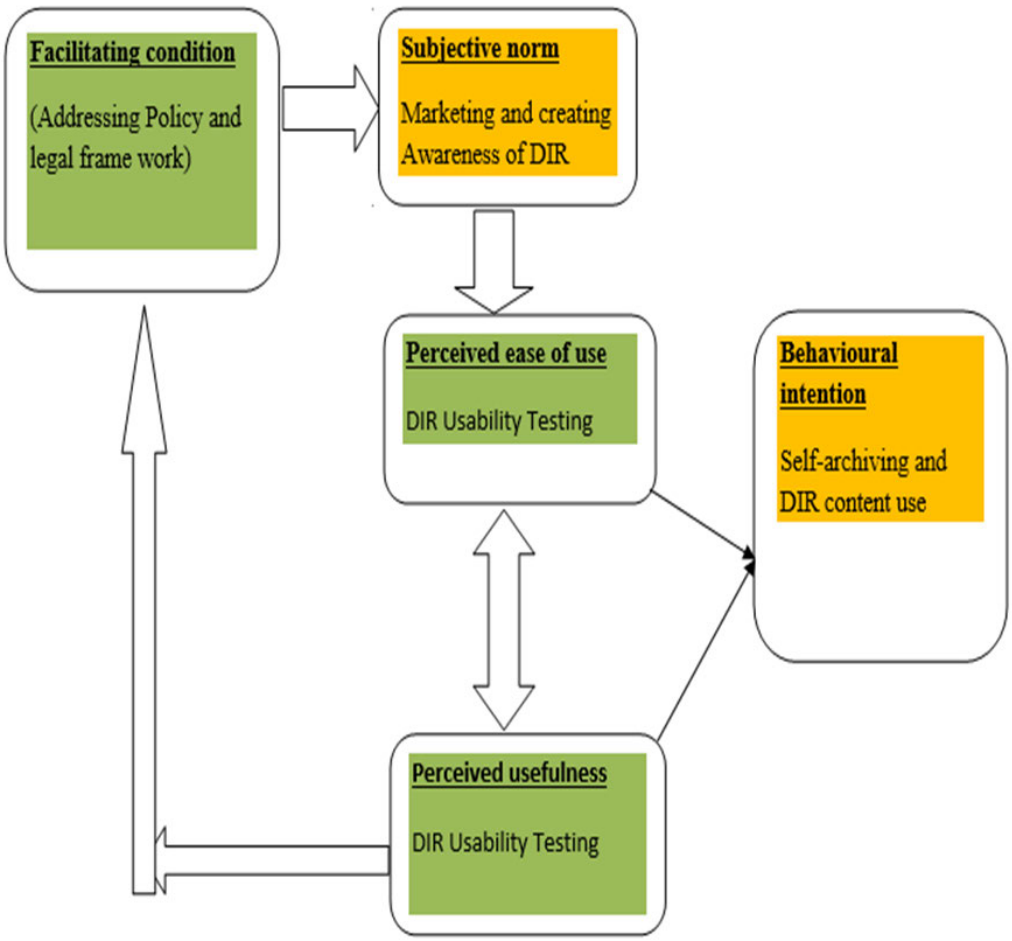

Figure: 6.7 Recommendations conceptual frame work

7.4 Recommendations for further research

Further studies should:

- Investigate the preparedness of institution system developers in terms of DSpace adoption and implementation. The study should investigate whether the system administrator's skills are relevant for the full adoption of the DIRs.
- Investigate the issues of the DSpace limitations or enabling in terms of customisation to suit the institutional needs. Further studies should find out what can be done or cannot be done on system and what implications that would have an impact the effectiveness of DIRs services.
- Investigate publishing policies which involve academic institutions and publishing companies on issues related to copy rights. Further studies should also investigate on conflict of publishing policies between authors, institutions and publishing companies.
- Investigate the preparedness of academic libraries in adopting the self-arching practice in terms of policies and ICT skills. The studies should find out to what extent academic institutions ready to implement the authors self-arching of their own research work and what are the implications.
- Investigate strategies employed by academic institutions/libraries in assessing and evaluating the accuracy of the content deposited in the DIRs.

