

**A MODEL FOR THE DIGITAL PRESERVATION OF INDIGENOUS KNOWLEDGE ON  
MEDICINAL PLANTS IN NAMIBIA VIA AN E-LEARNING PLATFORM**

by

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submitted in accordance with the requirements for  
the degree of

**MASTER OF SCIENCE**

in the subject

**COMPUTING**

at the

**UNIVERSITY OF SOUTH AFRICA**

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**FEBRUARY 2020**

## DECLARATION

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A model for the digital preservation of indigenous knowledge on medicinal plants in Namibia via an e-learning platform

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.



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**UNIVERSITY OF SOUTH AFRICA**

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**ABSTRACT**

The number of studies focused on the digital preservation of indigenous knowledge has been growing steadily over the years. Despite the growth in this area of research, there is still a lack of information technology tools that preserve and disseminate indigenous knowledge. Indigenous knowledge has been highlighted as an area that can advance sustainable development, and its preservation is therefore of the utmost importance. Indigenous knowledge is mostly present within older generations, and if it is not preserved, this knowledge will die with its custodians.

African communities rely heavily on indigenous medicine. A digital platform needs to be explored that can preserve practices relating to these medicines for future generations. Since indigenous knowledge is dynamic and is constantly evolving, there is a need to explore a digital tool that can highlight this dynamic nature.

Current methods of preserving indigenous knowledge of medicinal plants were found to be less than effective and marred by constraints such as space and time. The main objective of this study was therefore to develop a model that could be used to guide the design of a new e-learning system aimed at facilitating the preservation of indigenous knowledge of Namibia's medicinal plants.

In this study, e-learning technology was used to determine the requirements for presenting indigenous knowledge of Namibia's medicinal plants in such a way as to ensure that individuals can internalise and preserve this knowledge. An interpretivist qualitative approach was followed. Data was collected by conducting a literature review and carrying out a survey. A prototype e-learning system was developed and evaluated based on the collected data. It was found that preserving indigenous knowledge of medicinal plants through e-learning would require, among other things, engagement with the relevant knowledge custodians, leveraging multimedia, and offering content in indigenous languages.

**KEYWORDS:** Digital preservation; E-learning; Indigenous knowledge; Indigenous medicinal plants; Indigenous knowledge models; Indigenous knowledge preservation; Information system models

*This dissertation is dedicated to my loving husband Gehas and my two delightful sons, Tangi and Lukas. Thank you for all the sacrifices you made during this journey, allowing me time and space to complete this work.*

## ACKNOWLEDGEMENTS

I would like to thank the following people who contributed to the successful completion of this dissertation:

- The Father, the Son and the Holy Spirit who watched over me on every step of this journey.
- The mentors and spiritual leaders the Lord Jesus has placed in my life, Prophet Lukas MM and Prophet TB Joshua. Thank you for all your encouraging teachings.
- Dr Samuel Akinsola. Thank you for introducing me to this great topic that has become my dissertation and a massive thank you for your guidance during the initial stages of this journey.
- My supervisors, Dr Corne van Staden and Dr Marthie Schoeman. A massive thank you for your guidance and patience with me.
- Unisa's Directorate of Student Funding (DSF). Thank you for the generous bursary that took care of the study's financial needs.
- The Namibia University of Science and Technology. Thank you for allowing me to make use of your valuable resources.
- The students of the Namibia University of Science and Technology who participated in this study. Thank you for the valuable data that you provided for the study.
- Ms Jolette Roodt. Thank you for the meticulous language editing.
- My colleagues and friends. Thank you for your encouragement and your valuable input and feedback.
- My dear and good friend, Dr Irja Naambo Shaanika, who I consider a superwoman. Thank you for the motivation, the inspiration and the encouragement.
- To my entire family, both near and far. Thank you for the love.

This study would truly not be complete without you all.

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## LIST OF ABBREVIATIONS

ABSAT	Access and Benefit Sharing and Associated Traditional
AR	Augmented Reality
CBD	Convention on Biological Diversity
D&M IS Model	DeLone and McLean Information Systems Model
DKR	Data Knowledge Repository
ECHNH	E-cultural Heritage and Natural History
FCI	Faculty of Computing and Informatics
IK	Indigenous Knowledge
IKSC	National Council for Indigenous Knowledge System
LMS	Learning Management System
MOODLE	Modular Object-Oriented Dynamic Learning Environment
NCRST	National Commission on Research, Science and Technology
NIKMAS	National Indigenous Knowledge Management System
NUST	Namibia University of Science and Technology
TAM	Technology Acceptance Model
TDM	Tripartite Digitisation Model
TWCDF	Traditional Wood Carvers Database Framework
UN	United Nations
UNESCO	United Nations Education Scientific and Cultural Organisation

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# CHAPTER 1

## INTRODUCTION AND OVERVIEW

### 1.1 Introduction and background to the study

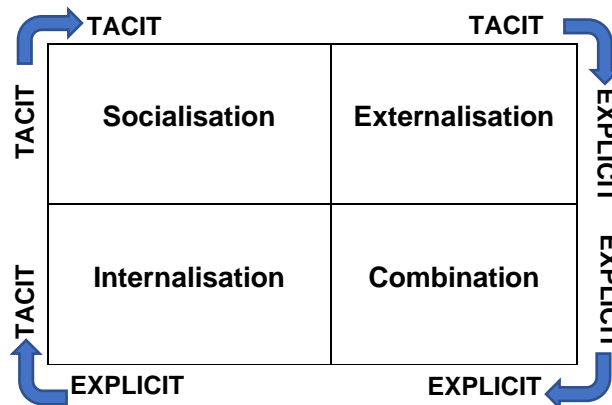
There has been a growing interest in research on digital preservation (Gardiner & Thorpe, 2014). This interest was brought about by the advancement of information technology devices that digitise large amounts of content at high speeds, and by the increased demand from users for easier access to information (Adu, Dube, & Adjei, 2016; Pendergrass, Sampson, Walsh, & Alagna, 2019). Digital preservation is a process that involves ongoing activities that ensure the management of digital content (electronic documents). Digital preservation of existing content that was created online as well as content that was converted from a physical to a digital format, enables the content to be accessed for a long time and prevents it from being lost forever (Madalli, Barve, & Amin, 2012; Ross, 2012).

Interest in digital preservation has also extended to preserving indigenous knowledge for future generations (Mallik, Chaudhury, & Ghosh, 2011). Indigenous knowledge is the knowledge that is unique to people living in one community, such as a village, a tribe or a country (Munyua & Stilwell, 2013).

Indigenous knowledge can exist in two forms, either explicit or tacit (Goujon, Didierjean, & Poulet, 2014; Intezari & Pauleen, 2017; VanPatten, 2016). Explicit knowledge is knowledge in a tangible form, such as books and manuals; direct contact with the custodian of the knowledge is not required and this form of knowledge is easily transferred, stored and accessed (Okuyama, 2017). On the other hand, tacit knowledge, which is also referred to as implicit knowledge, is knowledge that is embedded within a person. The person holding this knowledge is called a 'knower' or a custodian of the knowledge (Grandinetti, 2014). The tacit knowledge that a person possesses is made up of their experiences, characteristics, and the social context where they come from (Matoskova, Rehackova, Sobotkova, Polcakova, Jurasek, Gregar, & Svec, 2013).

Given the definition and characteristics of tacit knowledge, indigenous knowledge falls under this category (Jain, 2014). According to the knowledge creation theory developed

by Nonaka (1994), knowledge can be transformed either from tacit to explicit knowledge or from explicit to tacit knowledge (Grandinetti, 2014), as illustrated in Figure 1.1.



*Figure 1.1: The four modes of knowledge transformation (Nonaka, 1994, p. 19)*

Dlamini (2017) and Lwoga, Ngulube and Stilwell (2010) define the four modes of knowledge transformation as follows:

- Socialisation is the process of transforming knowledge from one tacit format into another tacit format. This transformation is achieved through oral communication, such as exchanging experiences and skills with others at events like social gatherings.
- Externalisation is the process of transforming knowledge from a tacit format into an explicit format. Tacit knowledge can be transformed into secondary formats such as documents and images so that other people can have access to it.
- Combination is the process of transforming knowledge from an explicit format into another explicit format. This process can be achieved by using a secondary form of knowledge to create another secondary form, such as turning a book into a film.
- Internalisation is the process of transforming knowledge from an explicit format into a tacit format. This can be achieved by learning from secondary forms such as books. The process is enhanced by practicing what is learned. The knowledge is created within the person who learns from the secondary forms. Internalisation ensures that explicit knowledge found in different formats does not become obsolete or remain unused.

Indigenous knowledge has been externalised into formats such as texts in books (Bow, Christie, & Devlin, 2017). Externalisation has also led to indigenous knowledge being digitally preserved in digital databases (Mangare & Li, 2018). The externalisation of indigenous knowledge allows it to be preserved. The knowledge generated from

externalisation efforts allows the people who make use of this knowledge to internalise it and thereby make it personally meaningful to them (Coleman, 2016).

Indigenous knowledge is slowly moving into extinction as the knowers pass away, hence the need for its preservation for future generations. Indigenous knowledge faces extinction; it is inherent in the older members of a community, and these elders are finding it hard to pass the knowledge on to younger generations and to other interested people (Mawere & Mwanaka, 2015). Preserving indigenous knowledge is a contributing factor in providing a means of sustainable development to a community or entire country (Cloonan, Drijfhout, & Madiba, 2016; Kari & Baro, 2016; Tapfuma & Hoskins, 2017). In this way, indigenous knowledge can decrease poverty, as it can help in managing health and natural resources through indigenous practices (Magni, 2017).

The government of Namibia has taken initiative in National Development Plans to highlight the importance of indigenous knowledge to the country. A document called *Namibia Vision 2030* has been created, which is a plan of where the country wants to be by the year 2030 in terms of improving its citizens' quality of life. In the *Vision 2030* document, it is highlighted that the country's indigenous knowledge can contribute to its plans (*Namibia Vision 2030*, 2004). To ensure that indigenous knowledge does not become extinct, the National Council on Indigenous Knowledge Systems (IKSC) was formed by the country's National Commission on Research, Science and Technology (NCRST). This committee will draw up plans to deal with indigenous knowledge and its inclusion in school curriculums, ensuring that ethical practices are followed in research on indigenous knowledge, and participating in activities that are aimed at its protection and promotion ("National Council on Indigenous Knowledge System (IKSC) Inaugurated," 2014).

The country's ministry of educational activities has launched a project called the Preserve Namibia Indigenous Knowledge project ("Deputy Minister Launches Preserve Namibia Indigenous Project," 2016). To ensure that indigenous knowledge is easily accessible, the Preserve Namibia Indigenous Knowledge project plans to digitise the country's indigenous knowledge and make it available in its public libraries for access by its citizens. Videos on some of the country's indigenous knowledge practices have been recorded on DVD and are stored at the National Archives Library of Namibia ("Deputy Minister Launches Preserve Namibia Indigenous Project," 2016).

These plans and initiatives demonstrate that the country is aware of the importance of indigenous knowledge and is aiming to preserve it. This study also aims to contribute to efforts to preserve the country's indigenous knowledge.

Indigenous medicine is considered a dominant area of indigenous knowledge (Dlamini & Ocholla, 2018; Maunganidze, 2016). Different illnesses can be treated by administering indigenous medicinal plants, and the plants can also serve as a potential source for the production of new medicines (Pienaar, 2017). In Namibia, the importance of indigenous knowledge has been highlighted in the use of indigenous plants for medicinal purposes, and researchers have undertaken studies to promote these uses (Chinsembu, Cheikhoussef, Mumbengegwi, Kandawa-Schulz, Kasanda, & Kazembe, 2015).

While indigenous knowledge is broad and encompasses many different areas such as farming and food preservation, the current study focuses on the digital preservation of indigenous medicine. African populations rely more heavily on indigenous medicinal plants than on pharmaceutical medication (Ezekwesili-Ofilii & Chinwe, 2019; Mahomoodally, 2013). Digital preservation will allow for both explicit and tacit preservation of indigenous knowledge of medicinal plants.

Dlamini and Ocholla (2018, p. 138) state that indigenous knowledge is a valuable asset; however, "there are no proper mechanisms for capturing, storing, processing, retrieving and disseminating the valuable asset for future generations". There has been a call to preserve indigenous knowledge digitally using information technology tools (Hunter, 2005). The use of information technology tools in the management of indigenous knowledge can minimise or eliminate the possibility of it going into extinction (Dlamini & Ocholla, 2018). There is currently a lack of technology tools that can manage indigenous knowledge, which is leading to its gradual decline among African communities (Dlamini & Ocholla, 2018).

Research has been undertaken to preserve Namibia's indigenous knowledge utilising different digital technologies. Kapuire, Winschiers-Theophilus, Stanley, Maasz, Chamunorwa, Mbinge, Cabrero, Møller and Rodil (2016) co-designed a tool with a community which allowed the community to identify key factors in the design of the tool and ensured the usability of the tool to the community. This tool was developed using the Android operating system, and it enabled the man considered to be the elder of the community to use a tablet device to collect and preserve the indigenous knowledge found in his community. In a similar study by Winschiers-Theophilus, Rodil, Zaman, Yeo and

Jensen (2013), three mobile technology tools were co-designed for capturing indigenous knowledge. These tools were also developed using the Android mobile operating system, and they, too, allowed community members to be active participants in the design and deployment of the tools. The tools by Kapuire et al. (2016) and Winschiers-Theophilus et al. (2013) show that there is work being done in the field of preserving Namibia's indigenous knowledge, but the work is still in its infancy.

The tools used so far in research on preserving Namibia's indigenous knowledge have been stand-alone tools and were more focused on collecting indigenous data from the communities; the knowledge that is only accessible to the knowledge holders themselves. It has not been discussed what happens to the knowledge that is collected and how it can be disseminated for preservation. Indigenous knowledge is constantly evolving and does not remain static; according to Tharakan (2015, p. 365), it "is dynamic, continually influenced by internal creativity within a community, and experimentation by the community in response to their environmental, social, and public health and safety stressors". Thus, a platform is needed to capture the changes that are taking place in the sphere of this knowledge.

## 1.2 Problem statement

It has been established that there is a lack of information technology tools aimed at preserving and disseminating indigenous knowledge. As stated in Section 1.1, indigenous knowledge is not static and is constantly changing. A technological tool is required to ensure that the knowledge is preserved and presented in a way that can allow for its dynamic nature. E-learning was chosen as the technological tool to be investigated in this study.

E-learning is an internet technology that ensures that people are not confined by the challenge of having to visit a learning institution to be able to learn, as the technology allows one to learn from anywhere as long as the person has a computing device and access to the internet (Lee, Chen, & Tseng, 2013; Potcovaru, 2018; Sousa & Pinto, 2013; Wang, Vogel, & Ran, 2011). E-learning enables implicit knowledge to be internalised by the individuals that work through the content presented on it (Liebowitz & Frank, 2011). E-learning has been widely adopted in institutions of higher learning and training institutes (Wongso, Rosmansyah, & Bandung, 2014). Marcial (2011) observed that educators are knowledgeable about e-learning, but not about its use to preserve indigenous knowledge.

The internet allows for indigenous knowledge to be made available globally (Dlamini & Ocholla, 2018). In fact, many people have taken an interest in indigenous knowledge due to its increased presence on the internet (Dlamini, 2017).

This research aims to contribute to indigenous knowledge preservation efforts by developing a model for using e-learning in the preservation of indigenous knowledge of Namibia's medicinal plants.

### 1.2.1 Research questions

The main research question driving this study is:

- What components are necessary in a model used to guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants?

The secondary research questions that will assist in answering the main research question are:

1. What models already exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)
2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)

### 1.2.2 Research objectives

The main research objective of the study is:

- To develop a model that will guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants.

The secondary research objectives that will assist in meeting the main research objective are:

1. To investigate existing models that are used in digitally preserving indigenous knowledge of medicinal plants. (RO1)

2. To identify information technology tools currently being used to preserve indigenous knowledge of medicinal plants. (RO2)
3. To determine the requirements to be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants. (RO3)

## 1.3 Methodology overview

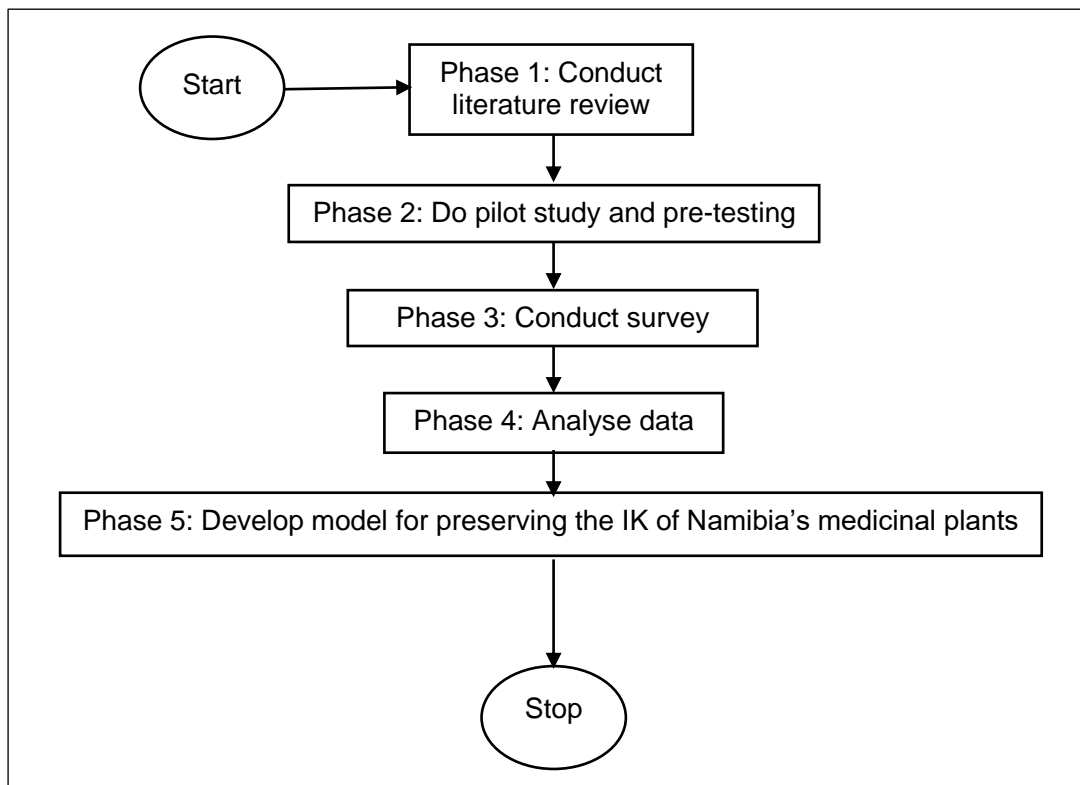
This section will focus on the research approach, research design, participants of the study, and the method that was used for analysing the data collected.

### 1.3.1 Research approach

In the current study, a multi-method qualitative research approach was followed. Qualitative research refers to research that involves interaction with human beings, and understanding their experiences and perceptions as pertaining to different situations (Roller & Lavrakas, 2015). Data gathered from qualitative studies is primarily expressed in words, as opposed to the interpretation of numerical data in quantitative studies (Morgan, 2018). The data in this study was collected using a literature review and a survey.