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APPENDICES

Appendix 1:Informed Consent Letter

P.O. [redacted]
[redacted]a
[redacted]
Cell: +264814048164
Email: tertuhaixwa@gmail.com

12 October 2017

TO WHOM IT MAY CONCERN

Informed Consent Letter

Researcher: Tertu .P. Shiweda
Institution; University of KwaZulu-Natal
Cell: +264814048164
Email address: tertuhaixwa@gmail.com

Supervisor: Prof. Stephen Mutula
Institution: University of KwaZulu-Natal
Telephone number: +2733-260 5093
Email address: Mutulas@ukzn.ac.za

I, Tertu Ponhele Shiweda, of University of KwaZulu-Natal, kindly invite you to participate in the research project entitled **Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST).**This research project is undertaken as part of the requirements of the PhD, which is undertaken through the University of KwaZulu-Natal, Information Studies Department.

The aim of this study is to investigate the Usability of Digital Institutional Repositories (DIR) at Namibia University of Science and Technology by Faculty and Postgraduate Students

Participation in this research project is voluntary. You may refuse to participate or withdraw from the research project at any point and for whateverintention. There will be no any type of reward or gain for participating in this research. Confidentiality and anonymityof records identifying you as a participant will be assured and maintained by the Department of Information Studies, at the University of KwaZulu-Natal.

If you have any questions or concerns about participating in this study, please feel free to contact myself or my supervisor at the numbers indicated above.

I really do appreciate your participation in the study.

Thank you
Yours sincerely

……..
Tertu.P. Shiweda

Please complete this form

I, ……., hereby consent to participate in the study as outlined in the document about the study/ as explained to me by the researcher.
I acknowledge that I have been informed about why the questionnaire/interview is being administered to me. I am aware that participation in the study is voluntary and I may refuse to participate or withdraw from the study at any stage and for any reason without any form of disadvantage.
I, ……., acknowledge that I understand the contents of this form and freely consent to participating in the study.

Participant

Signed: ……

Date:……

Researcher

Signed: ……

Date:……

Appendix 2: Questionnaire for Postgraduate Students

I, Tertu. P. Shiweda, kindly invite you to participate in the research project entitled,**Usability of Digital Institutional Repositories (DIR) by Faculty and Postgraduate Students: Namibia University of Science and Technology.** This research project is undertaken as part of the requirements of the PhD, which is undertaken through the University of KwaZulu-Natal, in the Information Studies programme.Participation in this research project is voluntary. You may refuse to participate or withdraw from the research project at any point and for whatever intention. There will be no any type of reward or gain for participating in this research. Confidentiality and anonymity of records identifying you as a participant will be assured and maintained by the Department of Information Studies, at the University of KwaZulu-Natal.
Please answer the questions below to the best of your ability. Please be truthful. Remember, this is NOT a test and there are NO right or wrong answers. If you have any questions or concerns about participating in this study, please feel free to contact myself Ms T. P Shiweda at tertuhaixwa@gmail.com or cell, 0814048164

Definition "A digital institutional repository (DIR) is a web-based searchable database of scholarly materials that has been created by faculty and other researchers." These materials are "collected, stored, and made accessible by an institution or group of institutions to preserve scholarly communication in a digital environment across disciplines" (Alemayehu, 2010:62).

SECTION A:

Background Information

Please indicate the most appropriate answers by a tick in the brackets provided below.
Where a space is provided, use a pen to write your answers.

1. Gender:

(a) Male ☐
(b)Female ☐

2. State your age group:

20-30 ☐
31-40 ☐
41-50 ☐

51-60 ☐

60 and older ☐

3. State your faculty:

1. Faculty of Computing and Informatics ☐
2. Faculty of Engineering ☐
3. faculty of Health and Applied Science ☐
4. Faculty of Human Science ☐
5. Faculty of Management Science ☐
6. Faculty of Natural Resources and Spatial Science ☐
7. HPG School of Business ☐

4. State your degree programme of study: (e.g. Masters, PhD, etc)

_____

SECTION B: **THE ATTITUDES AND PERCEPTIONS TOWARDS DIR**

5. In terms of benefits associated with publishing in a DIR, Please rate the following statements according to the extent to which you agree or disagree. (Please select all that applies)

I can share my work with the public more easily

Strongly Agree ☐ Agree ☐ Neutral (Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

I can share my work with other students more easily

Strongly Agree ☐ Agree ☐ Neutral (Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

I can share my work with my peers and the research community

Strongly Agree ☐ Agree ☐ Neutral (Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

The DIR will give my work more exposure DIR will increase the number of times my work is cited.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

My work will be available on Google Scholar

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I can rely on the university to preserve a digital copy of my research in the long term

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Open access is important because it removes cost as a barrier to accessing research (and allows public access to research and information).

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Other students in my field can find my work and contact me (professional networking)

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR will enhance the research profile of my university

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR will enhance my own research profile

Agree ▭ Strongly Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

It will help me keep track of my research (for CV)

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make my research available with very little effort on my part and without having to maintain a website of my own

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Provide long-term preservation of my digital research materials.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make it easy for other people to search for and locate my work

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Allow me to search the DIR for the most current research findings of my Institution.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make my research available faster than the traditional publishing process

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make available types of materials that have not been made available through the traditional publishing process, such as audio, video, and graphic images online.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

6. If you have interest in contributing your work to DIR what motivates you?

Increase accessibility of my research work ▭

Create publicity for my research work and impact on research community ▭

I am told to contribute by the university administrators ▭

Other, please specify

---

7. If you do not have any interest in contributing to DIR what is your reason for not contributing is? (Select all that apply)

Redundancy with other mode of disseminating information ▭

Fearing for misuse of my work (e.g. copyright, Plagiarism, infringement, etc.)☐

Conflict with publishers polices ☐

Nature of my research work does not allow me to publish on DIR (e.g. co-authoring, versioning) ☐

Lack of information to submit my research work to DIR ☐

Lack of rewards on submission to DIR ☐

Complexity and difficulty to use the system ☐

Lack of skills to use the DIR ☐

Additional time and effort required to perform self- archiving any other ☐

Any other, please specify

---

8. **What is your personal opinion about the following statements?**

Scholarly research of Namibia University of Science and Technology should be freely accessible through DIR

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Open access is important because it removes cost as a barrier to accessing research and allows public access to research and information

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

SECTION C: SELF-ARCHIVING OF RESEARCH OUTPUT AND USE OF THE DIR CONTENT

9. Have you had any previous experience contributing digital materials, such as digital photographs, images, data, and documents to DIR?

Yes ☐

No ☐

8. **If yes for Q.9, where did you prefer to submit your research work?**

To Personal webpage ☐

To Subject repositories ☐

To Institutional Repository but not DIR ☐

To University/Department website ☐

To Profession/research group open accessed website ☐

Others……..

10.If your answer is NO to Q.9, what is the reason for not using the DIR for depositing?

I am not aware of about IR ☐

I don't know how to find the IR ☐

I don't know how to use the IR ☐

I am not given an opportunity to do so ☐

Others, please specify……

11.If your answer is NO to Q.9, are you planning to deposit materials in future?

YES ☐

NO ☐

Not decided ☐

12. In terms of submission of materials into the DIR, state whether you agree or disagree with the following statements?

A) I am willing to comply to and I prefer a mandatory submission policy

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

B) I prefer voluntary submission

Strongly Agree ☐Agree ☐Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

SECTION D: PERCEIVED USEFULNESS OF DIRS

13. In relation to the usefulness and ease of use of the DIR, in your own opinion, would you agree or disagree with the following statements.