### 1.3.2 Research design

Data was initially collected through a literature review to determine the requirements to be included in a conceptual theoretical model for preserving indigenous knowledge. Onwuegbuzie and Frels (2016) assert that a literature review can form part of the data collection of a study. Additional data was collected from a survey to determine additional requirements to include in the model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning. In survey research, questionnaires are the primary data collection tools (Fink, 2003). Questionnaires allow researchers to gain an understanding of a situation by selecting a sample that will be used to generalise to the wider population (Jann & Hinz, 2016). In this study, the views, beliefs and experiences of the participants regarding indigenous knowledge of medicinal plants and e-learning being used in the preservation of the knowledge were obtained by means of open-ended questions. The qualitative responses from the participants also helped in determining what information technology tools are currently being used to preserve indigenous knowledge of Namibia's medicinal plants. The study was carried out in five phases, as displayed in Figure 1.2.



**Figure 1.2: Research design flowchart**

The research was divided into five phases:

- Phase 1: A literature review was conducted to assist in fulfilling RO1 to RO3 of the study. The literature review evaluated the information technology tools that are currently used to preserve indigenous knowledge of medicinal plants. Possible requirements needed in a model for preserving indigenous knowledge were identified from existing models and frameworks. The output of this phase was a conceptual theoretical model for preserving indigenous knowledge, a prototype e-learning system for preserving indigenous knowledge, and a questionnaire that was used in the subsequent phases. The questionnaire was used in Phase 3 to collect data from participants to extend the conceptual theoretical model developed in Phase 1. Information systems models that are being used to evaluate the success of e-learning systems were also investigated to assist in identifying a success model to evaluate the prototype e-learning system.
- Phase 2: A pilot study and pre-testing of the questionnaire were carried out to validate and refine the questionnaire constructed from Phase 1.
- Phase 3: A survey was carried out to expand the conceptual theoretical model from Phase 1. The survey was administered in two stages. A first questionnaire was administered before the participants logged onto and worked through the



content on the prototype e-learning system that was developed in Phase 1. The purpose of the first questionnaire was to collect data on the participants' demographics, their prior knowledge and experience of indigenous medicinal plants, and their perceptions of an e-learning system to preserve indigenous knowledge of medicinal plants. A second questionnaire was administered to the participants after their interaction with the prototype e-learning system. The second questionnaire collected data on aspects of the prototype e-learning system, such as the quality of the system and the information on indigenous medicinal plants presented on it.

- Phase 4: The data collected from Phase 3 was analysed using thematic analysis techniques to assist in achieving RO2 and RO3 of the study.
- Phase 5: The conceptual theoretical model developed in Phase 1 was extended using the findings from the data analysis conducted in Phase 4.

Table 1.1 indicates how the literature review and survey were carried out.

**Table 1.1: Data collection tools and chapters in which RQs are answered**

Research questions	Research strategy		Chapter in which the question is answered	
	Literature review	Survey	Chapter 3	Chapter 4
1. What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)	X		✓	
2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)	X	X	✓	✓
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)	X	X	✓	✓

As indicated in Table 1.1, the literature review contributed to answering all three research questions of the study, while the survey contributed to answering RQ2 and RQ3. The literature review can be found in Chapter 3.

The survey in this study was conducted using two questionnaires. The questionnaires were refined during the pilot study and pre-testing phase. The first questionnaire contributed to answering RQ2 of the study, while the second questionnaire contributed to answering RQ3. The results and findings from the survey are provided in Chapter 4.

### 1.3.3 Participants

The participants in the study were students from the Namibia University of Science and Technology (NUST). Convenience sampling and purposive sampling methods were used to select them. The students were selected to participate in the study because they had access to and were proficient with the e-learning system on which the prototype system used in the study was developed. The participants also needed to be of Namibian nationality, as the study focused on Namibia's indigenous medicinal plants. The final selection of participants depended on students' availability and willingness to participate in the study. Ethical clearance was obtained to collect data from the participants.

### 1.3.4 Data analysis

The data collected through the survey was analysed using qualitative analysis techniques. Qualitative analysis techniques enable the researcher to interpret the themes and patterns that emerge from the data that has been collected (Oates, 2006). In the current study, the thematic qualitative analysis technique was carried out using a qualitative analysis software called MAXQDA.

Lapadat (2010, p. 926) defines thematic analysis as:

“A systematic approach to the analysis of qualitative data that involves identifying themes or patterns of cultural meaning; coding and classifying data, usually textual, according to themes; and interpreting the resulting thematic structures by seeking commonalities, relationships, overarching patterns, theoretical constructs, or explanatory principles.”

Thematic analysis allowed the researcher to create codes and generate themes from the survey data. It also assisted in identifying the requirements to include in the model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning.

## 1.4 Significance of the study

The outcome of the study was a model that can be used to guide the design of an e-learning system aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants. The e-learning system facilitates the preservation of explicit indigenous knowledge by converting it to tacit knowledge in people who use the e-learning system and internalise this knowledge. The model contributes to the theoretical body of knowledge on e-learning and the preservation of indigenous knowledge. According to Olivier (2009, p. 45), "a model captures the essential aspects of a system or process. It can serve as a blueprint for new systems or processes or may be used to evaluate existing systems or processes". The model from this study will be beneficial to e-learning system developers, as it will guide them when designing systems aimed at facilitating the preservation of indigenous knowledge.

An implementation of the model will be beneficial to the general population that will use the e-learning system. The preservation of knowledge is expected to be two-fold: knowledge preserved in the repository of the e-learning system, as well as knowledge preserved internally within the individuals who work through the content on the system.

## 1.5 Scope, limitations and assumptions

In this study, a new e-learning system was not developed. However, the researcher used an existing e-learning system to develop a prototype that assisted in achieving the objectives of the study. Moodle was used to develop the prototype; it was selected because of convenience as it is the platform used at the participants' university, and because the researcher had been granted permission to make use of the platform.

Only literature written in the English language was consulted in the study.

Due to a lack of multimedia content, only text and image information on indigenous medicinal plants could be presented on the prototype e-learning system.

The study was limited to the preservation of indigenous knowledge of medicinal plants and no other types of indigenous knowledge.

Namibia has more than thirty indigenous medicinal plants, but only thirty plants were selected as a sample for the prototype e-learning system.

The study used a convenience sampling method and only focused on students from one institution, the Namibia University of Science and Technology. The researcher does work

in the Faculty of Computing at this institution, but no students personally known to the researcher or taking her classes were selected. More than half of the students were from the Faculty of Computing and Informatics, but this did not create bias in the study as the students were from diverse regions and from different backgrounds.

The model resulting from this study is envisaged to guide in the design of an e-learning system to preserve indigenous knowledge of medicinal plants. This e-learning system is intended to be expanded and to be made available to anyone, both nationally and internationally, who has an interest in the information preserved on it. However, it was only tested on students of the Namibia University of Science and Technology. The assumption was made in this study that people who grew up in the rural areas of Namibia are more knowledgeable about the country's indigenous medicinal plants than those who grew up in urban areas.

## 1.6 Chapter outline

The dissertation comprises five chapters. A discussion of what each of the remaining four chapters entails, follows.

- ***Chapter 2: Research methodology***

In Chapter 2, the focus is on the research process. The discussion centres on the philosophical orientation of the study, the research design that was employed, the data collection tools, and the method that was used to analyse the data. The research methodology chapter was discussed before the literature review as the literature review formed part of the data collection tools used in this study. How ethical principles were maintained is also discussed in this chapter.

- ***Chapter 3: Literature review***

The importance of indigenous knowledge is discussed in Chapter 3. Existing models for digitally preserving indigenous knowledge are also discussed, as are the current information technology tools used in the digital preservation of indigenous knowledge of medicinal plants. Requirements important to indigenous knowledge preservation are identified, and a conceptual theoretical model for the preservation of indigenous knowledge is developed. A success model is adapted from the literature to guide in the development of the questionnaires used in collecting data from the study participants.

- ***Chapter 4: Data analysis, findings and development of model***

The focus of Chapter 4 is on presenting the data that was collected using a survey. The data is analysed using thematic analysis. The findings from the data and the themes that emerge are discussed. Additional requirements are identified to adapt the conceptual theoretical model for the preservation of indigenous knowledge developed in Chapter 3.

- ***Chapter 5: Summary and recommendations***

The findings of the study are summarised. Recommendations for future research are provided.

Table 1.2 provides an outline of the sections found in each of the remaining chapters.

**Table 1.2: Structure of remaining chapters**

<b>Chapter 2: Research Methodology</b>	<b>Chapter 3: Literature Review</b>	<b>Chapter 4: Data Analysis, Findings and Development of Model</b>	<b>Chapter 5: Conclusions, Contributions and Recommendations</b>
2.1 Introduction 2.2 Philosophy 2.3 Approach to theory development 2.4 Research design 2.5 Ethical considerations 2.6 Summary and conclusion	3.1 Introduction 3.2 Indigenous knowledge 3.3 E-learning 3.4 Information systems models used to evaluate the success of e-learning systems 3.5 Adaptation of the E-learning Success Model 3.6 Models and frameworks for digitally preserving indigenous knowledge 3.7 Requirements abstracted from literature 3.8 Conceptual theoretical model for the digital preservation of indigenous knowledge 3.9 Contribution of Chapter 3 to research questions 3.10 Summary and conclusion	4.1 Introduction 4.2 Data collection and participant demographics 4.3 Data analysis 4.4 Model to guide the design of an e-learning system to facilitate the digital preservation of indigenous knowledge of Namibia's medicinal plants 4.5 Contribution of Chapter 4 to research questions 4.6 Summary and conclusion	5.1 Introduction 5.2 Summary of the research process 5.3 How the research questions were answered 5.4 Contributions and limitations of the study 5.5 Conclusions and recommendations for future work 5.6 Personal reflection

## **1.7 Referencing style**

The APA 6<sup>th</sup> Edition referencing style was used in this study and the Mendeley Desktop application was used for citation and reference management.

## **1.8 Conclusion**

The purpose of this study was to develop a model that can be used as a guide in the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants. In this chapter, a brief background of the study was provided, and the problem statement and research objectives of the study were discussed to highlight the significance of the study. The research methodology that was used to achieve the objectives of the study was discussed. In the next chapter, the discussion is on the research methodology followed in this study.

# CHAPTER 2

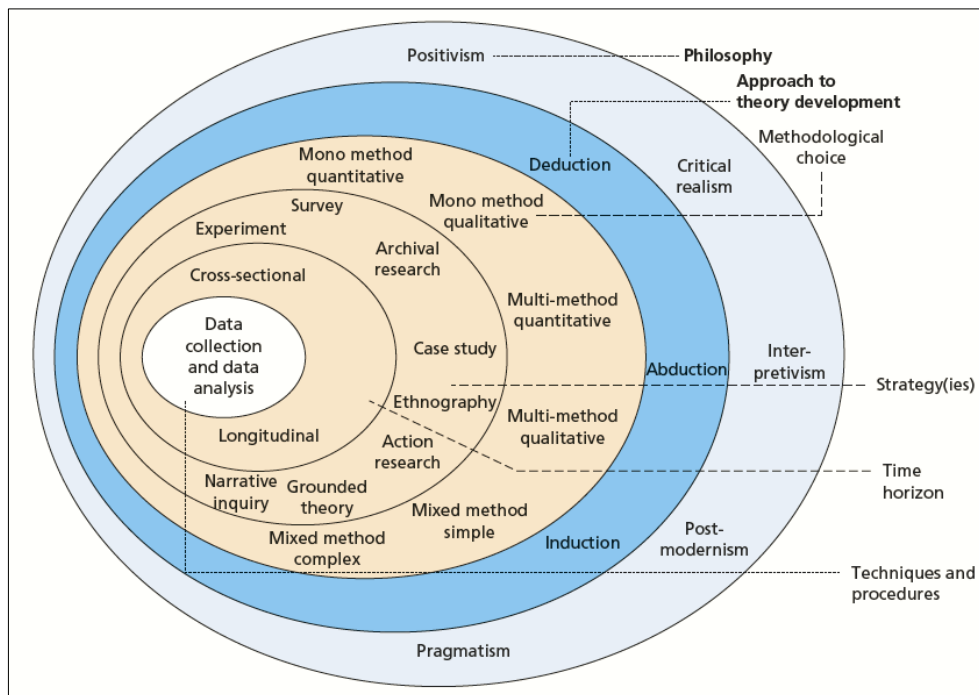
## RESEARCH METHODOLOGY

<b>Chapter 2: Research Methodology</b>
2.1 Introduction
2.2 Philosophy
2.3 Approach to theory development
2.4 Research design
2.5 Ethical considerations
2.6 Summary and conclusion

### 2.1 Introduction

The purpose of this study was to develop a model that will guide the design of an e-learning system aimed at facilitating the digital preservation of indigenous knowledge of Namibia’s medicinal plants.

In this chapter, the researcher discusses the research methodology that was followed in the study. The discussion is structured according to the “research onion” presented in Figure 2.1.

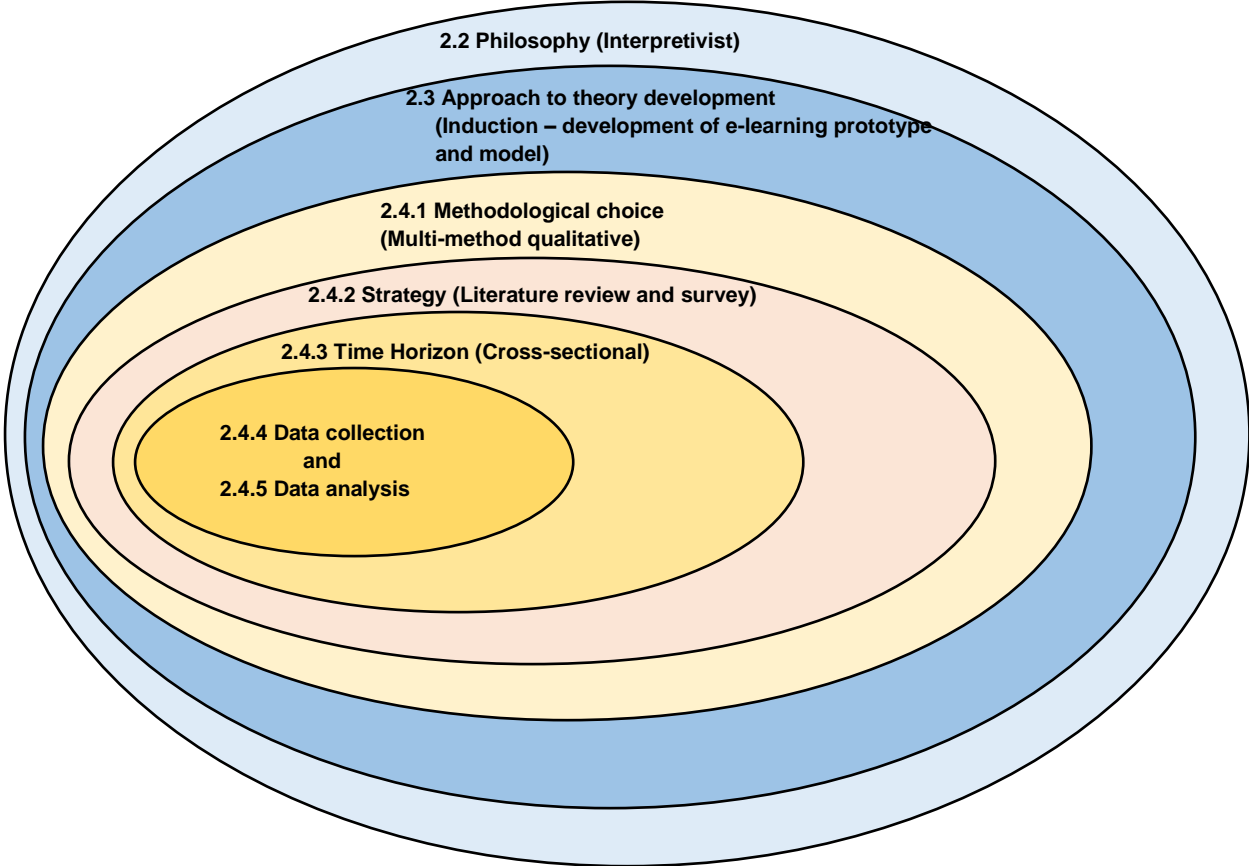


**Figure 2.1: The “research onion” (Saunders, Lewis, & Thornhill, 2016)**



The “research onion” was developed by Saunders, Lewis and Thornhill (2016). It presents layers that guide the structure of a research methodology chapter. The discussion starts from the outer layer, which is the philosophy layer, going down to the techniques and procedures layer. The onion presents different options in each layer, from which researchers can choose as guided by their research objectives and the intended outcomes of their studies.

Figure 2.2 displays the choices made for each layer in this study, and the sections in which these choices are discussed.



**Figure 2.2: Research methodology for this study adapted from Saunders et al., (2016)**

The current study is situated within the interpretivist philosophical view, which is the focus of Section 2.2. The approach to theory development is discussed in Section 2.3. In Section 2.4, a discussion on the research design of the study is provided, divided into five subsections. In Section 2.4.1, the multi-method qualitative approach, which is the methodological choice used in this study, is discussed. Section 2.4.2 focuses on the survey and literature review research strategies which are used in this study. In Section 2.4.3, an overview of the cross-sectional time horizon is provided. The data collection and

data analysis techniques are discussed in Sections 2.4.4 and 2.4.5 respectively. The discussion in Section 2.5 highlights how ethical standards were ensured during the study. The chapter concludes in Section 2.6, with a discussion summarising the relevance of the chapter to the study and what is to be expected in the next chapter.

## 2.2 Philosophy

Saunders et al. (2016, p.130) define research philosophy as “a system of beliefs and assumptions about the development of knowledge”. The research philosophy is also referred to as the research paradigm (Edson, Henning, & Sankaran, 2017). Kroeze, (2012b, p. 47) defines a research paradigm as “the philosophical stance that encompasses one’s underlying assumptions about reality and knowledge”. The research paradigm influences our beliefs concerning the validity, legitimacy and justifiability of research (Strang, 2015).

Van Zyl (2015) and Oates (2006) recognise three prominent research paradigms employed within studies carried out in information systems and computing in general. These paradigms are positivism, interpretivist (constructivism) and critical realism.

Positivism is considered a popular paradigm within research in the information systems and computing fields. However, Oates (2006, p. 302) mentions that research in these fields is “based, often unthinkably, on positivism”, whereas it is important to consider the views of the intended users in order to improve an IT artefact or a model, as this results in “artefacts that the stakeholders perceive as good and appropriate for all of them” (Oates, 2006, p. 303).

The interpretivist and critical realism paradigms are also referred to as the non-positivist paradigms. Studies carried out within the non-positivist paradigms are said to be easily influenced by the subjectivity of the researcher, as the findings of a study can be influenced by the views and experiences of the researcher, while those carried out in the positivist paradigm are of a more objective nature and their results independent from the views of the researcher (Aliyu, Bello, Kasim, & Martin, 2014). Subjectivity has to do with the researcher’s feelings, opinions and preferences, which can result in findings being personally biased (Roulston & Shelton, 2015).

Creswell (2014, p. 8) states that the interpretivist approach seeks to “understand the historical and cultural settings of the participants”. The participants’ meanings are subjective and are influenced by their backgrounds, experiences and social interactions

(Johannesson & Perjons, 2014). Critical realism is not only concerned with social events and participants' views but also with what has caused these events (Thapa & Omland, 2018). Critical realists are objective and believe that the world is external to people's beliefs and experiences and other possibilities should be explored to determine why people hold these views (Kozhevnikov & Vincent, 2019).

The current study is situated within the interpretivist paradigm. The interpretivist paradigm was best suited to this study, as it deals with understanding participants, their experiences and views. In this paradigm, the complexity of meanings that rely on participant views (Saunders, Lewis, & Thornhill, 2016) is investigated. Research carried out in the interpretivist paradigm is research-question driven and geared towards the qualitative approach, whereas research carried out in the positivist paradigm is generally hypothesis-driven and geared towards the quantitative approach (Kroeze, 2012a). The interpretivist paradigm assisted in selecting a research approach that deals with human beings and understanding and exploring their perspectives. Open-ended questions are preferred within the interpretivist paradigm, and in the current study, both open-ended and closed-ended survey questions provided the researcher with the data that was needed to assist in answering the research questions. The data collected was of a qualitative nature and thus interpretivist was a good fit for the study.

In the next section, the researcher will discuss the approaches to theory development that were applied in the study.

## 2.3 Approach to theory development

Induction, deduction and abduction are the methods used in developing theories in research studies, and they are also referred to as forms of logical reasoning (Reichertz, 2014). Kennedy (2018) and Åsvoll (2014) provide the following explanations for the three methods of theory development:

- Induction – the method begins by exploring the general phenomena of a situation and moves to the specific. Induction can be used to generalise the findings from one study to another study in a similar context, as the rules in one situation can apply in similar situations. Conclusions in an inductive study are generated from the data collected in the study.
- Deduction – in deductive studies, researchers work within set rules. The method begins with a rule, and data is collected to test the rule. The data either supports or disproves the rule.

- Abduction – in abductive studies, the aim is to develop new hypotheses. Further investigations are carried out to explore the hypotheses. Unlike with deduction, abduction is not only aimed at confirming or invalidating a hypothesis but rather builds on it by collecting data to expand the hypothesis and create a new understanding of a phenomenon. In abduction, the processes of data collection and data analysis may be carried out multiple times to support the expansion of hypotheses and theory building.

The inductive method of reasoning was used in this study. Induction was used to identify requirements from the data collected, and this assisted in developing the model for digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. Initial requirements were obtained from the literature to develop a conceptual theoretical model for preserving indigenous knowledge. Additional requirements were obtained from a survey and used to expand the conceptual theoretical model.

## 2.4 Research design

Research design is influenced by the choice of research philosophy and consists of the methodology, the research strategy, the time-horizon requirements of the study, and the data collection and data analysis techniques (Saunders, Lewis, & Thornhill, 2016).

### 2.4.1 Methodology

Research approaches are categorised into three broad categories, which are qualitative, quantitative and mixed methods (McCusker & Gunaydin, 2015; Myers, 2013):

- Qualitative: The qualitative approach is used to answer research questions to which individuals assign different meanings. These meanings can result from their feelings, perceptions and experiences. The final report of a study using this approach generally has a flexible structure. This approach is inductive, as meanings are generated from data collected in the field.
- Quantitative: The quantitative approach measures variables. The final report of a study using this approach generally has a set structure. This approach is deductive in nature and is mostly used when testing theories.
- Mixed methods: The mixed-methods approach combines elements from both the qualitative and quantitative approaches.

The qualitative research approach was selected for this study. A qualitative approach allowed the researcher to collect data on the views and perceptions of the participants,

which assisted in obtaining the requirements used to develop the model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning. Saunders et al. (2016) distinguish between two approaches to qualitative designs, namely mono- and multi-method. Mono-method design makes use of only one data collection tool, whereas in multi-method design, more than one data collection tool is used (for example, using both structured interviews and document analysis in the same study). In this study, a multi-method qualitative approach was followed, as data was collected using both a survey and a literature review. The data collected from the literature review assisted in obtaining requirements for the conceptual theoretical model for preserving indigenous knowledge, developing a prototype system, and formulating a questionnaire.

According to Sedmak and Longhurst (2010, p. 82), "qualitative research is that in which the data obtained is in the form of words and observations, rather than numbers". Numerical data can present a challenge when answering questions that have to do with human behaviour, experiences and perceptions (Vhurumuku & Mokeleche, 2009). In Tsai (2015), where a quantitative study was carried out using the Technology Acceptance Model (TAM) to evaluate the effects of using an e-learning system on students' academic performance, a recommendation is suggested for the use of qualitative research methods to enable researchers to obtain more detailed information from their participants. The researcher in the current study followed the recommendation of Tsai (2015) in conducting qualitative research. To obtain detailed information, a prototype e-learning system was developed. The participants of the study worked through the prototype system and provided their perceptions and views to help determine the requirements for a model for preserving indigenous knowledge of medicinal plants via an e-learning platform.

The qualitative research method encompasses different choices of research strategies that enable researchers to gather data on the views and behaviours of participants as directed by the study being conducted (Flick, 2018). In the next section, we will discuss the research strategy used in the current study.

#### **2.4.2 Research strategy**

Oates (2006); Olivier (2009) and Vogt, Gardner, and Haeffele (2012) highlight six research designs commonly implemented by researchers using a qualitative approach:

- Narrative research: the researcher studies the life of a participant and poses questions to the participant to provide details about the story of their life.

- Phenomenology: the researcher describes a phenomenon based on data collected from participants.
- Grounded theory: the researcher derives a theory from the data collected from the participants.
- Ethnography: the researcher, over a period of time, studies a cultural group of people in a natural setting.
- Case study: the researcher undertakes an in-depth analysis of a case, which can be “a program, event, activity, process, or on one or more individuals” (Creswell, 2014, p.14).
- Survey research: the researcher collects information for the description, comparison, or explanation of the participants’ knowledge, attitudes and behaviours (Fink, 2003).

In the current study, the researcher made use of the survey research strategy. Hageman, Kim, Sanchez and Bertolli (2015, p. 342) define survey research as “the systematic method of gathering information with the use of questionnaires to draw quantitative conclusions about the respondents' attitudes, beliefs, opinions, and behaviours”. Yet according to Jansen (2010), surveys can also be employed in qualitative research, with the major difference being in its design to obtain information of a diverse nature from the participants – information that is not concerned with statistical data such as frequencies and standard deviations, but with users’ views and perceptions. Jansen (2010, para. 11) states that “a survey is a qualitative survey if it does not count the frequencies of categories(/values), but searches for the empirical diversity in the properties of members, even if these properties are expressed in numbers”. According to Braun and Clarke (2013), qualitative surveys are well suited to research questions on experience, understandings and perceptions.

Before conducting the survey, the researcher collected data by conducting a literature review. Requirements for a conceptual theoretical model for preserving indigenous knowledge were identified from the literature review. The survey and literature review both assisted in providing answers to the research questions, as demonstrated in Table 2.1.

**Table 2.1: Strategies used to provide answers to the research questions**

Research questions and research instruments	Strategy used	
	Literature review	Survey
1. What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)	X	
2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)	X	X
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)	X	X

Surveys can be self-administered or interviewer-administered. Self-administered surveys involve respondents completing the questionnaires alone with no direction or involvement from the interviewer, whereas interviewer-administered surveys involve one or multiple respondents completing the questionnaire in the presence of the interviewer. During an interviewer-administered survey, the interviewer provides guidance if the respondent(s) do not understand a question (Hageman et al., 2015). Table 2.2 provides the advantages and disadvantages of the two types of surveys.

The questionnaires administered in the current study were printed on paper and the interviewer personally administered them to the participants in a computer lab. A disadvantage of interviewer-administered surveys highlighted in Table 2.2 is that of interviewer bias. To avoid interviewer bias, at the beginning of the administration of the questionnaire, the researcher collectively discussed the format of the questionnaire with all the participants and informed them of the importance of completing the open-ended questions for qualitative analysis purposes. Individual consultation between the researcher and a participant was only done when a participant requested the researcher to explain to them a question they did not understand. The researcher provided an explanation but did not lead the participant to an answer by providing examples of responses that the participant could make use of.

**Table 2.2: Advantages and disadvantages of self-administered and interviewer-administered survey types (Hageman et al., 2015)**

Survey type	Advantage	Disadvantage
Self-administered	<ul style="list-style-type: none"> <li>- The respondent completes the questionnaire in the absence of the interviewer, and this minimises bias that could have been introduced if the interviewer were present.</li> </ul>	<ul style="list-style-type: none"> <li>- Questions are not explained to the respondent.</li> <li>- Probing is not done to obtain more data from the respondents.</li> <li>- Respondents may not complete the questionnaire in full.</li> </ul>
Interviewer-administered	<ul style="list-style-type: none"> <li>- Questions can be explained to the respondents.</li> <li>- If a response is not clear, probing may be done to understand what the respondents want to say.</li> <li>- The probability of the respondent completing the questionnaire in full is increased.</li> </ul>	<ul style="list-style-type: none"> <li>- It may be expensive to administer.</li> <li>- The interviewer may require some training.</li> <li>- The respondents may be influenced by the interviewer (interviewer bias).</li> </ul>

### 2.4.3 Time horizon

Survey research studies can be conducted in either a longitudinal or cross-sectional time horizon. Longitudinal research is undertaken over a long period of time, sometimes over a course of years, with the aim of evaluating differences between the time periods (Hofer & Piccinin, 2010; Mathison, 2005), while cross-sectional studies are undertaken only at a single instance (Salkind, 2010). Table 2.3 provides the difference between longitudinal and cross-sectional surveys.

In the current study, data was collected from the participants at a single point in time. Data will not be collected from the same participants in future for the purpose of this same study, thus implying a cross-sectional design.



**Table 2.3: Difference between cross-sectional and longitudinal time horizons** (Ruel, Wagner III, & Gillespie, 2016)

Cross-sectional	Longitudinal
<ul style="list-style-type: none"> <li>• This is a snapshot of opinions at one point in time.</li> </ul>	<ul style="list-style-type: none"> <li>• These are cross-sectional studies that are repeated at different intervals.</li> <li>• Studies may also be set up to collect data from a group of people with similar characteristics and later from another group of people with a set of different characteristics.</li> <li>• Data collection can be done at different time intervals and data sets are compared against each other to determine the cause of a situation or medical condition, such as a chronic illness.</li> <li>• The study may follow the same people and collect data from them over time until the completion of the study.</li> </ul>

The next section is centred on the techniques that were followed in the data collection process.

#### 2.4.4 Data collection

Research instruments are tools that are used to collect data, either from participants or from objects such as documents and experiments. Research instruments are also referred to as data collection tools (Mtebe & Raisamo, 2014).

Stuart, Maynard and Rouncefield (2015) and Vogt, Gardner and Haeffele (2012) identify the following data collection tools used in the qualitative research approach:

- Observation: the researcher is submerged into the process by studying the behaviours and practices of a group of people, and takes notes of what he or she observes from the group.
- Interviews: a participant is met face-to-face and a range of structured or semi-structured questions are posed to him or her; the researcher can probe for more information from the participant.
- Focus groups: an interview is carried out with more than one participant to get the general views of the group.
- Document analysis: the researcher gathers different documents, such as policy documents, email conversations, financial documents, etc. and analyses them.

- Literature reviews: the researcher reviews existing scholarly peer-reviewed journal articles and books.
- Questionnaires: usually self-administered and require little or no interaction with the researcher. Data can be collected on the views, beliefs and experiences of participants by means of open-ended questions. Questionnaires allow researchers to gain an understanding of a situation by selecting a sample that can be used to generalise to the wider population.

A literature review and survey comprising two questionnaires were used for collecting data in this study.

#### 2.4.4.1 Questionnaires

Questionnaires are sets of questions that are administered to the participants of a study, using either paper-based or online methods for delivery (Harris, 2014; Saris & Gallhofer, 2014). Questionnaires are one of the most inexpensive methods of data collection and can be administered to many people simultaneously (De Rada & Domínguez-Álvarez, 2014). During administration, interaction with the researcher is not necessary as the instructions are normally printed on the first page of the questionnaire. Researchers should ensure that the instructions are clear to avoid confusion and nonresponse from the participants. As stated in Section 2.4.2, it is, however, preferable for the researcher to be present during administration to avoid a high nonresponse to open-ended questions. Questionnaires can comprise of both open-ended and closed-ended questions as determined by the study at hand (Lalmas, O'Brien, & Yom-Tov, 2014). Open-ended questions are preferred for qualitative research studies.

Two questionnaires were used in this study (see Appendix B and C). The questionnaires consisted of both closed-ended and open-ended questions:

- The questions in the first questionnaire enquired on the participants' demographics, on their prior knowledge and experience of indigenous medicinal plants, and on their perceptions of an e-learning system to preserve knowledge of indigenous medicinal plants. When the participants had completed the first questionnaire, they worked through the content on Namibia's indigenous medicinal plants that was presented on the prototype e-learning system<sup>1</sup> developed in this

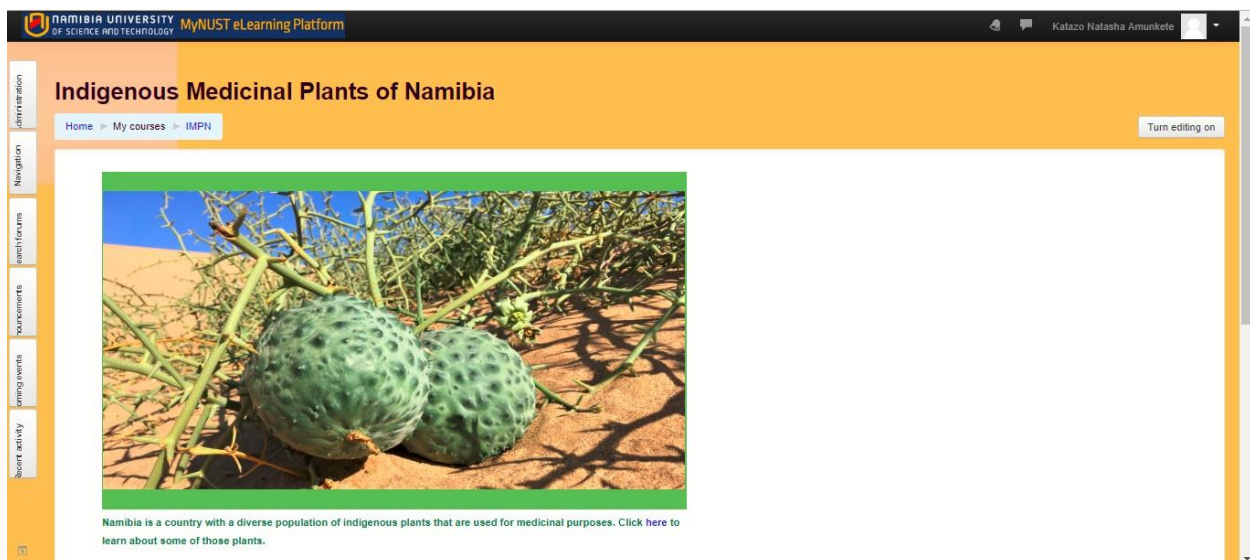
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<sup>1</sup> Access to the prototype e-learning system requires users to provide valid authentication details. The researcher can be contacted in this regard.

study. After working through the content, the participants then completed Questionnaire 2.

- The questions in the second questionnaire enquired on the quality of the prototype e-learning system and the information on indigenous medicinal plants that was presented on the system; the participants' satisfaction with the e-learning system; and the positive and negative impacts that the participants perceived would be derived from using the e-learning system.

The questions in the first questionnaire assisted in answering RQ2 of the study. The first questionnaire was divided into two sections. In Section 1, the questions posed were on the demographics of the participants. The questions in Section 2 were on the methods by which the participants obtained indigenous knowledge of Namibia's medicinal plants, their experience with indigenous medicinal plants, and their perceptions of using an e-learning system to preserve indigenous knowledge of these plants. The information on the indigenous medicinal plants found in Appendix A was presented as content on the e-learning system used as a prototype. The information presented on the system included both the common and scientific names of each plant, an image of the plant, and its uses in treating minor illnesses. The prototype e-learning system was developed using the Moodle (Modular Object-Oriented Dynamic Learning Environment) Learning Management System. Figure 2.3 is an image of the interface of the e-learning system.



**Figure 2.3: Interface of the e-learning system (prototype)**

The first questionnaire was completed by the participants before they logged onto the prototype e-learning system and worked through the content on indigenous medicinal

plants. The participants worked through the content and it is expected that during this process, they obtained and preserved tacit knowledge by internalising the information. When the participants were done working through the content, they completed the second questionnaire.

The questions in the second questionnaire were constructed with guidance from the E-learning Success Model by Holsapple & Lee-Post (2006) as adapted by the researcher. The model is discussed in more detail in Chapter 3.

#### 2.4.4.2 Pilot study and pre-testing of the questionnaire

A pilot study is necessary to determine that an instrument is collecting data that can answer the research questions of the study (Holyk, 2008; Wolf, Joye, Smith, & Fu, 2016). Pre-testing the questionnaire before it is administered can also be used to validate a questionnaire (Ruel, Wagner III, & Gillespie, 2016). Pre-testing a questionnaire assists in determining whether the questions are understandable and in the right order, whether the questionnaire is too lengthy, and whether it contains other errors such as grammar problems (Willis, 2016). The questionnaire used in the piloting and pre-testing phase was divided into Questionnaire 1 and 2 (see Appendices D and E).

At the time of the pilot study, the prototype e-learning system was not yet developed, and thus only Questionnaire 1 was used for the pilot. The data collected was published in Amunkete, Van Staden and Schoeman (2019). The pilot study was carried out among thirty-four participants who were willing and available to participate in the pilot. After completion of the e-learning prototype system, Questionnaire 2 was pre-tested among colleagues of the researcher.

The participants in the pilot and pre-testing did not form part of the participants for the final data collection for this study. The pilot study and pre-testing helped with ensuring that the questions were comprehensible and would obtain the necessary data to answer the research questions of the study. The outcome of the pilot and pre-testing was a refinement of the questionnaire.

The following changes were implemented to the questionnaire:

- Changes to Section 1 of Questionnaire 1:
  - A new Question 1.3 was added, *Which Faculty do you belong to?* This was done to determine which faculties participated in the study. (The participants of the study are discussed in the next section.)

- The previous Question 1.3 became Question 1.4 and it was changed from *Which tribe do you belong to?* to *Which region do you belong to?*. The participants of the pilot had trouble with associating with the tribes indicated on the questionnaire; they would choose *Other* and specify the region from which they originate.
- Question 1.5 was changed from *Which mobile technology devices do you have access to?* to *Which of the following devices do you have access to?* The change in wording was done due to the option *Desktop Computer* appearing on the list even though the device is not a mobile technology.
- Changes to Section 2 of Questionnaire 1:
  - Question 2.2 was changed to 2.5, as it was placed too early in the questionnaire and a positive response to the question was required to complete Question 2.6.
  - A new question, Question 2.3, was added to enquire whether participants had ever used indigenous medicinal plants to treat minor illnesses, as Question 2.4 enquired on the effectiveness of the indigenous medicinal plants that have been used by the participants in treating minor illnesses.
  - Question 2.5 was changed from *On which electronic platform(s) would you prefer to learn more about indigenous medicinal plants?* to *How would you prefer to learn more about indigenous medicinal plants and why?*. The question was reworded as the pilot participants chose the *Other* option and indicated mechanisms that are not electronic. Non-electronic options were therefore also added.
  - Question 2.8 was changed from *Please provide any additional comments you have on preserving indigenous knowledge on e-learning?* to *Please provide any additional comments you have on the indigenous knowledge of medicinal plants preserved from engaging on an e-learning system?*. The question was reworded for clarity as the pilot participants could not understand the question and enquired from the researcher on what the question required. The question did also not indicate the type of indigenous knowledge that was being referred to.
- Changes to Questionnaire 2:
  - The words “*course*” and “*platform*” had been used interchangeably to refer to the prototype e-learning system. To avoid confusion, they were changed to the word “*system*” throughout the questionnaire.