Retrieved information from credible source

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Retrieved information is current

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Information retrieved is valid

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR resources relate well to my study.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Adequate resources for the study

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION E: EXTENT OF SYSTEM USABILITY (EASE OF USE)

14.

The system responded quickly to the task

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

There was no error or delay

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Few steps were required to complete the task

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Memorable interface

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Easiness error rectification and navigation

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Stable, self-explanatory and consistent links

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Easiness of DIR usage

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION E: THE DOMAIN KNOWLEDGEDIR

15.Relating to the domain knowledge of the Digital Institutional Repository would you agree or disagree with the following statements? (please select all that apply)

I am familiar with the subject domain that I search for on the DIR.

Agree ▭ Strongly Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I am knowledgeable in the topic to search for on the DIR

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION F: THE LEVEL OF SATISFACTION IN USING DIRS

16. Relating to the satisfaction of the Digital institutional repository to you, would you agree or disagree with the following statements? (please select all that apply)

SECTION F: THE LEVEL OF SATISFACTION IN USING DIRS

20. Relating to the satisfaction of the Digital institutional repository to you, would you agree or disagree with the following statements? (please select all that apply)

Text type and font size are engaging and readable

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Colours, graphics, and icons have been used appropriately

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The terms used to label the menu functions are simple, straightforward and understandable

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The organisation of information is simple, straightforward, logical, and makes it easy to look up things

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I do not get lost and always know how to recover from mistakes.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Links are stable, self-explanatory and consistent

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Each click helps me get closer to the information I will be looking for.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

On the whole, the digital institutional repository satisfies me

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I understand most of the terms used throughout the DIR.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The use of terms throughout the DIR is consistent.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION G: RELEVENCE OF REASEARCH OUTPUT

17. Relating to the relevance of research output from digital institutional repository to you, would you agree or disagree with the following statements?

Information retrieved relevant and reflected the query

Strongly Agree ☐ Agree ☐ Neutral (Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

END OF QUESTIONNAIRE, THANK YOU FOR YOUR COOPERATION.

Appendix 3: Questionnaire for Faculty

I, Tertu Shiweda, kindly invite you to participate in the research project entitled,**Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST).**

This research project is undertaken as part of the requirements of the PhD, which is undertaken through the University of KwaZulu-Natal Information Studies programme. Participation in this research project is voluntary. You may refuse to participate or withdraw from the research project at any point and for whatever intention. There will be no any type of reward or gain for participating in this research. Confidentiality and anonymity of records identifying you as a participant will be assured and maintained by the Department of Information Studies, at the University of KwaZulu-Natal. Please answer the questions below to the best of your ability. Please be truthful. Remember, this is NOT a test and there are NO right or wrong answers. If you have any questions or concerns about participating in this study, please feel free to contact myself Ms T.P. Shiweda at tertuhaixwa@gmail.com or cell, 0814048164.

Definition "A digital institutional repository (DIR) is a web-based searchable database of scholarly materials that has been created by faculty and other researchers." These materials are "collected, stored, and made accessible by an institution or group of institutions to preserve scholarly communication in a digital environment across disciplines" (Alemayehu, 2010:62).

SECTION A:

Background Information

Please indicate the most appropriate answers by a tick in the brackets provided below.
Where a space is provided, use a pen to write your answers.

1. **Gender:**
   Male ☐
   Female ☐
2. **Status:**

Professor ☐
Associate professor ☐
Senior research fellow ☐
Assistant professor ☐

Research fellow ☐

Research assistant ☐

Other

Specify:……

3. State you age group:

20-30 ☐

31-40 ☐

41-50 ☐

51-60 ☐

60 and older ☐

4. Please specify your department

8. Faculty of Computing and Informatics ☐
9. Faculty of Engineering ☐
10. faculty of Health and Applied Science ☐
11. Faculty of Human Science ☐
12. Faculty of Management Science ☐
13. Faculty of Natural Resources and Spatial Science ☐
14. HPG School of Business ☐

SECTION B: **The attitudes and perceptions towards DIR**

5. In terms of benefits associated with publishing in a DIR, Please rate the following statements according to the extent to which you agree or disagree. (Please select all that applies)

I can share my work with the public more easily

Strongly Agree ☐Agree ☐Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

I can share my work with other students more easily

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I can share my work with my peers and the research community

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR will give my work more exposure DIR will increase the number of times my work is cited.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

My work will be available on Google Scholar

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I can rely on the university to preserve a digital copy of my research in the long term

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Open access is important because it removes cost as a barrier to accessing research (and allows public access to research and information).

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Other students in my field can find my work and contact me (professional networking)

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR will enhance the research profile of my university

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

The DIR will enhance my own research profile

Agree ▭ Strongly Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

It will help me keep track of my research (for CV)

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make my research available with very little effort on my part and without having to maintain a website of my own

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Provide long-term preservation of my digital research materials.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make it easy for other people to search for and locate my work

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Allow me to search the DIR for the most current research findings of my Institution.

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make my research available faster than the traditional publishing process

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Make available types of materials that have not been made available through the traditional publishing process, such as audio, video, and graphic images online.

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

6. If you have interest in contributing your work to DIR what motivates you?

Increase accessibility of my research work ☐

Create publicity for my research work and impact on research community ☐

I am told to contribute by the university administrators ☐

Other, please specify

---

7. If you do not have any interest in contributing to DIR what is your reason for not contributing is? (Select all that apply)

Redundancy with other mode of disseminating information ☐

Fearing for misuse of my work (e.g. copyright, Plagiarism, infringement, etc.)☐

Conflict with publishers polices ☐

Nature of my research work does not allow me to publish on DIR (e.g. co-authoring, versioning) ☐

Lack of information to submit my research work to DIR ☐

Lack of rewards on submission to DIR ☐

Complexity and difficulty to use the system ☐

Lack of skills to use the DIR ☐

Additional time and effort required to perform self- archiving any other ☐

Any other, please specify

---

8. **What is your personal opinion about the following statements?**

Scholarly research of Namibia University of Science and Technology should be freely accessible through DIR

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Open access is important because it removes cost as a barrier to accessing research and allows public access to research and information

Strongly Agree ☐ Agree ☐ Neutral (Neither Agree nor Disagree ☐ Disagree ☐ Strongly Disagree ☐

SECTION C: SELF-ARCHIVING OF RESEARCH OUTPUT AND USE OF THE DIR

9. Have you had any previous experience contributing digital materials, such as digital photographs, images, data, and documents to DIR?

Yes ☐

No ☐

10. **If yes for Q9, where did you prefer to submit your research work?**

To Personal webpage ☐

To Subject repositories ☐

To Institutional Repository but not DIR ☐

To University/Department website ☐

To Profession/research group open accessed website ☐

Others……..

10.If your answer is NO to Q.9, what is the reason for not using the DIR for depositing?

I am not aware of about IR ☐

I don't know how to find the IR ☐

I don't know how to use the IR ☐

I am not given an opportunity to do so ☐

Others, please specify……

11. If your answer is NO to Q.9, are you planning to deposit materials in future?

YES ☐

NO ☐

Not decided ☐

12. In terms of submission of materials into the DIR, state whether you agree or disagree with the following statements?

A) I am willing to comply to and I prefer a mandatory submission policy

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

B) I prefer voluntary submission

Strongly Agree ☐Agree ☐Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

13. Have you ever used the DIR for accessing information?

YES ☐

NO ☐

15. If your answer to Question 1 is NO, what channel do you use to access research output from your institution?

Google ☐

Google scholar ☐

Library shelves ☐

Directly though DIR ☐

Others please specify

……

…

SECTION D: PERCEIVED USEFULNESS OF USE OF DIR

14. In relation to the usefulness and ease of use of the DIR, in your own opinion, would you agree or disagree with the following statements.