- Question 4.2 was removed as it was similar to Question 4.1 and the participants left the question blank, provided the same response to both questions, or referred the researcher to Question 4.1 when completing Question 4.2.
- Question 5.1 was removed as the participants provided similar responses to Question 2.7 of Questionnaire 1 because the questions were exactly the same. The question was intended to find out if the participants had differing opinions on the usefulness of e-learning at preserving the indigenous knowledge of medicinal plants. The responses were the same for both questions.
- Question 6.1 was changed from *Was there anything missing on the course that would make it successful?* to *Would you like to add or remove anything from the e-learning system to make it more useful?*. This was done for clarity as the participants indicated that the question was leading them into responding that they felt that the system had missing features.

The changes made to the pilot and pre-tested questionnaires were implemented in the final questionnaires. The pilot and pre-tested Questionnaires 1 and 2 were changed to Pre-system use questionnaire (Questionnaire 1) and Post-system use questionnaire (Questionnaire 2). The sections in the questionnaires remained unchanged. The refined questionnaires can be found in Appendix B and C.

In the next section, the researcher will provide a brief discussion on the participants that formed part of the study and how they were selected.

#### 2.4.4.3 Sampling method

The participants were students from the Namibia University of Science and Technology (NUST), selected using convenience and purposive non-probability sampling methods. Sampling is a procedure of selecting an adequate number of participants from a population of possible participants; the population is generally large, as it is comprised of all the individuals who for the purpose of the study are of interest to the researcher (Shields, 2017).

Convenience sampling is also referred to as opportunity sampling. It is a nonprobability sampling method that allows a researcher to select participants on the basis of their availability, how accessible they are, and their willingness to form part of a study (Budiarto, Purnamasari, Yennisa, Surmayanti, Siradjuddin, Hermawan, & Herawan, 2018; Farrokhi & Mahmoudi-Hamidabad, 2012).

On the other hand, purposive sampling is a sampling technique used to select participants based either on the participants' characteristics or on their prior knowledge; or on their relevance to the research questions of the study (Saunders & Townsend, 2018; Schwandt, 2007; Tongco, 2007).

In purposive sampling, participants can also be selected due to a certain feature (Brewis, 2014). In the current study, for relevance to the research questions, the participants were selected on the basis of being of Namibian nationality. The students of the university all have access to the university's resources and have login credentials to the e-learning system used for the prototype system used in the study. The participants had to be Namibian students at NUST who were accessible, available and willing to participate. The researcher made use of a computer lab at NUST and the university's e-learning system to develop the prototype system used in the study. The participants of the study are discussed in detail in Chapter 4 (Section 4.2).

#### 2.4.5 Data analysis

Thematic analysis was used to analyse the data collected. When using the thematic method of data analysis, researchers code the data and develop categories and themes from the codes generated. Thematic analysis allows for the analysis, organisation, description and reporting of the themes that are found within the data (Nowell, Norris, White, & Moules, 2017). To identify themes in the data, it is necessary to read and re-read the data carefully as many times as possible (Fereday & Muir-Cochrane, 2006). The thematic analysis technique assisted in identifying recurrent themes in the data which provided the requirements to include in the model for the digital preservation of indigenous knowledge on medicinal plants in Namibia via an e-learning platform.

The Braun and Clarke (2006) thematic analysis method was used to analyse the data. The method consists of six phases (Braun & Clarke, 2012; Clarke & Braun, 2013; Terry, Hayfield, Clarke, & Braun, 2017), namely:

1. Familiarisation with the data
2. Coding
3. Theme development
4. Reviewing themes
5. Defining and naming themes
6. Writing up and producing the report

In Phase 1 of the Braun and Clarke thematic analysis model, the data is read and re-read and is organised for analysis. Audio-recorded interviews are transcribed, while survey data may be recorded and organised into an Excel sheet. In Phase 2, the researcher reads through the data, notes similar words and expressions, and assigns codes to them. Similar codes are later combined into categories. In Phase 3, the categories are examined to generate themes. The themes generated in Phase 3 are reviewed to ensure that no categories have been omitted. After the themes have been reviewed, in Phase 4, the themes are finalised by defining and assigning names to them. The final phase, Phase 6, is a write-up of the processes that were followed during the analysis from Phase 1 to 5. Additionally, in Phase 6, the write-up cumulates in a report where the themes generated are related back to the research questions of the study, and to the existing literature.

Certain requirements were identified from the literature review and guided the researcher in the construction of the conceptual theoretical model for the preservation of indigenous knowledge. One of the themes from the survey concurred with one of the requirements identified from the literature review, but several additional themes also emerged. Additional requirements obtained from the themes were incorporated into the design of the final model.

Ethical principles were maintained during the study, as discussed in the next section.

## 2.5 Ethical considerations

Ethics is about valuing human conduct (Manhas & Oberle, 2015). The participants in a study should feel that their contribution is valued and meaningful and that no harm is done to their human dignity. The Namibia University of Science and Technology granted the researcher access to the participants by issuing a letter of approval (see Appendix F) to use their students as participants in the study. Riese (2019, p. 23) defines access as “an ongoing and dynamic process which lasts as long as the research project” and which determines how the researcher and the participants relate to each other (Walby & Luscombe, 2017). The participants were provided with a participant information sheet (see Appendix G) which provided information on the purposes of the study, the participants’ voluntary involvement and their right to withdraw whenever they chose to. Participants also signed a consent to participate form (see Appendix H) before they proceeded with completing the questionnaires and engaging with the e-learning system. Appendices G and H were also provided to the participants who took part in the piloting



and pre-testing phase. Ethical clearance approval to conduct this study was granted by the UNISA School of Computing Ethics Review Committee (see Appendix I).

The researcher undertook to follow relevant ethical principles and ensured that the participants of the study were not harmed (Connor, Copland, & Owen, 2018; Doyle & Buckley, 2017) by:

- disclosing the purpose of the study to the participants.
- informing the participants of their consent to participate. The researcher did not coerce the participants into participating and participants were at liberty to withdraw if they no longer wished to continue with the study.
- not disclosing the personal particulars of the participants and keeping their data confidential.
- avoiding discriminatory questions.

The questionnaires did not have any identifiers and the anonymity and confidentiality of the participants were maintained. The researcher had no affiliation with the participants and did not ask for their names during the administration of the questionnaires.

## 2.6 Summary and conclusion

In this chapter, the research philosophy and research design utilised in the study were discussed. The study was carried out using a qualitative research approach and was centred around the interpretivist philosophy. A multi-method research strategy was adopted, in which a literature review and survey were used to collect the data used in the study. This cross-sectional research study was carried out using the Namibia University of Science and Technology's students as participants. A prototype e-learning system on which information on a selected number of Namibia's indigenous medicinal plants is presented was developed for the purpose of this study. The participants of the study completed one questionnaire before working through the content on the prototype e-learning system and thereafter provided their views on the system by completing the second questionnaire. The questionnaires were interviewer-administered and were carried out in a computer lab. The data collected was thematically analysed to assist in providing answers to the research questions of the study. The procedures that were followed to adhere to the ethical principles of carrying out research were also discussed.

The outcome of the study was a model for preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. In the literature review, requirements were identified and were used to construct a conceptual theoretical model for preserving indigenous knowledge. Themes generated from the survey were incorporated into the conceptual model to develop a model for preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform.

The next chapter focuses on the literature review carried out for the study. The literature review contributed to providing answers to the research questions of the study.

# CHAPTER 3

## LITERATURE REVIEW

### **Chapter 3: Literature Review**

- 3.1 Introduction
- 3.2 Indigenous knowledge
- 3.3 E-learning
- 3.4 Information systems models used to evaluate the success of e-learning systems
- 3.5 Adaptation of the E-learning Success Model
- 3.6 Models and frameworks for digitally preserving indigenous knowledge
- 3.7 Requirements abstracted from literature
- 3.8 Conceptual theoretical model for the digital preservation of indigenous knowledge
- 3.9 Contribution of Chapter 3 to research questions
- 3.10 Summary and conclusion

### 3.1 Introduction

Literature reviews are carried out for different purposes, such as to provide the current state of knowledge on a topic of interest, to identify a gap in the literature, or to provide a synthesis of the theories and research methods used within a certain field of study (Van Wee & Banister, 2016). The purpose of the literature review in this study was to provide an overview of the literature in the field of indigenous knowledge preservation and e-learning, and also to identify the gaps that exist within the current literature. The literature reviewed in this chapter contributed to providing answers to the research questions of the study.

Literature searches were carried out on the following databases: Science Direct, JSTOR, Emerald Insight, ACM Digital Library, ProQuest Science and Technology, Taylor and Francis; IEEEExplore and Google Scholar. The following key terms were used to search the databases: digital preservation, e-learning, indigenous knowledge, indigenous medicinal plants, indigenous knowledge models, indigenous knowledge preservation and information system models. The key terms were selected based on the objectives of the study.

This chapter is divided into ten sections. In Section 3.2, indigenous knowledge and information technology tools that have been used in its preservation are discussed. E-learning technology is discussed in Section 3.3, while different models that have been

used to evaluate the design of e-learning systems are discussed in Section 3.4. In Section 3.5, the adaptation of the E-learning Success Model that was used to guide in the preparation the questionnaires that were used to evaluate the prototype e-learning system is discussed. Existing models and frameworks that are used for the digital preservation of indigenous knowledge are discussed in Section 3.6. Section 3.7 provides the requirements used to develop a conceptual theoretical model for preserving indigenous knowledge. The conceptual theoretical model developed is discussed in Section 3.8. In Section 3.9, a discussion on how the chapter contributed to providing answers to the research questions is provided. The chapter concludes with a summary in Section 3.10.

## 3.2 Indigenous knowledge

Nwauche (2014) posits that there is no single definition for indigenous knowledge. Gardiner and Thorpe (2014, p. 111) define indigenous knowledge as “the practices, representations, expressions, knowledge, skills, instruments, objects, artefacts and cultural spaces that communities, groups and in some cases, individuals recognise as part of their cultural heritage”. According to Plockey (2015, p. 33), indigenous knowledge is “the people or things originating from a particular place and native to the place”. Makinde and Shorunke (2013, p. 4) define it as “the knowledge systems held by a traditional community, that is based on their experience and adaptation to a local culture and environment and is relevant for development especially in agriculture, arts, crafts, medicine, music, natural resources management and theatre”.

The definitions of indigenous knowledge by Makinde and Shorunke (2013), Gardiner and Thorpe (2014) and Plockey (2015) pointed the researcher to defining indigenous knowledge as information that has been accumulated over a period of time by a group of people living within a common context and which these people apply when dealing with different situations, such as when treating illnesses or preserving foods for consumption in times of drought.

Indigenous knowledge is mostly present in the minds of its custodians and is primarily transferred through an oral tradition, i.e. spoken communication and demonstrations that are not easily transferred (Sraku-Lartey, Acquah, Samar, & Djagbletey, 2017; Van Wyk, 2015). Dlamini and Ocholla (2018, p. 138) also assert that indigenous knowledge is “commonly exchanged through personal communication and demonstration and gets transmitted from master to apprentice, from parents to children, and from one neighbour

to the other". The oral tradition of exchanging indigenous knowledge from generation to generation is ineffective, as there can be miscommunication within the transmission. It is thus important to document indigenous knowledge for preservation (Agyepong, 2017).

Indigenous knowledge is internalised within the people who hold it; such a person is referred to as a knower (Gone, 2019). When a knower dies without sharing the indigenous knowledge they were holding, the knowledge dies with them and is lost forever (Moahi, 2012).

### 3.2.1 Indigenous knowledge and education

Studies have shown the great importance of indigenous knowledge in providing communities with a means of sustainable development (Chaudhuri, 2015; Gatimu, 2014; Moahi, 2012; Ugboma, 2014). Makinde and Shorunke (2013, p. 4) assert that indigenous knowledge can inform "sustainable agriculture, affordable and appropriate public health, and conservation of biodiversity". Examples include using indigenous knowledge practices to preserve food when there is a food shortage, such as in times of drought or flooding, or making use of medicinal plants instead of visiting a healthcare practice.

Due to the importance of indigenous knowledge, various efforts have been undertaken to preserve indigenous knowledge. One such effort is studies that aim to integrate indigenous knowledge into educational activities to ensure that it is preserved for future generations (Acton, Salter, Lenoy, & Stevenson, 2017; De Wet, 2011; Gatimu, 2014; Sheya, 2014; Visagie, 2016). Educating the younger generation on indigenous knowledge is instrumental in ensuring that it is preserved and is not lost when the holders of the knowledge pass on (Kaya & Seleti, 2013).

A KhoeSan Early Learning Centre Pilot Project was formed for the KhoeSan indigenous people of South Africa (De Wet, 2011). The project highlighted the KhoeSan community's contributions to the nation's development goals by integrating the community's indigenous knowledge and their language into the lessons that the centre delivers. The KhoeSan Early Learning Centre Pilot Project also seeks to integrate KhoeSan studies into the curriculums of lower and higher education.

Acton et al., (2017) investigated the basis of cultural sustainability in integrating Australian indigenous knowledge into the curriculums of institutions of higher learning to ensure that students learn about ways of using indigenous knowledge for sustainable development. Gatimu (2014) furthermore argued that making use of practical lessons to teach

indigenous knowledge in Kenya's education system would enhance its preservation and also contribute to sustainable development. Gatimu (2014, p. 249) suggested that "instead of teaching geography or an environment lesson in a classroom, a teacher could use a practical pedagogy model by having students go to the rivers and creeks to set up restoration and clean-up projects".

Visagie (2016) looked at integrating indigenous knowledge into the teaching of water conservation in the Natural Science subject of Senior Primary schools in Namibia, and noted that indigenous knowledge techniques would be a catalyst in sustaining and conserving water. Teaching primary school children this knowledge would help them conserve water for future generations. Sheya (2014) investigated the role of indigenous knowledge in the Environmental Education component of the Life Science subject for High School learners in the rural areas of Namibia. In Life Science, learners are exposed only to Western concepts of environmental education, and the integration of indigenous knowledge into this course could help them in situating the knowledge in their local surroundings (Sheya, 2014).

Although the current study does not investigate the integration of indigenous knowledge into formal education systems, the studies by De Wet (2011), Acton et al., (2017), Gatimu (2014), Visagie (2016) and Sheya (2014) indicate that there is a growing interest in preserving indigenous knowledge for future generations by ensuring that younger generations are learning about this knowledge and how it helps in sustaining their environments.

### **3.2.2 Protection of indigenous knowledge from possible exploitation**

Due to the importance of indigenous knowledge for sustainable development (Kari & Baro, 2016), indigenous knowledge has become prone to exploitation (Popova, 2014). Natea (2018) states that due to globalisation and the world constantly changing, it has become a difficult task to protect indigenous knowledge. Although protecting indigenous knowledge is not an easy task, different legislative measures have been put in place with the aim of protecting it.

At a global level, the Convention on Biological Diversity (CBD) was instituted by the United Nations (UN) in 1992 to ensure the protection of indigenous natural resources such as indigenous medicinal plants from unprecedented use by non-indigenous inhabitants such as international pharmaceutical corporations (Chakravarty & Mahajan,

2010; Popova, 2014). The United Nations Education Scientific and Cultural Organisation (UNESCO) has also set up diverse tools such as the Convention on the Protection and Promotion of the Diversity of Cultural Expressions, the UNESCO Universal Declaration on Cultural Diversity, and the Recommendation on the Safeguarding of Traditional Culture and Folklore (Natea, 2018). The tools implemented by UNESCO are all aimed at safeguarding indigenous knowledge and ensuring that the interests of indigenous inhabitants are met. In Namibia, the National Assembly of Namibia passed the Access and Benefit Sharing and Associated Traditional (ABSAT) Bill to regulate the commercialisation of indigenous knowledge in order to enable indigenous people to profit from the commercial use of their knowledge products and practices (“Access and benefit sharing Bill soon a reality: Shifeta,” 2016; Goitom, 2017; Shigwedha, 2017; Vilho, 2014). Despite legal efforts to protect indigenous knowledge, there is still no “international consensus” that fully guards against the exploitation of indigenous knowledge (Sraku-Lartey et al., 2017).

Indigenous medicinal plants are prone to possible exploitation (Cheikhoussef, Shapi, Matengu, & Ashekele, 2011). In the next section, an overview of indigenous medicinal plants is provided.

### 3.2.3 Indigenous medicinal plants

Indigenous medicinal plants are plants that are unique to different communities (Iwu, 2014). The plants have healing properties and are used in medicinal preparations that are administered for health treatments (Iwu, 2014).

Namibia has indigenous plants that are used for medicinal purposes (Chinsembu, Cheikhoussef, et al., 2015). Different parts of these plants such as barks, roots, fruits, seeds and leaves are used to cure and manage various ailments, but there is a lack of information in the literature on how communities prepare these plants for administration (Chinsembu, Cheikhoussef et al., 2015). Literature suggests that some of the plants are prepared by crushing the fresh or dried parts and administering in food or water, while others are prepared through the methods of decoction and infusion (Chinsembu, Cheikhoussef et al., 2015). Appendix A provides information on thirty indigenous medicinal plants that are found in Namibia, including the scientific name of each plant, its common English name, and the illnesses that it is used to treat. The information in Appendix A was used as the content on the prototype e-learning system that was developed for this study.

Information technology tools have already been used to preserve indigenous knowledge, and these existing tools are discussed in the next section.

### 3.2.4 Related studies using information technology to preserve indigenous knowledge

Information technology is the use of software, hardware and techniques to manage and transmit information (Heeks, 2017). Information technology is used to process information and disseminate it to people that will have an interest in making use of it. Efforts using information technology to preserve indigenous knowledge have been undertaken, as the studies below show.

In India, attempts were made to preserve the cultural knowledge of the Indian classical dance using a browsing tool that highlights the different dances and the meanings behind the different poses in them (Mallik et al., 2011). The tool allows users to browse through the different dances, see images of the poses, and read about what each pose represents to the overall dance sequence.

Serious games have been designed and developed to preserve indigenous knowledge. Chittaro and Buttussi (2015) describe serious games as computer-based games that allow for learning and that are not only meant for entertainment purposes. According to Andreoli, Corolla, Faggiano, Malandrino, Pirozzi, Ranaldi, Santangelo and Scarano (2017, p. 2) “serious games are widely used in pedagogy because they assist students in attaining learning goals and because they enable a pleasurable and relaxed learning process”.

In Taiwan, a serious game aimed at preserving tangible and intangible indigenous knowledge artefacts was developed (Huang & Huang, 2013). The participants of the study, elementary school learners, played the serious game for two hours and were assessed through observations, questionnaires and interactive interviews. The game is called Papakwaga, which is the land of origin of the Atayal people on which the game is based. The indigenous knowledge of the Atayal people is mostly made up of rituals and tribal ceremonies, and the serious game addressed these two areas in the game design (Huang & Huang, 2013). The authors matched the current learning outcomes of a cultural studies course in the elementary school with the design categories of a serious game to develop the framework. Before, the school had only made use of text-based textbooks that contained some images. Huang and Huang (2013) found that the learners were not



motivated because the material in the textbooks was too monotonous. Assessments were done on the students both before and after they had engaged with the serious game. The assessment evaluated the effectiveness of the game to determine whether the children had learned from the game, and to gauge their prior knowledge of their tribe before engaging with the serious game. The findings from the study showed that the learners were more motivated to learn about their cultures when they engaged in the game than when they were reading about them from the textbooks. The findings indicated that young people are more prone and motivated to engage in learning about their cultures when they use interactive platforms and are not limited to monotonous material such as text-heavy books (Huang & Huang, 2013).