Retrieved information from credible source

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Retrieved information is current

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Information retrieved was from a credible source

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Information retrieved is current

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Information retrieved is valid

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION E: EXTENT OF SYSTEM USABILITY (EASE OF UE)

16. In your experience in using the DIR, would you agree or disagree with the following statement?

The system responded quickly to the task
Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

There was no error or delay
Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Few steps were required to complete the task
Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Memorable interface

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Easiness error rectification and navigation

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Stable, self-explanatory and consistent links
Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Easiness of DIR usage

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION E: THE DOMAIN KNOWLEDGEDIR

17.Relating to the domain knowledge of the Digital Institutional Repository would you agree or disagree with the following statements? (please select all that apply)

I am familiar with the subject domain that I search for on the DIR.

Agree ▭ Strongly Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I am knowledgeable in the topic to search for on the DIR

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION E: THE DOMAIN KNOWLEDGEDIR

18. Relating to the domain knowledge of the Digital Institutional Repository would you agree or disagree with the following statements? (please select all that apply)

I am familiar with the subject domain that I search for on the DIR.

Agree ▭ Strongly Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

I am knowledgeable in the topic to search for on the DIR

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

SECTION F: THE LEVEL OF SATISFACTION IN USING DIRS

19. Relating to the satisfaction of the Digital institutional repository to you, would you agree or disagree with the following statements? (please select all that apply)

Readable and engaging text types and font size

Strongly Agree ▭Agree ▭Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Appropriately used icons graphics and colours

Strongly Agree ▭Agree ▭ Neutral (Neither Agree nor Disagree▭ Disagree▭ Strongly Disagree▭

Concise terms used to label menu functions

Strongly Agree ☐Agree ☐Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Logically organising of information

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Self-explanatory consistent and stable links

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Every click leads to the information being searched

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

DIR satisfies the users

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Understandable terms used throughout the DIR

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

Consistent terms used throughout DIR

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree☐ Strongly Disagree☐

SECTION G: RELEVENCE OF REASEARCH OUTPUT

20. Relating to the relevance of research output from digital institutional repository to you, would you agree or disagree with the following statements?

Information retrieved relevant and reflected the query

Strongly Agree ☐Agree ☐ Neutral (Neither Agree nor Disagree☐ Disagree ☐ Strongly Disagree☐

END OF INTERVIEW, THANK YOU FOR YOUR PARTICIPATION

Appendix 4: Interview Schedule for Librarians and System Developers

I, Tertu Shiweda, kindly invite you to participate in the research project entitled, **Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST.**

This research project is undertaken as part of the requirements of the PhD, which is undertaken through the University of KwaZulu-Natal, Information Studies programme. Participation in this research project is voluntary. You may refuse to participate or withdraw from the research project at any point and for whatever intention. There will be no any type of reward or gain for participating in this research. Confidentiality and anonymity of records identifying you as a participant will be assured and maintained by the Department of Information Studies, at the University of KwaZulu-Natal. Please answer the questions below to the best of your ability. Please be truthful. Remember, this is NOT a test and there is NO right or wrong answers. If you have any questions or concerns about participating in this study, please feel free to contact myself Ms T. P. Shiweda at tertuhaixwa@gmail.com or cell, 0814048164

A) Archiving and Self-archiving of research output

a) According to your own experience, does the institution have the archiving policy and since when?
b) If yes, how does it guides in regard to archiving and submission/depositing of the materials into the DIR?
c) If No, how does the institution work in regard to archiving and submission of the materials into the DIR?
d) According to your own experience what type materials are housed in the DIR?
e) Would you say faculty and post graduate students are well aware of the DIR and its benefits?
f) How do you rate the growth and the progress of the DIR in your institution?