In South Africa, a National Indigenous Knowledge Management System (NIKMAS) was developed (Chamunorwa, Winschiers-Theophilus, & Zaman, 2018). The NIKMAS was developed to ensure that the knowledge of indigenous knowledge holders is recorded on the system to enable recognition of the holders, and to ensure compensation if the knowledge is utilised for commercial purposes (Chamunorwa et al., 2018). An online indigenous digital library was also developed in South Africa (Greyling & Zulu, 2010). The digital library forms part of the resources of a public library (the eThekweni Municipal Library) and community members, such as community leaders and volunteer field workers, provide the content for it (Greyling & McNulty, 2011; Greyling & Zulu, 2010). Efforts similar to those in South Africa have been carried out in Namibia, resulting in a prototype system that allows the holder of the indigenous knowledge to have control over their knowledge that is shared on the system (Chamunorwa et al., 2018).

Indigenous knowledge researchers at the Namibia University of Science and Technology's Faculty of Computing and Informatics have been carrying out research since 2008, which has allowed them to co-design information technology tools with indigenous communities (Chamunorwa et al, 2018; Gallert, Stanley, & Rodil, 2018; Kapuire et al., 2016; Maasz, Winschiers-Theophilus, Stanley, Rodil, & Mbinge, 2018; Winschiers-Theophilus, Bidwell, Chivuno-Kuria, & Kapuire, 2010). The tools designed include the Homestead Creator, the Homestead Scenario Depiction Tool, the Media Collection Tool, a Task Management Application and Wikipedia (Chamunorwa, Winschiers-Theophilus, & Zaman, 2018; Maasz, Winschiers-Theophilus, Stanley, Rodil, & Mbinge, 2018). These are summarised below.

- Homestead Creator (HSC) – The HSC is a 3D application that allows the indigenous knowledge holders in a community to depict their traditional

households in a virtual environment to relate their culture to the meanings of the different parts of the household (Rodil & Winschiers-Theophilus, 2018).

- Homestead Scenario Depiction Tool (HSDT) – The HSDT is an extension of the HSC. Whereas the HSC does not allow users to determine the type of indigenous knowledge present in the different locations of the homestead, the HSDT does. The HSDT provides visual hints that allow a user to determine the type of indigenous knowledge that is embedded in the different locations of the homestead (Chamunorwa et al., 2018).
- Media Collection Tool (MCT) – The MCT is an application that is loaded on a tablet device. The tablet device is left in the communities with the indigenous knowledge holders and the holders use the application to capture the indigenous knowledge in their communities. The application allows the indigenous knowledge holders to take pictures, record videos and audio, create drawings, and input text (Kapuire et al., 2016).
- Task Management Application – The Task Management Application is a type of crowdsourcing platform that enables indigenous knowledge holders to source design ideas from a global audience. Relevant ideas obtained from the platform are integrated into the other tools that the researchers are developing (Gallert et al., 2018; Maasz et al., 2018).
- Wikipedia – Attempts have been made to use the Wikipedia online platform as a means for indigenous knowledge holders to share their knowledge (Mushiba, Gallert, & Winschiers-Theophilus, 2016). The effort is still ongoing and is plagued by challenges, such as indigenous languages not being recognised on the platform, and the fact that the platform requires sources such as books to verify the content that is added. Most indigenous knowledge is not available in books, and some of the knowledge that is, is not presented from the perspective of the indigenous holders, which means it might not be completely accurate (Gallert, Winschiers-Theophilus, Kapuire, Stanley, Cabrero, & Shabangu, 2016; Mushiba et al., 2016).

The Homestead Creator, Homestead Scenario Depiction Tool, Media Collection Tool, Task Management Application and Wikipedia all ensure that indigenous knowledge holders are involved in the capturing of their knowledge.

Dlamini (2017) provided an overview of different information technology tools that are used to capture, preserve and disseminate indigenous knowledge. These include:

- To capture indigenous knowledge:
  - Mobile phones
  - Conventional cameras
  - Video cameras
  - Sound recorders

Mobile phones, conventional cameras and video cameras are used to capture photos and videos of indigenous practices and artefacts (Agyemang, Ngulube, & Dube, 2019; Kapuire et al., 2016; Winschiers-Theophilus et al., 2013). Sound recorders are used in recording voice narrations during indigenous knowledge practices and story-telling times.

- To store indigenous knowledge:
  - Computers
  - Laptops
  - USBs
  - CDs
  - DVDs
  - Audiotapes

The devices listed above are used to store and preserve indigenous knowledge that has been captured using different technological devices (Dlamini & Ocholla, 2018).

- To disseminate indigenous knowledge:
  - Internet
  - Social media
  - E-mail
  - Telephones
  - Radio
  - Television

The internet is a prominent tool in the dissemination of indigenous knowledge, as it allows other tools such as social media and email to function (Dlamini & Ocholla, 2018). Social media sites and applications allow for the sharing of images, videos and text on indigenous knowledge (Owiny, Mehta, & Maretzki, 2014). Sharing of indigenous knowledge can be done on social platforms such as on Facebook, Twitter, Instagram and YouTube. Email is a less effective tool, as it is limited to sharing information with known email addresses (Agyemang et al., 2019; Dlamini & Ocholla, 2018). Telephones, radio

and television are mostly used in rural communities or other communities with limited internet access and resources (Mtega, Dulle, & Benard, 2013; Rice, Haynes, Royce, & Thompson, 2016).

Information technology tools have been developed specifically to preserve indigenous knowledge of medicinal plants. In India, to guarantee that patents relating to the country's medicinal plants are not wrongfully awarded, a digital library was developed (Chakravarty & Mahajan, 2010; Thomas, 2010). The library is known as the Traditional Knowledge Digital Library and enables searches on indigenous medicinal plants to be performed. If a plant is found on the system, a patent for that plant cannot be awarded to an individual or corporation. This ensures that indigenous people do not lose out on making use of their medicinal plants. The digital library also acts as a resource for information on the country's indigenous medicinal plants.

In China, a database was developed to store patents on the country's indigenous medicine (Khalala, Makitla, Botha, & Alberts, 2014). The database stores patents on indigenous medicinal plants that have been registered since April 1985. The database also includes information on how the plants are used for medicinal purposes.

In Ghana, an online database was developed to preserve indigenous knowledge of the country's forest foods and medicinal plants (Sraku-Lartey et al., 2017). The online database is accessible through the URL <http://csir-forig.org.gh/tikfom/>. DRUPAL open-source software was used to develop the database. The information presented includes images of the plants, their traditional names, scientific names, uses and seasons of availability. Through the online database, accessibility to information on the country's indigenous forest foods and medicinal plants has been improved for its citizens and for anyone wanting to know more about these foods and plants.

Ten databases containing information on Africa's indigenous medicinal plants have been found (Mangare & Li, 2018). These databases ensure that indigenous knowledge of medicinal plants is preserved for future generations, and that it is easily accessible to those that require information on the plants.

This section provided a brief overview of information technology tools that have thus far been used to preserve indigenous knowledge. The studies discussed demonstrate that work is being carried out in this field. They also highlight that the use of information technology tools in preserving the indigenous knowledge of medicinal plants is still in its

infancy, as only databases and a digital library have been used for this endeavour. As stated in Chapter 1 (Section 1.1), indigenous knowledge is constantly changing due to different factors such as environmental changes and the fact that communities are continuously experimenting with new techniques in response to the changes (Tharakan, 2015). A tool is needed that does not present indigenous knowledge in a static format but allows for engagement and for the dynamic nature of the knowledge to be portrayed. At the time of this study, no studies were found in which an information technology tool was used to facilitate the preservation of indigenous knowledge of Namibia's medicinal plants.

In this study, the researcher therefore proposes using e-learning technology in preserving indigenous knowledge of medicinal plants. E-learning technology is discussed in the next section.

### 3.3 E-learning

The literature provides diverse definitions of e-learning. Tessier and Dalkir (2016, p. 416) define e-learning as “the process of a training activity being conducted in an online environment”. Lwoga and Komba (2015, p. 738) define it as “education and training provided through ICTs to support individual learning”. Deborah, Baskaran and Kannan (2014, p. 801) define it as a tool that “provides anytime and anywhere study saving lot (*sic*) of time, cost and effort”.

E-learning refers to digital learning technologies that enable learning to take place. Learning is achieved by absorbing knowledge from different materials, both print and electronic (Aparicio, Bacao, & Oliveira, 2016). In this study, e-learning is viewed as a system that enables the process of internalising indigenous knowledge of medicinal plants in the people who work through the information on these plants that is presented on the system. A major technology in digital learning technologies is the Learning Management System (LMS) (Al-Busaidi, 2013).

An LMS “includes several tools that enable content development, discussion management, group work and class participation, communications, students' study, student tracking and administrative tools” (Al-Busaidi 2013, p. 1168). An LMS provides “a platform for administrating, documenting and delivering e-learning contents” (Caputi & Garrido, 2015, p. 115). An LMS is used because of its advantages, such as “convenience, flexibility, accessibility, and cost-effectiveness” (Al-Shboul & Alsmadi, 2010, pp. 4-5).

An LMS called Moodle (the Modular Object-Oriented Dynamic Learning Environment) was used to develop the prototype e-learning system that was used in this study. Moodle is an open-source, free-to-use system that is used to create and manage e-learning courses. Moodle is written in the PHP programming language and its functionality is constantly being improved by a global community of developers (Muñoz, Delgado, Rubio, Grilo, & Basto-Fernandes, 2017). Moodle offers diverse functionalities and activities; Table 3.1 provides a brief discussion on some of those functionalities. The prototype e-learning system in this study was used to present information on Namibia's indigenous medicinal plants. The participants worked through the content on indigenous medicinal plants to evaluate the prototype system and assist in identifying what requirements would be necessary for a model for preserving the indigenous knowledge of Namibia's medicinal plants via an e-learning platform.

**Table 3.1: Moodle functionalities (Gogan, Sirbu, & Draghici, 2015, p. 1145)**

<b>Functionality</b>	<b>Description</b>
Online self-learning and virtual classroom	The e-learning platform provides users with the ability to study at their own pace and connect to other users via its virtual classroom capabilities.
Online testing	Different assessments can be set up on e-learning. The platform allows the instructor to select the start and end times of these assessments. Most of the assessments, such as those that contain only multiple-choice questions, can be assessed by the system and when users submit the assessment, they immediately receive a report containing their score and feedback.
Communication and exchange	There are communication platforms on which users and instructors can exchange ideas and information. These platforms include private messaging, chat rooms and discussion boards.
Monitoring and control	The platform can produce reports that can be used for monitoring and control. Reports can be generated on activities such as the number of registered users in a course, an individual user's grades, the overall class performance, etc.
Administration and security	The platform has authentication and authorisation processes in place. Only users with a valid username and password are allowed access to the platform. Users have different roles, such as instructors (who are allowed to enrol users, set assessments and edit courses) and students (who are able to engage on communication platforms and access and download materials from the courses, but are unable to edit the course).

Deepak (2017, p. 122) defines activities in Moodle as “a group of features in a Moodle course, generally an activity that students will conduct”. They are also referred to as modules. Deepak (2017) listed the following fourteen items as activities on Moodle:

- Assignments module
- Choice module for creating single question surveys
- Database module for maintaining records
- Feedback module
- Forum module for discussions
- Glossary for storing a list of definitions
- Lesson module for content delivery
- Quizzes
- SCORM package module for displaying multimedia content
- Chat module for instant messaging
- Wiki module for the modification webpages
- Survey module for data collection
- Workshop module for collecting student’s assessments
- External tools module for integrating plug-ins

The researcher decided to develop the prototype e-learning system in Moodle due to convenience, as it is the LMS used at the educational institution of the study’s participants. Content on Namibia’s indigenous medicinal plants was made available on the prototype system. The participants worked through the content presented on the prototype e-learning system. The focus was not on testing the prototype e-learning system, but the system provided the context in which the participants could identify and determine the requirements that would be important to include in the model for preserving indigenous knowledge of Namibia’s medicinal plants via an e-learning platform.

Models have been used to evaluate the success of e-learning systems. These models will be discussed in the next section.

### **3.4 Information systems models used to evaluate the success of e-learning systems**

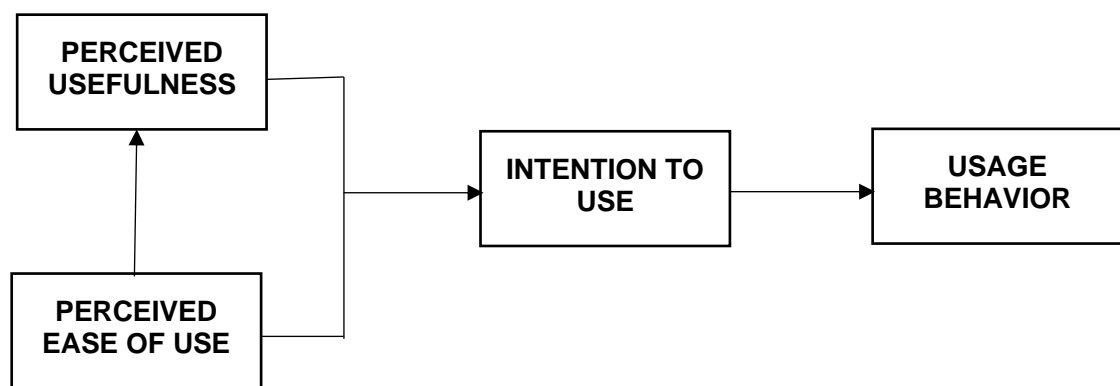
Various information systems models are used in evaluating the success of e-learning systems. The Technology Acceptance Model (TAM), the DeLone & McLean IS Success Model (D&L IS Success Model) and the E-learning Success Model are primarily used in



evaluation (Cruz-Benito, Sanchez-Prieto, Theron, Garcia-Peñalvo, Zaphiris, & Ioannou, 2019; Eom & Ashill, 2018; Hagos, Anteneh, & Garfield, 2018; Holsapple & Lee-Post, 2006; Kari & Baro, 2016; Mohammadi, 2015; Solangi, Al Shahrani, & Pandhiani, 2018; Yakubu & Dasuki, 2018). These models will be discussed in this section.

### 3.4.1 The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Davis (1989). The model consists of four components: perceived usefulness, perceived ease of use, behavioural intention to use, and actual system use (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012), as displayed in Figure 3.1.

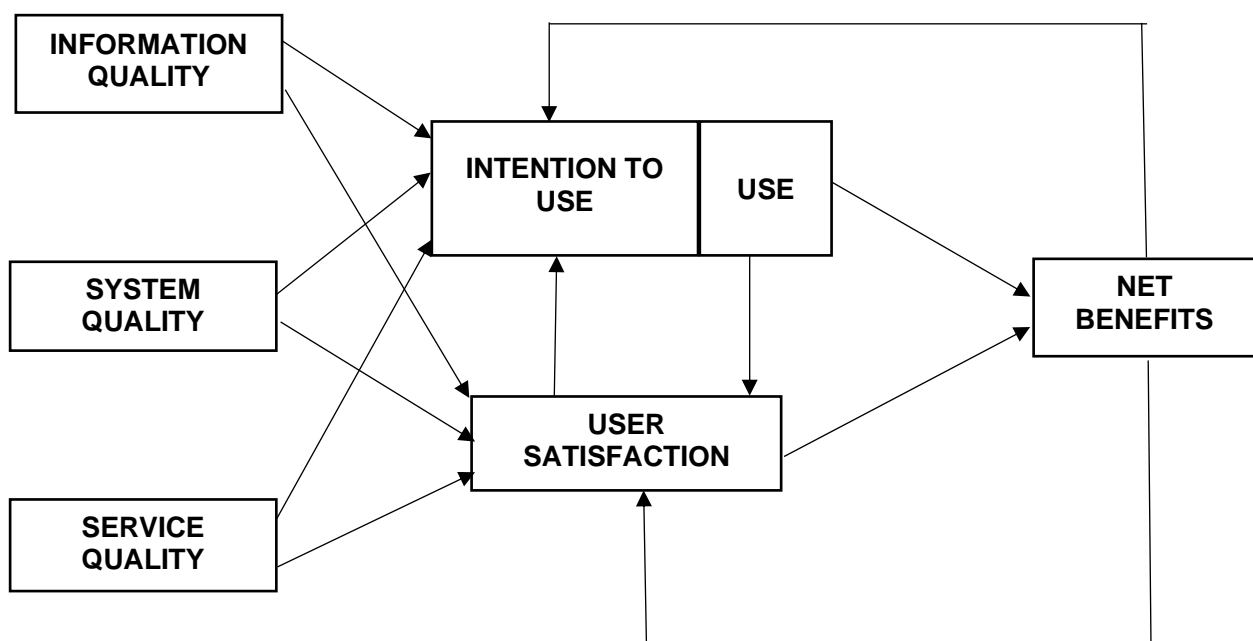


*Figure 3.1: TAM (Davis, 1989)*

TAM is used in the evaluation of factors that influence the use and acceptance of technologies by users (Del Barrio-García, Arquero, & Romero-Frías, 2015). The perceived usefulness component evaluates the extent to which a user believes that their performance will be improved by making use of a certain system (Alsabawy, Cater-Steel, & Soar, 2013). The perceived ease of use component evaluates the extent to which a user believes that it will require little to no effort to make use of a certain system (Harrati, Bouchrika, Tari, & Ladjailia, 2016). The perceived usefulness and perceived ease of use components determine the outcome of the behavioural intention to use and actual system use components (Ramayah, Ahmad, & Hong, 2012). According to Gellerstedt, Babaheidari and Svensson (2018), TAM has been widely used to study the acceptance and use of technological systems, resulting in researchers modifying and extending it according to their research findings.

### 3.4.2 The DeLone and McLean Information Systems Success Model

The DeLone and McLean Information Systems (IS) success model, commonly referred to as the D&M IS success model or just the IS success model, has been widely used to measure the success and effectiveness of e-learning systems (Marjanovic, Delić, & Lalic, 2016). DeLone and McLean (1992) pioneered this model. It consists of six components: information quality; system quality; use; individual impact; and organisational impact. These components are used to evaluate how successful an implemented information system is. Due to criticism from other researchers and the advancement in technology over the years, DeLone and McLean (2003) updated the IS success model to include an additional component, i.e. service quality, while two components from the earlier model, individual impact and organisational, impact were grouped into a single component called net benefits (Hsu, Chang, Chu, & Lee, 2014). Thus, the updated IS success model has six components: information quality; system quality; service quality; system use: (made up of intention to use and use); user satisfaction; and net benefits (DeLone & McLean, 2003; Mohammadi, 2015). These are illustrated in Figure 3.2.