B) SYSTEM UABILITY

EFFICIENCY

a) How do you find the response time of the system?
b) What have you to say about the level of errors that user encounter when using the DIR?

c) What can you say about the steps that must be taken in order to retrieve information from the DIR?
d) What can you say about the steps that must be taken in order to submit materials in the DIR?

EFFECTIVENESS

e) In your opinion, do users achieve what they want to do when using the DIR?
f) What can you say about the disciplines coverage of the digital library?
g) What is your opinion about the accuracy and completeness of the information located on the digital library?

LEARNABILITY

h) What difficulties do users face when learning to use the DIR for the first time?
i) How long does it take for users to begin searching the digital library?
j) What is your opinion about the search instruction and utilisation of the DIR?

C) **Perceived usefulness and ease of use of DIR**

a) What is your opinion about the adequacy of collection of the digital institutional repository in your institution?
b) In your opinion, do you find the information provided by the search results useful?
c) What can you say about the credibility, currency and validity of the information retrieved from the digital library?
d) In your opinion does the DIR provide adequately for research information needs for researchers?
e) What type of materials are there in the DIR
f) In your own view would you say the DIR is adequately used?

D) The level of satisfaction in the use of DIRs

a) What is your view about the text and font size on the DIR?
b) How do you find the colours, graphics, and icons on the DIR?
c) What can you say about the terminology used to describe the menu functions of the DIR?
d) How would you describe the organisation of information on the DIR?
e) How difficult is it for users to recover from mistakes during your searching on DIR?
f) What would you say is the exciting or interesting part about the digital library?

g) What would you say are the drawbacks of DIR in your institution?

h) In your opinion, what can be done to improve the digital library?

i) What is your overall view about the DIR?

j) What challenges do you face in designing the DIR for usability?

k) What source of information do students mostly use to access research output such as Journal articles and thesis?

E) The attitudes and perceptions towards DIR

1. What do you think are factors affecting the effeteness of contribution to the DIR by PGs and faculty?
2. Which features and functions of the digital institutional repository would you like to see improved or removed?

END OF INTERVIEW, THANK YOU FOR YOUR PARTICIPATION

Appendix 5: Observation checklist

1. Researcher's name ……..……
2. Observed institution.....……..…….
3. Date/Month/Year …….

4. Library facilities

- Any other form of access to research output……..……
- ICT equipment (computers) ……..……
- ICT facilities e.g internet …...……..…….
- Internet connection …….…….
- Internet connection(type of connection)
- ICT Training schedules for Postgraduate student and faculty……
- Digital services and user access available……

5. Access to information (research output) by postgraduate students

- Form of assistance of Postgraduate students with research output……..
- Number of computers connected to the Internet …….
- Students interaction with DIR…….
- Number of Postgraduate student's interaction with computers/Laptops

6. The information system –DIR

- Form of assistance with self- archiving
- Usage statistic
- Types of materials
- Number of materials deposited
- Perceived ease of use(Screen design, instruction, complexity and mobility)
- Type of software used for the DI

Appendix 6: Documents analysis

1. Researcher's name ……..……
2. Reviewed institution.....……..…….
3. Date/Month/Year …….

4. **Post graduate students**

- Number of students …….

5. Faculty

- Number of faculty

6. **Library facilities**

- Any other form of access to research output……..……
- ICT equipment (computers) ……..……
- ICT facilities …...……..…….
- Internet connection ……..…….
- Internet connection (type of connection and capacity)
- ICT Training schedules for Postgraduate student and faculty……
- Digital services and user access available……

7. **Access to information (research output) by postgraduate students**

- Form of assistance of Postgraduate students with research output……..
- Number of computers connected to the Internet …….
- Number of Postgraduate student's interaction with computers/Laptops

8. The information system –DIR

- Form of assistance with self- archiving
- Usage statistic
- Types of materials
- Number of materials deposited
- Type of software used for the DIR

Appendix 7: Heuristics Expert evaluation guideline

- Expert's name ……..……
- Evaluated institution.....……..…….
- Date/Month/Year …….

1. **System accessibility**

The system should include the features of a possibility of visually impaired people to interact with each other through sharing information.

Comment……

……

2. **Match between the system and the real world**

- The metaphors used should correspond to real world objects and concepts. The system should speak the user's language by using terms, phrases, symbols and concepts familiar to the user and common to the natural domain in which the system is applicable, in a logical order.

  Comment……

  ……

  ……

3. **User control and freedom**

- Users are able to exit the system at any time when they need to do so. Even when they have made errors, there are clearly marked 'emergency exits' to leave the unwanted state without having to go through an extended dialogue

Comment……

……

4. **Semantic web and linked data**

The systems should be linked to various systems within the institution to act as a platform of sharing skills, knowledge within the institution

Comment……

……

5. **Consistency and standards**

- The system should be consistent in that the same words, situations, or actions refer to the same thing. It is advisable to use standard platform conventions

Comment……

……..

6. **Error prevention**

- The system should be designed to prevent errors from occurring, part from giving good er ror messages

Comment……

……

7. **Collaboration features**

The system should incorporate the interaction forum between various authors across the globe, hence this will improve the knowledge between authors

Comment……

……

8. **Flexibility and efficiency of use**

The objects, actions, and options, instructions on how use the system, how to perform tasks should be visible, for example, "they should be bold and/or in large font sizes".

Comment……

……

9. **Help users know, identify, and escape from errors**

The system should give "error messages" spoken a simple language. The messages should indicate precisely what the problem is and suggest constructive solutions.

Comment……

…….

10. Navigation

- The system should provide navigational feedback so that the user knows where he/she has been, where he/she is, and the link options he/she has on where to go next. Navigational aids such as search facilities should be available.

Comment……

……

Appendix 8: Ethical Clearance Certificate

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

3 October 2017

Ms Tertu P Shiweda (212536715)
School of Social Sciences
Pietermaritzburg Campus

Dear Ms Shiweda,

Protocol reference number: HSS/0511/017D
Project title: Usability of Digital Institutional Repositories (DIR) by Faculty and Postgraduate Students: Case study of University of Namibia and Namibia University of Science and Technology

Full Approval – Expedited Application/Amendment

In response to your application received 29 September 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL** with following amendment.

- ***Amendment to study site – Removal of UNAM***

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Professor S Mutula
cc Academic Leader Research: Professor M Naidu
cc School Administrator: Ms Nancy Mudau

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
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Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** simbac@ukzn.ac.za / snymthnm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix 9: Editor's Letters

Professional EDITORS Guild

Barbara Mutula
Associate member

Membership number: MUT001
Membership year: March 2018 to February 2019

0786439029
kabangebarbara@gmail.com

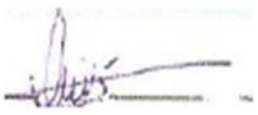
www.editors.org.za

06 November 2018

TO WHOM IT MAY CONCERN

This is to confirm that the dissertation written by Tertu Ponhele Shiweda, titled '**Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST)**' was copy edited for layout (including numbering, pagination, heading format, justification of figures and tables), grammar, spelling and punctuation by the undersigned. The document was subsequently proofread and a number of additional corrections were advised.

The undersigned takes no responsibility for corrections/amendments not carried out in the final copy submitted for examination purposes.



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To whom it may concern

LANGUAGE EDITING – TERTU PONHELE SHIWEDA

This letter serves to confirm that a Doctor of Philosophy (Information Studies) thesis entitled "Usability of Digital Institutional Repositories (DIRs) by Faculty and Postgraduate (PG) Students: Namibia University of Science and Technology (NUST)" by Tertu Ponhele Shiweda was submitted to me for language editing.

The thesis was professionally edited and track changes and suggestions were made in the document (expect the references), which if followed by Ms Tertu Ponhele Shiweda will result in a thesis with a high standard of English.

Yours faithfully

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