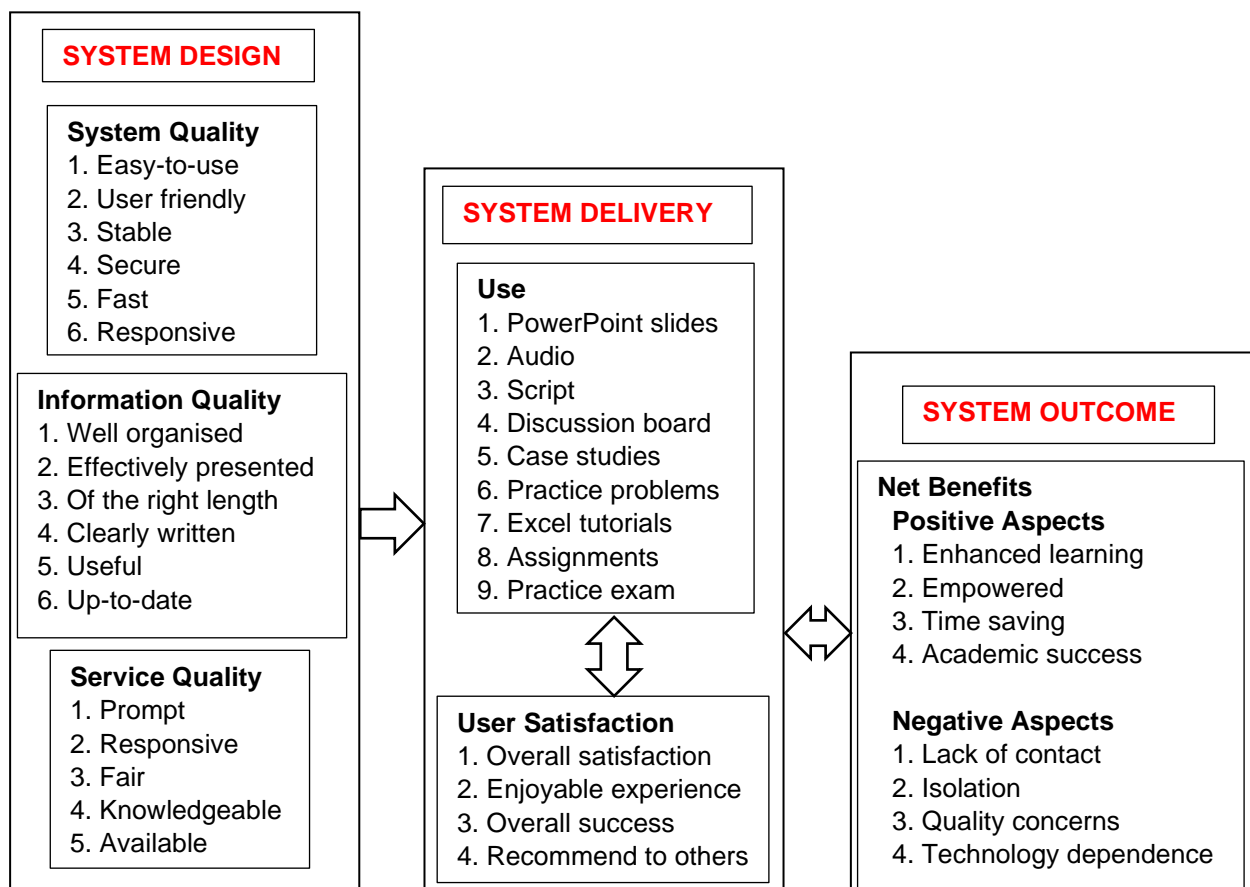
**Figure 3.2: Updated D&M IS Success Model (DeLone & McLean, 2003, p. 24)**

An E-learning Success Model was developed from the updated D&M IS success model (Holsapple & Lee-Post, 2006). The E-learning Success Model is also used to evaluate

the successfulness of e-learning systems, and this model will be discussed in the next section.

### 3.4.3 The E-learning Success Model

Holsapple and Lee-Post (2006) modified the updated D&M IS success model to develop the E-learning Success Model. In this model, the six components of the updated D&M IS success model were grouped into three categories: system design, system delivery and system outcome, as illustrated in Figure 3.3. Holsapple and Lee-Post (2006) suggest that for an e-learning system to be considered successful, all three categories should be evaluated. System delivery is dependent on system design, while system delivery and system outcome are dependent on each other (Holsapple & Lee-Post, 2006).



**Figure 3.3: The E-Learning Success Model (Holsapple & Lee-Post, 2006, p. 71)**

The six components of the updated D&M IS Success Model and the E-learning Success Model are summarised as follows (Balaban, Mu, & Divjak, 2013; Sarrab & Rehman, 2014):

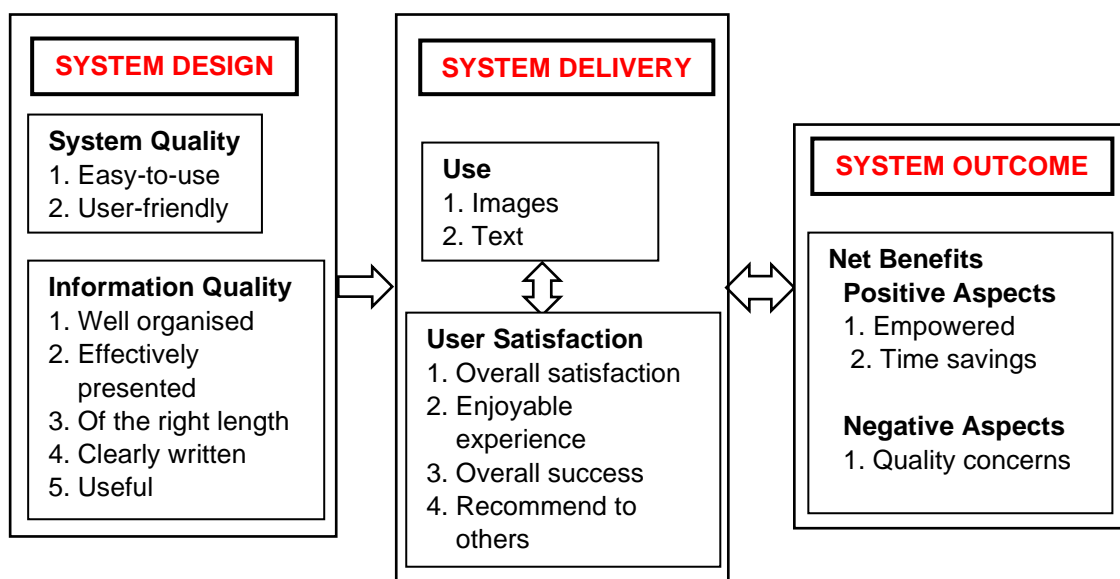
- System quality – evaluates the characteristics of an information system in terms of how usable it is (ease of use, user-friendliness), how reliable it is (stability, security, speed), how adaptable it is, and its availability.
- Information quality – determines how personalised, complete, relevant, easy to understand, and secure the users of an information system find it to be. It is used to evaluate the course content on aspects such as organisation, presentation, length, usefulness, and currency.
- Service quality – measures student–instructor interactions on attributes such as promptness, responsiveness, fairness, competency, and availability.
- Usage – determines what actions a user executes on an information system and measures the extent to which the course elements are actually used.
- User satisfaction – assesses the experience that users have after they have engaged with an information system, and gauges the opinions of the users about e-learning based on their experience with the course. It rates the users’ satisfaction and enjoyment with the system.
- Net benefits – determines the positive and negative impacts that arise from usage of the system. Positive impacts include time saving, enhanced learning, empowerment, and academic achievement, while negative impacts refer to aspects such as lack of face-to-face contact, social isolation, quality concerns, and dependence on technology.

The models discussed in this section are used to evaluate the success of information systems. E-learning is viewed as an information system (Holsapple & Lee-Post, 2006). TAM is appropriate for studies that evaluate the adoption of an information system or any other information technology tool (Dutot, Bhatiasevi, & Bellallahom, 2019; Scherer, Siddiq, & Tondeur, 2019; Taherdoost, 2018; Wu & Wang, 2005). According to Adukaite, Van Zyl, Er and Cantoni (2017), TAM is incapable of addressing contextual characteristics and is more suited to the business environment. The D&M IS Success Model and the E-learning Success Model are more suited to evaluating the success of e-learning systems. The E-learning Success Model was, after all, specifically developed to evaluate e-learning systems. In the current study, the researcher used the E-learning Success Model to develop the second questionnaire.

The adaptation of the E-learning Success Model for this study is discussed in the next section.

### 3.5 Adaptation of the E-learning Success Model

The objective of this study is to develop a model to guide in the design of an e-learning system that facilitates in the preservation of indigenous knowledge of Namibia’s medicinal plants. The E-learning Success Model developed by Holsapple and Lee-Post (2006) was adapted for this study. The model was used to prepare the second questionnaire that evaluated the prototype e-learning system. The service quality component of the E-learning Success Model was excluded from the adaptation, as this component deals with student and instructor interactions, whereas the model developed by the researcher for the current study was intended for non-pedagogical purposes. Figure 3.4 is an illustration of the adapted model.



*Figure 3.4: The E-learning Success Model (Holsapple & Lee-Post, 2006) as adapted by the researcher for this study*

The version of the E-learning Success Model (Holsapple & Lee-Post, 2006) adapted by the researcher was used as a guide in constructing the second questionnaire used in this study. Questionnaire 2 assisted in answering RQ3. Questionnaire 2 was divided into six sections, as displayed in Table 3.2.

**Table 3.2: Sections in Questionnaire 2**

<b>Categories</b>	<b>Section</b>	<b>Description</b>	<b>References</b>
<b>System Design</b>	Section 1: System Quality	Questions on system quality were based on how usable the e-learning system was in terms of how easy it was to use and its user-friendliness.	(Yakubu & Dasuki, 2018); (Mou & Rajib, 2019); (Chopra, Madan, Jaisingh, & Bhaskar, 2019)
	Section 2: Information Quality	Questions on information quality were on whether the information provided on the e-learning system contributed to the participants' knowledge of indigenous medicinal plants; and on the organisation, presentation, length, usefulness and currency of the information.	(Waheed, Kaur, & Qazi, 2016); (Yakubu & Dasuki, 2018); (Chopra, Madan, Jaisingh, & Bhaskar, 2019)
<b>System Delivery</b>	Section 3: Use	Questions on use evaluated whether the formats (images and text) used on the e-learning system assisted the participants to learn more about indigenous medicinal plants and whether these formats helped the participants in preserving this information for future use.	(Marjanovic et al., 2016); (Zain, Hanafi, Don, Yaakob, & Sailin, 2019); (Mtebe, 2019)
	Section 4: User Satisfaction	Questions on user experience were based on the overall experience of the participants after they had worked through the content presented on the e-learning prototype system; their satisfaction or dissatisfaction with the system, who the participants thought the system would be of value to, and whether the participants would recommend it to others.	(Pawirosumarto, 2017); (Mtebe & Raphael, 2018); (Almaiah & Alismaiel, 2019)
<b>System Outcome</b>	Section 5: Net Benefits	The questions on net benefits evaluated the overall experience of the participants' use of the prototype e-learning system and the benefits they derived from working through the content on Namibia's indigenous medicinal plants that was presented on the system. The questions determined both the positive and negative aspects that the participants gained from their engagement with the e-learning prototype system.	(Marjanovic et al., 2016); (Hadullo, Oboko, & Omwenga, 2017); (Yakubu & Dasuki, 2018)

Section 6 in Questionnaire 2, which does not appear in Table 3.2, was on the participants' views on what they felt was missing from the prototype e-learning system that would make it more useful, and any additional comments they had which were not addressed by the questions in the other sections.

### 3.6 Models and frameworks for digitally preserving indigenous knowledge

During this study, literature on e-learning being used in preserving the indigenous knowledge of medicinal plants could not be found. A search on models and frameworks used in preserving indigenous knowledge revealed five models and frameworks.

#### 3.6.1 Tripartite Digitisation Model (TDM)

The Tripartite Digitisation Model (TDM) is used to digitise indigenous knowledge and comprises four phases, as displayed in Figure 3.5 (Rodil & Rehm, 2015; Rodil & Winschiers-Theophilus, 2018). The phases are intangible heritage, capture, representation, and dissemination. These phases fall under three components, which are domain, digitisation, and evaluation.

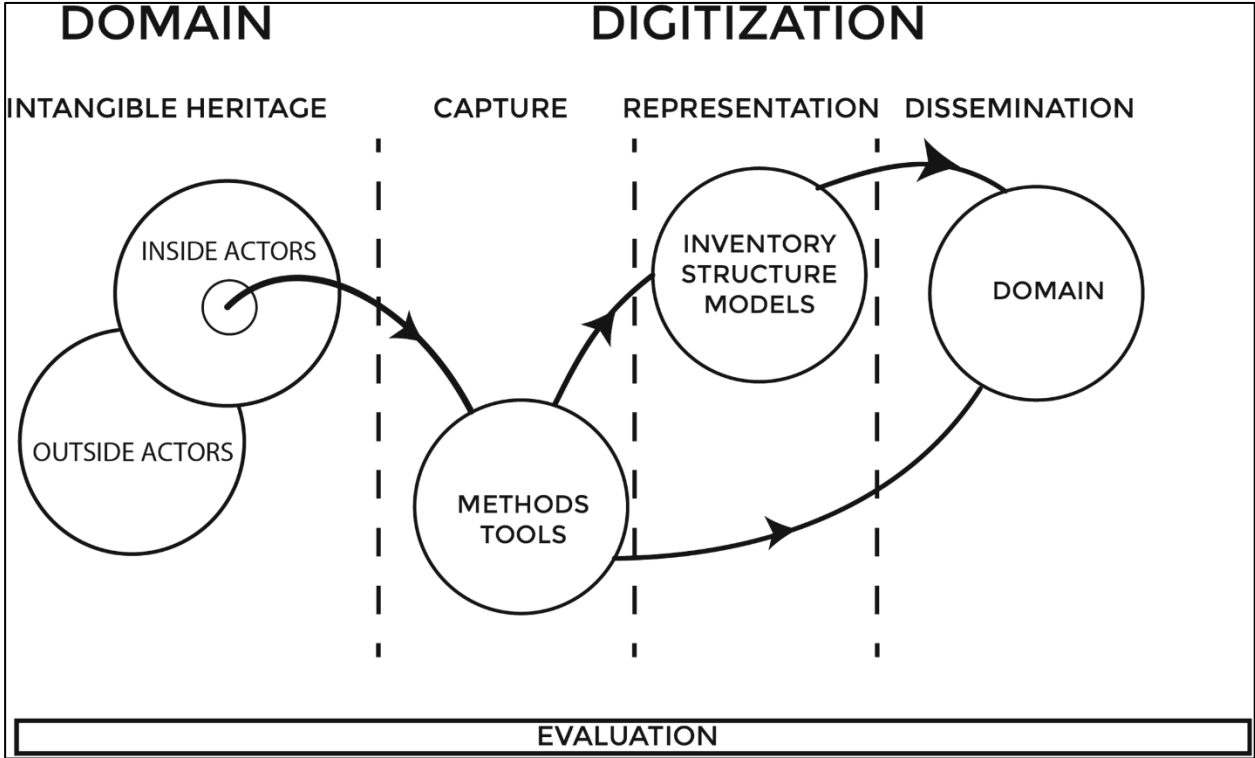


Figure 3.5: The Tripartite Digitisation Model (TDM) (Rodil & Rehm, 2015, p. 51)

Rodil and Rehm (2015) describe the phases as follows:

Phase 1 – Intangible heritage:

- Inside actors: Local people or communities interested in finding ways to digitally portray and preserve their indigenous knowledge.
- Outside actors: People, such as research teams, to whom the indigenous knowledge does not belong but who have an interest in its portrayal in the digital environment.

Phase 2 – Capture:

- The process by which to collect data to be presented on the system, and the format of the data to be captured, for example, videos, text, images, etc.

Phase 3 – Representation:

- The methods by which the collected data is represented.

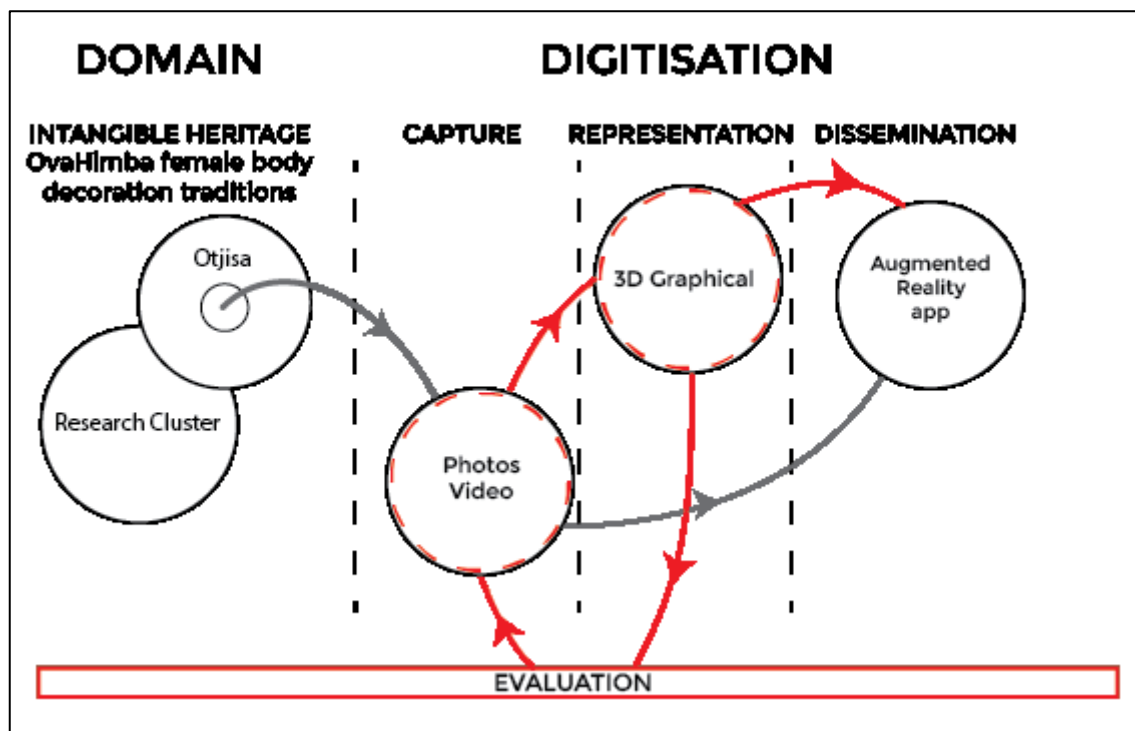
Phase 4 – Dissemination:

- The data collected is disseminated in different ways, which can either be static, dynamic or interactive. Static methods include journal articles and video recordings. Dynamic methods include browse-able web archives, while interactive methods include approaches that allow people to actually experience aspects of the indigenous cultural heritage in some way, for instance by being taught a specific craft in the classroom or by playing an educational game about how to behave in a given culture (Rodil & Rehm, 2015).

The first component in the model is the domain component, which defines the actors involved in the preservation process and the context in which the indigenous knowledge to be preserved is found. Phase 1 falls under this component. Phases 2 to 4 are in the digitisation component, which specifies the processes that are taken to digitise the knowledge and disseminate it for consumption by its intended recipients. The third component is the evaluation component, which ensures that evaluation is carried out by indigenous knowledge holders within all four phases of the model in order to prevent misrepresentation of the captured data.

An example of the application of the Tripartite Digitisation Model to Ovahimba female body decoration traditions is provided in Figure 3.6.



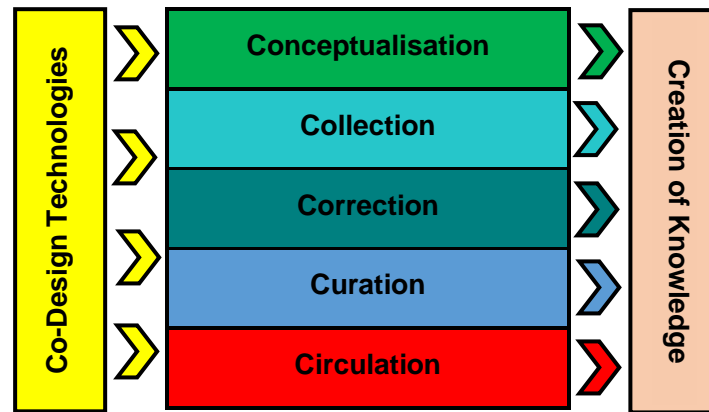


*Figure 3.6: An example of the application of the TDM to the Ovahimba female body decoration tradition (Rodil & Winschiers-Theophilus, 2018, p. 147)*

The inside-actors are the Otjisa community, while a research cluster comprises the outside-actors. Data was captured using photos and videos and was represented using a 3D graphic. The data collected was disseminated using an augmented reality application, and indigenous knowledge holders were involved in evaluating the processes in all four phases of the model.

### 3.6.2 The Digital Indigenous Knowledge Preservation Framework (The 7C Model)

The Digital Indigenous Knowledge Preservation Framework is made up of seven components (see Figure 3.7). The framework was designed to guide the process of preserving indigenous knowledge with the use of information technologies (Maasz et al., 2018).



*Figure 3.7: The Digital Indigenous Knowledge Preservation Framework (the 7C Model) (Maasz et al., 2018)*

The components of the 7C Model framework (Maasz et al., 2018) are:

1. **Co-design technologies:** positioning indigenous knowledge holders at the centre of the design of technologies used to preserve the holders' knowledge.
2. **Conceptualisation:** having a thorough knowledge of both the indigenous knowledge to be preserved and the technology to be used in the preservation endeavour.
3. **Collection:** the actual tool that will be used by the indigenous knowledge holder to collect data from their community.
4. **Correction:** the indigenous knowledge holder reviewing the data collected to ensure that it is correctly portrayed.
5. **Curation:** "the stage where the collected knowledge is put into a contextual environment for the users to interact with and learn about the cultures" (Maasz et al., 2018, p. 41).
6. **Circulation:** disseminating the knowledge to the intended audience using different means such as Wikipedia and Augmented Reality (AR).
7. **Creation of knowledge:** knowledge generated and created within the communities and among the researchers and the community members through internalising tacit knowledge from the explicit knowledge that is disseminated by a tool such as AR.

The first phase, which is co-design technologies, and the last phase, the creation of knowledge, are continuous processes and are embedded into the other five components of the framework (Maasz et al., 2018). The Digital Indigenous Knowledge Preservation Framework is centred on co-designing principles and involves the indigenous knowledge holder in all seven components of the framework. To emphasise the co-designing

principle, Maasz et al. (2018, pp. 36-37) state that “the main goal of all our efforts is positioning the IK holders as the main proprietors of the technologies, and digitisation processes of their own IK, leading to new knowledge creation”.

### 3.6.3 Traditional Wood Carvers Database Framework (TWCDF)

The Traditional Wood Carvers Database Framework (TWCDF) was developed to preserve indigenous knowledge on the word sculpting skill of carving. Figure 3.8 displays the TWCDF.

The framework presents processes for preserving indigenous knowledge of wood carving skills on a database platform. The information contained in the database was gathered from the holders of indigenous knowledge on wood carving practices. The database allows individuals to make queries. The composite sites 1, 2 and 3 ensure that there is redundancy and data recovery in case of a failure occurring on one of the composite sites (Coleman, 2016).

The component sites resolve conflicts and are used for data redundancy. Data from the composite sites is fed into the knowledge base for querying by the users. User queries are resolved by the integration knowledge engine, which interacts with the database management system.

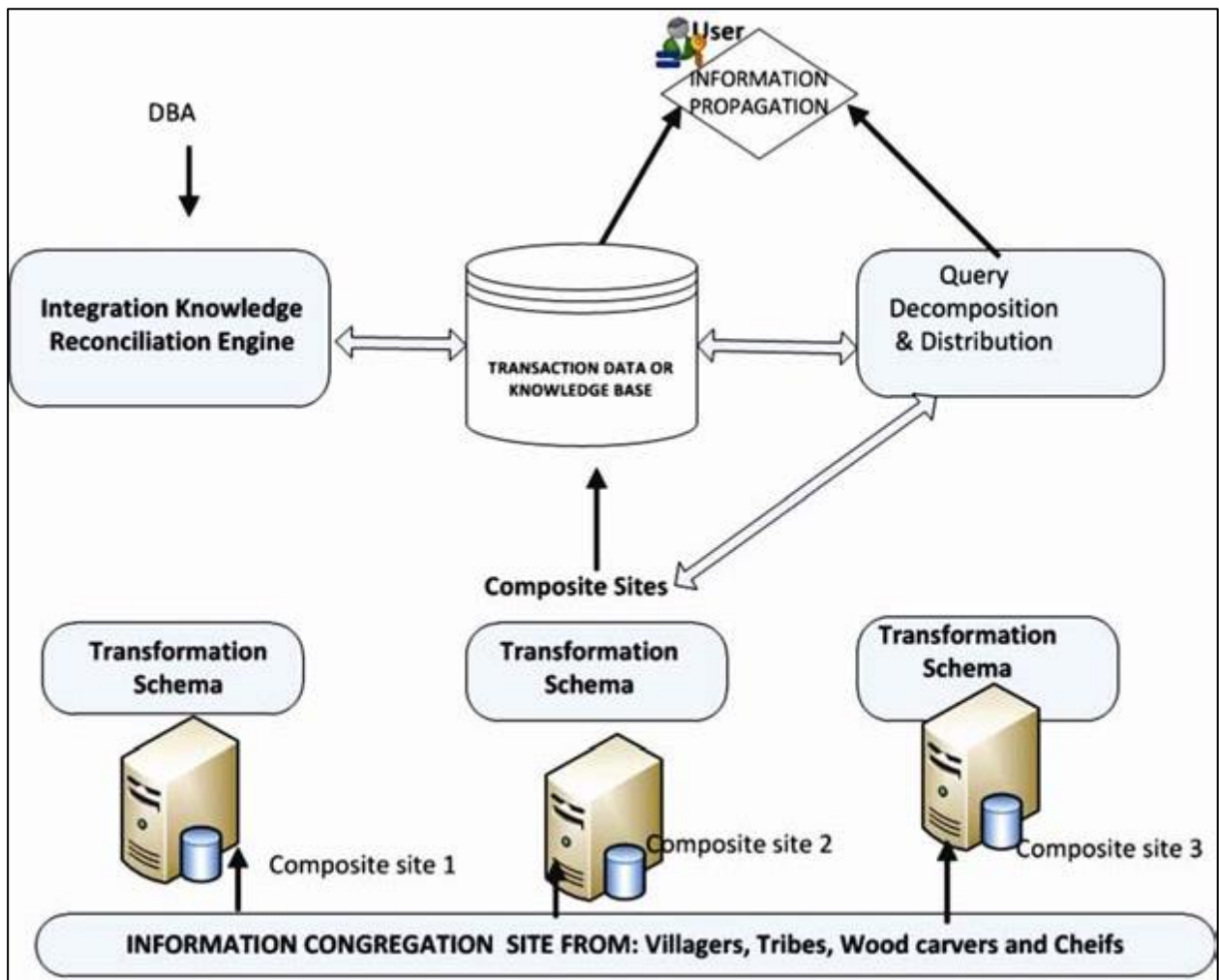


Figure 3.8: Traditional Wood Carvers Database Framework (TWCDF) (Coleman, 2016, p. 375)

### 3.6.4 National IK Management System (NIKMAS) Software Architecture Framework

The National IK Management System (NIKMAS) Software Architecture Framework was developed to preserve South African indigenous knowledge (Fogwill, Viviers, Engelbrecht, Krause, & Alberts, 2011). The framework is displayed in Figure 3.9.

Users gain access to the NIKMAS through the portal which presents different user interfaces. The integration services subsystem enables the system to display data from external sources. The portal accesses the community registry and catalogue by invoking remote methods on them (Fogwill et al., 2011). The security service component authenticates and authorises the users of the system. The integral part of the framework is its Data Knowledge Repository (DKR), which is displayed in Figure 3.10.

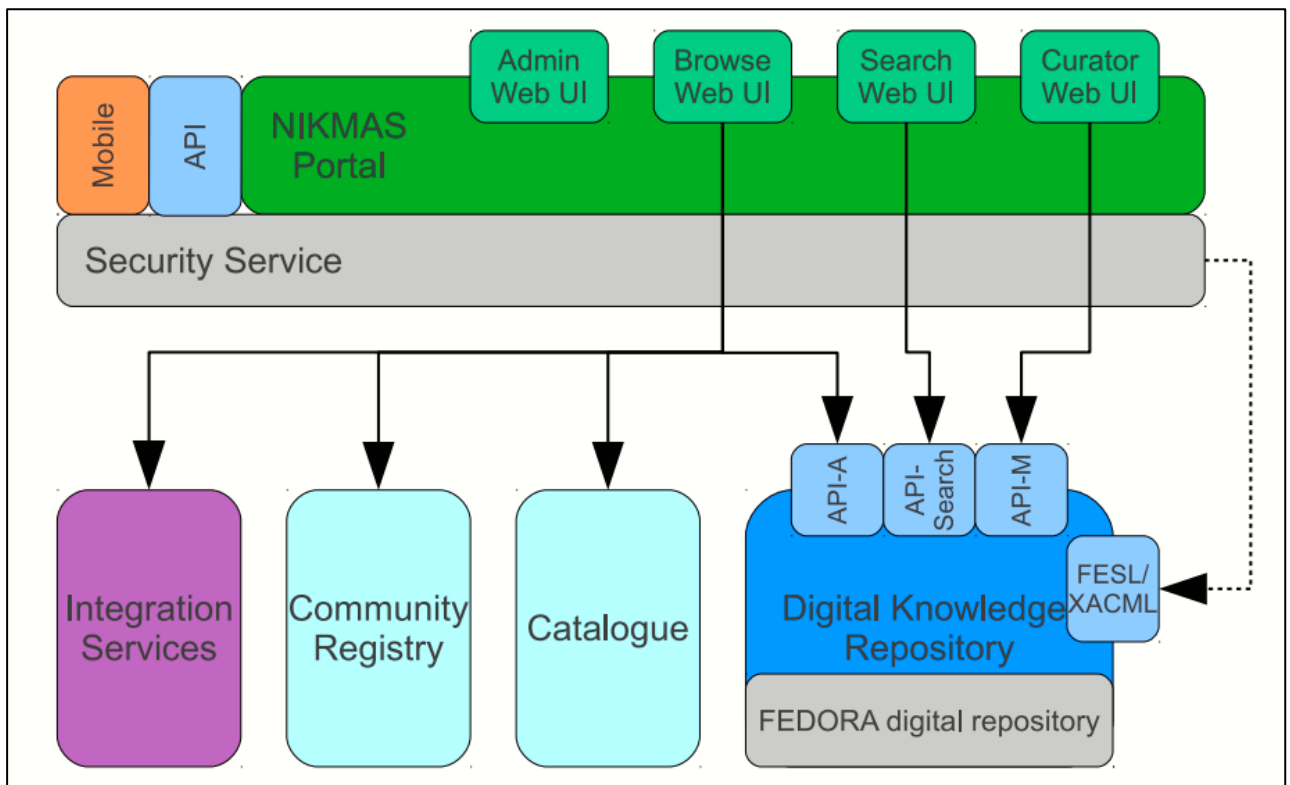


Figure 3.9: NIKMAS Software Architecture Framework (Fogwill et al., 2011, p.5)

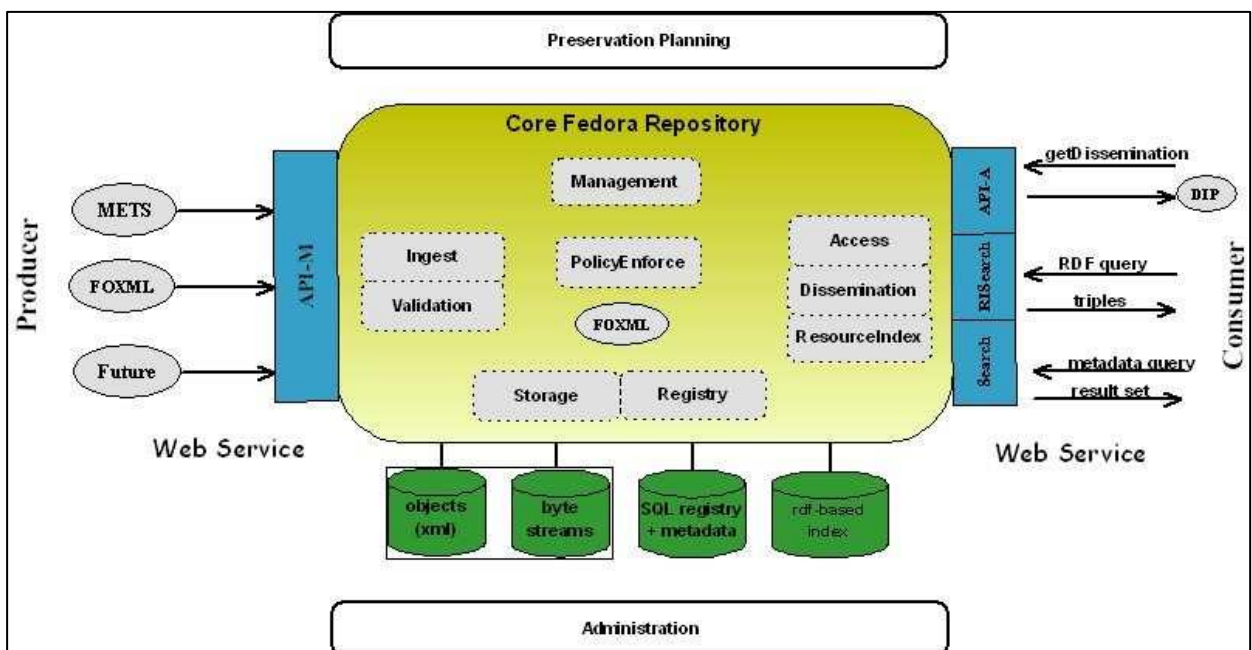
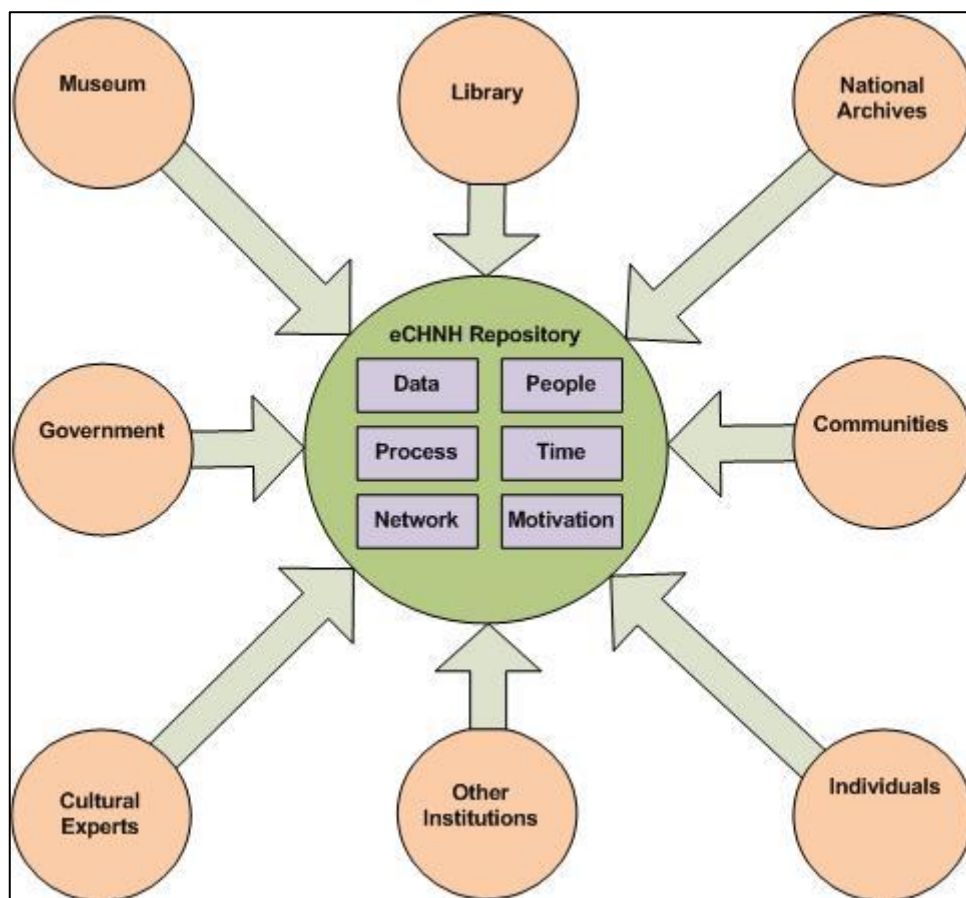


Figure 3.10: NIKMAS Digital Knowledge Repository (DKR) design (Fogwill et al., 2011, p. 6)

The indigenous knowledge on the NIKMAS is captured and preserved on the DKR. Authorised users can access and update the information on the DKR.

### 3.6.5 E-cultural Heritage and Natural History (ECHNH) Framework

The E-cultural Heritage and Natural History (ECHNH) framework is based on the Zachman Architecture Framework. The Zachman Framework is a template that is used to visualise an entire enterprise in one glance; it organises documents, people and issues, such as the functionality of a system, to generate models that describe how a system will fit in with a company's existing information ecosystem (Bente, Bombosch, & Langade, 2012; Hughes, 2016; Tupper, 2011).



*Figure 3.11: ECHNH Framework (Kurniawan, Salim, Suhartanto, & Hasibuan, 2011, p. 181)*

The ECHNH (Figure 3.11) is used to store, disseminate and preserve indigenous knowledge on cultural heritage and natural history that is in a digital format. The Zachman Framework components of data integration, process, network, people, time, and motivation are integrated into the ECHNH. The government, cultural experts, individuals, communities, national archives, libraries, museums, and other stakeholder institutions involved in the preservation of cultural heritage and natural history all form part of the ECHNH framework.

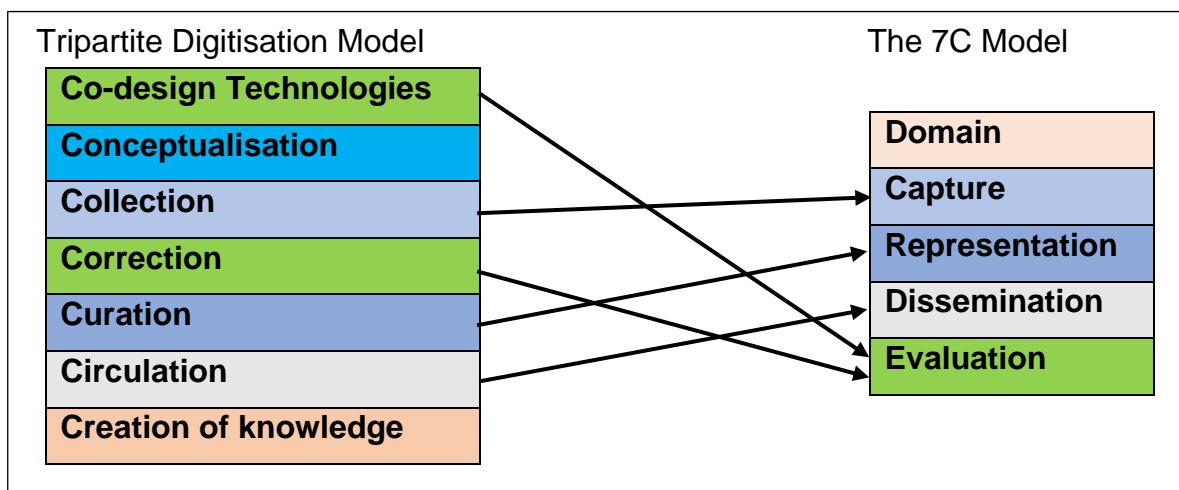
### 3.7 Requirements abstracted from the literature

In this section, the requirements for the model for indigenous knowledge preservation which were identified from the literature will be discussed.

The requirements abstracted from the existing models and frameworks will be discussed in Section 3.7.1, while Section 3.7.2 will be focused on additional requirements that were obtained from the literature review.

#### 3.7.1 Requirements abstracted from current models and frameworks

The Tripartite Digitisation Model and The Digital Indigenous Knowledge Preservation Framework (7C Model) discussed in Section 3.6.1 and 3.6.2 have some components that overlap, as displayed in Figure 3.12.



*Figure 3.12: Similarities between TDM and 7C Model*

Co-design technologies, correction and evaluation have to do with the indigenous community overseeing the preservation process and ensuring that their indigenous knowledge is not misinterpreted. Collection and capture involve the processes that will be used to collect the indigenous knowledge data. Curation and representation have to do with the media that will be used to represent the data. Circulation and dissemination deal with the technology that will be used to make the knowledge available to its intended recipients for them to preserve the knowledge internally.

The following requirements were identified from the existing models and frameworks:

- In the TDM and 7C models, the **capturing of data** and **disseminating** it to its intended audience were identified as being important in a model for indigenous knowledge preservation. Other requirements of importance were co-designing with

indigenous communities, selecting the media that will be used to represent the data, and the technology that will be used to disseminate it. **Methods for capturing the indigenous knowledge data** should be determined and **the LMS** that will be used for dissemination should be identified. The co-design principle highlights the **need for indigenous knowledge holders to evaluate the knowledge** that is captured and presented on a technological tool to ensure that it is accurate before it is disseminated.

- The TWCDF highlights the importance of ensuring **data recovery** in case of system failures. An e-learning system comprises a database that is used to store the content presented on the system (Nurhudatiana, Hiu, & Ce, 2018). In-built functionalities are present on e-learning platforms that safeguard against the loss of valuable data (Bouchrika, Harrati, Mahfouf, & Gasmallah, 2018).
- The DKR in the NIKMAS shows the importance of having a repository to store indigenous knowledge for querying by the users of a system. The database on e-learning systems acts as a **knowledge repository** on which queries for data can be run (Khan & Khader, 2014; Shrestha & Kim, 2013; Tessier & Dalkir, 2016).
- The NIKMAS also shows that having **authentication and authorisation processes** is paramount on a system. Basic authentication procedures which make use of a username and password are employed on most e-learning systems. There are, however, studies that explore stronger authentication measures such as using biometric procedures (Fenu, Marras, & Boratto, 2018; Kaur, Prasad, Alsadoon, Pham, & Elchouemi, 2017; Kawamata, Ishii, Fujimori, & Akakura, 2016).
- The ECHNH highlights the importance of **identifying stakeholders** that are necessary in a digital preservation endeavour in order to ensure its success. Different stakeholders are needed to determine the roles and responsibilities that they will assume in the preservation endeavour (Ravenwood, Muir, & Matthews, 2015).

Additional to the requirements from the existing models and frameworks, other requirements were obtained from the literature review, as discussed in the next section.

### 3.7.2 Additional requirements from the literature

The requirements obtained from other literature are:

- The protection of indigenous knowledge, as discussed in Section 3.2.2, is identified as being of paramount importance to its preservation and thus a **legal**



**requirements** factor was added to the model to be developed. Gallert et al. (2018) also assert the importance of safeguarding indigenous knowledge for its preservation. Codifying indigenous knowledge into explicit formats and rendering it for public consumption is a controversial issue and intellectual property rights need to be taken into consideration when disseminating it (Shizha, 2017). Policies and procedures need to be followed to ensure that the indigenous knowledge is portrayed in a valid manner and according to set procedures (Munyua & Stilwell, 2013; Popova, 2014; Shizha, 2017). The use of information technology in the preservation of indigenous knowledge should not infringe on copyright issues (Mazonde & Thomas, 2007).

- Kok (2005) suggests that to effectively preserve indigenous knowledge, the knowledge should be managed in an innovative and creative manner; a **community of practice** should be formed to facilitate the transfer of knowledge. The community of practice should consist of three important stakeholders: the community, outsiders, and facilitators (Kok, 2005). The community possess the knowledge and can contribute to the knowledge base. Outsiders are people who have knowledge that can be used by the community. Facilitators have the responsibility of managing the knowledge base.

In total nine requirements were identified and used to develop a conceptual theoretical model for the preservation of indigenous knowledge. Table 3.3 displays these requirements and the type of knowledge and knowledge transformation that they represent.

The first seven requirements were abstracted from the existing models and frameworks, while the last two emerged from the literature review.

Zaman et al. (2015) identified additional requirements necessary in the design of information technology tools that are used in the preservation of indigenous knowledge. These requirements are community active engagement (the community being actively engaged in the preservation efforts of their indigenous knowledge), intellectual property rights legislation, choice of media, and access to the technology, which are all in line with the requirements in Table 3.3, as presented in Table 3.4.

**Table 3.3: Requirements from the literature**

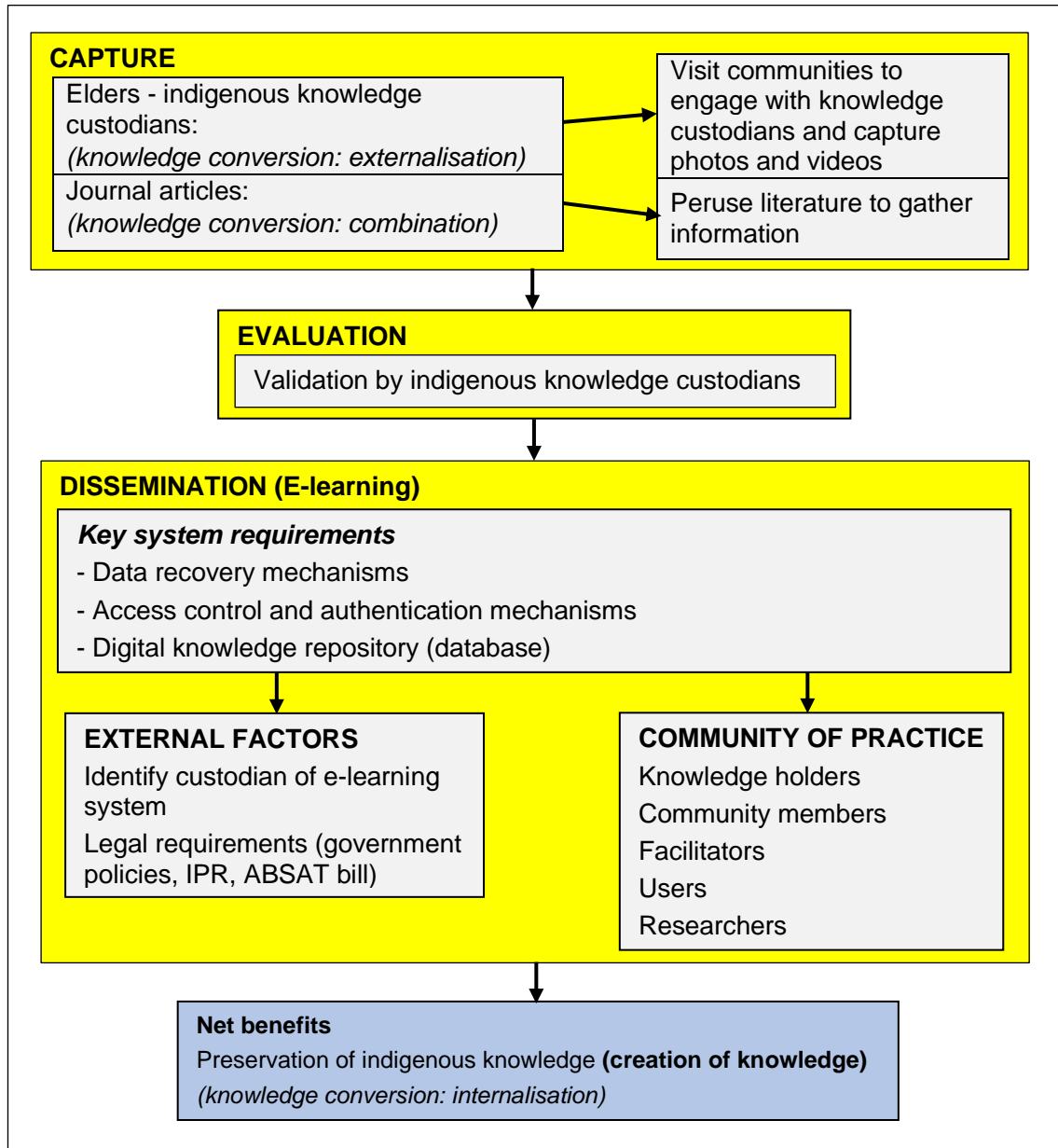
<b>Requirement to include</b>	<b>References</b>	<b>Type of knowledge</b>	<b>Knowledge transformation process</b>
Methods and tools to capture indigenous knowledge	(Rodil & Rehm, 2015); (Maasz et al., 2018)	Tacit knowledge	- Socialisation - Externalisation - Combination
Tools to disseminate the data	(Rodil & Rehm, 2015); (Maasz et al., 2018)	Explicit knowledge	- Externalisation
Co-designing with and validation by indigenous communities	(Winschiers-Theophilus et al., 2013); (Rodil & Rehm, 2015); (Kapuire et al., 2016); (Maasz et al., 2018); (Rodil & Winschiers-Theophilus, 2018)	Tacit knowledge	- Socialisation - Externalisation
Digital knowledge repository (database)	(Fogwill et al., 2011)	Explicit knowledge	- Externalisation - Combination
Data recovery mechanisms	(Coleman, 2016); (Nurhudatiana et al., 2018)		
Access control and authentication mechanisms	(Fogwill et al., 2011)		
Identification of stakeholders	(Kurniawan et al., 2011)		
Legal requirements	(Munyua & Stilwell, 2013); (Popova, 2014); (Shizha, 2017); (Gallert et al., 2018); (Natea, 2018)		
Community of practice	(Kok, 2005); (Zaman et al., 2015)		

**Table 3.4: Comparison of requirements of Zaman et al. (2015) and this study**

<b>Requirements of Zaman et al. (2015)</b>	<b>Requirements identified in this study</b>
<ul style="list-style-type: none"> <li>• Community active engagement</li> </ul>	<ul style="list-style-type: none"> <li>• Co-designing with and validation by indigenous communities</li> <li>• Community of practice</li> </ul>
<ul style="list-style-type: none"> <li>• Intellectual property rights legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Legal requirements</li> </ul>
<ul style="list-style-type: none"> <li>• Choice of media</li> </ul>	<ul style="list-style-type: none"> <li>• Methods and tools to capture the indigenous knowledge</li> </ul>
<ul style="list-style-type: none"> <li>• Access to the technology</li> </ul>	<ul style="list-style-type: none"> <li>• Tools to disseminate the data</li> </ul>

### **3.8 Conceptual theoretical model for the digital preservation of indigenous knowledge**

The requirements identified in the previous section were incorporated into a conceptual theoretical model for the digital preservation of indigenous knowledge. The model is discussed in this section and is displayed in Figure 3.13.



**Figure 3.13: A conceptual theoretical model for the preservation of indigenous knowledge**

The model comprises five components:

- Capture – the methods by which the knowledge is captured in order to be presented on the e-learning system. In the conceptual theoretical model, indigenous knowledge is captured from journal articles and indigenous knowledge holders. Journal articles were included, as the researcher made use of information from journal articles to develop the content that was presented on the prototype e-learning system used in the study. As discussed in Chapter 1 (Section 1.1), transforming knowledge from a tacit format into an explicit format is referred to as externalisation, while transforming explicit knowledge into another form of explicit knowledge is referred to as combination. The tacit indigenous knowledge from

elders will be externalised into an explicit format for presentation on the e-learning system. The knowledge from the journal articles (which is in an explicit format) will be transformed into another format of explicit knowledge that can be presented on the e-learning system.

- Evaluation – the validation by the knowledge custodians of the information presented on the e-learning system. Indigenous knowledge holders will be required to validate the information that is presented on the e-learning system.
- Dissemination – the e-learning platform is the disseminating tool, and key requirements to preserve knowledge on indigenous medicinal plants are included under the dissemination component. These requirements are:
  - Data recovery mechanisms to ensure that there is a possibility of recovering the indigenous knowledge data that is preserved on the system in the event of a disaster that results in the loss of the data.
  - Access control and authentication mechanisms to ensure that users of the system are assigned different roles.
  - A data repository to ensure the storage of the indigenous knowledge data and enable users to query the repository.
- External factors – factors outside the e-learning system, which include identifying the custodian of the e-learning system, and adhering to legal requirements such as government policies when designing and presenting information on the e-learning system. External requirements, such as adhering to government policies, will impact the information that can be presented on the e-learning system. A custodian of the e-learning system needs to be identified who will be responsible for making the system available to the public. Possible custodians include a public library or a government or private institution that deals with the preservation of indigenous knowledge. The custodian should have a direct interest in preserving indigenous knowledge on medicinal plants.
- A community of practice – identifying the stakeholders of the system and their roles and responsibilities. The stakeholders of an indigenous knowledge digital preservation effort need to be identified in order to recognise who it is that will add knowledge to the system and who the intended audience are. The contributors of the knowledge can come from the community of practice and this can be community members, facilitators, or outsiders such as researchers.

The community of practice and external factors play an important role in dissemination. The net benefit that will be derived from using the e-learning system is the internalisation of tacit knowledge by users of the e-learning system from the explicit knowledge of indigenous medicinal plants that is presented on the system. This internalisation will result in the preservation of the knowledge.

Indigenous knowledge is unique to a community or group of people (Tharakan, 2015) and thus technology tools being developed for its preservation should be unique to the community in which the indigenous knowledge is located (Agber, 2017). A survey of Namibian participants was carried out to extend the conceptual theoretical model developed in this section. The conceptual theoretical model was extended using the requirements found in the data collected from the survey, as discussed in Chapter 4.

### 3.9 Contribution of Chapter 3 to research questions

This chapter contributed to providing answers to all the research questions of the study.

As stated in Chapter 1 (Section 1.2.1), the main research question of this study is:

- What components are necessary in a model used to guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants?

The secondary research questions to assist in answering the main question are:

1. What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)
2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)

In Sections 3.9.1 to 3.9.3, how this chapter contributed to answering the research questions is discussed.

### **3.9.1 RQ 1: What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants?**

Five models used to digitally preserve indigenous knowledge were found and discussed in Section 2.5.

The models that were found are:

- The Tripartite Digitisation Model (TDM)
- The Digital Indigenous Knowledge Preservation Framework (7C Model)
- The Traditional Wood Carvers Database Framework (TWCDF)
- The National IK Management System (NIKMAS)
- The E-cultural Heritage and Natural History (ECHNH)

None of the existing models were developed specifically for preserving indigenous knowledge of medicinal plants. The existing models contributed to the development of the conceptual theoretical model for digitally preserving indigenous knowledge.

### **3.9.2 RQ2: What information technology tools are currently used to preserve indigenous knowledge of medicinal plants?**

The current information technology tools used to preserve indigenous knowledge of medicinal plants are digital libraries and online databases, as discussed in Section 3.2.4. No digital libraries or online databases for preserving indigenous knowledge of Namibia's medicinal plants in particular were found.

### **3.9.3 RQ3: What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants?**

From the existing models and other literature, the requirements of (a) co-designing technologies for indigenous knowledge preservation with the indigenous knowledge holders, and (b) determining the methods for capturing and disseminating the data were identified. Requirements to have on the e-learning system were identified as data recovery mechanisms, access control and authentication mechanisms, and a digital knowledge repository. External factors, such as identifying the stakeholders of the e-learning system and adhering to legal requirements, were identified to safeguard against the exploitation of indigenous medicinal plants. Having a community of practice, with

members of different roles needed on the e-learning system, was also identified as an important requirement to consider.

### 3.10 Summary and conclusion

In Chapter 3, the importance of indigenous knowledge was highlighted. Different information technology tools that have been used to digitally preserve indigenous knowledge were discussed. The e-learning technology which was selected as the information technology tool to use in this study was discussed. Models that have been used to evaluate the success of e-learning systems were discussed, and the E-learning Success Model was chosen and adapted to the study. The model was adapted to assist in constructing the second questionnaire used for the survey. Models and frameworks that have been used to digitally preserve indigenous knowledge were investigated to determine the requirements in them that would be necessary for a model for preserving indigenous knowledge of Namibia's medicinal plants, which was to be developed in this study. This chapter contributed to providing answers to RQ1 to RQ3 of the study, and how this was done was highlighted. The outcome of this chapter is a conceptual theoretical model for the digital preservation of indigenous knowledge. The model is extended in Chapter 4 using the data that was collected from the survey.

In the next chapter, the data collected through the survey is thematically analysed and discussed. The conceptual theoretical model developed in this chapter is extended by the themes that emerged from the survey data. The extension of the conceptual theoretical model resulted in the development of a model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning.



## CHAPTER 4

# DATA ANALYSIS, FINDINGS AND DEVELOPMENT OF MODEL

### Chapter 4:

#### Data Analysis, Findings and Development of Model

- 4.1 Introduction
- 4.2 Data collection and participant demographics
- 4.3 Data analysis
- 4.4 Model to guide the design of an e-learning system to facilitate the digital preservation of indigenous knowledge of Namibia's medicinal plants
- 4.5 Contribution of Chapter 4 to research questions
- 4.6 Summary and conclusion

## 4.1 Introduction

In Chapter 3, existing models used to preserve indigenous knowledge were explored to identify the requirements in them to be included in the model for preserving indigenous knowledge of Namibia's medicinal plants. Information technology tools that have been used to preserve indigenous knowledge of medicinal plants were also discussed. The outcome of Chapter 3 was the development of a conceptual theoretical model for digitally preserving indigenous knowledge. The literature review in Chapter 3 contributed to providing answers to the research questions of the study.

In this chapter, an analysis of the data collected will be provided to improve the conceptual theoretical model developed in Chapter 3.

As stated in Chapter 1 (Section 1.2.1), the main research question of this study is:

- What components are necessary in a model used to guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants?

Three secondary research questions were formulated to assist in answering the main research question:

1. What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)

2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)

This chapter assisted in answering RQ2 and RQ3 of the study. The findings in this chapter were collected from a survey. The survey completed by the participants of the study was divided into two questionnaires.

The first questionnaire (Questionnaire 1) assisted in providing answers to RQ2 and comprised of questions that were aimed at gathering data on the participants' knowledge of Namibia's indigenous medicinal plants, the methods by which they became aware of these plants, and their perceptions of using e-learning in the preservation of indigenous medicinal plant knowledge. A prototype of an e-learning system for the preservation of knowledge of Namibia's indigenous medicinal plants was developed and the participants completed the first part of the questionnaire before working through the content on the prototype system. The participants logged onto the prototype system and thereafter completed the second part of the questionnaire.

The second questionnaire (Questionnaire 2) was made up of questions on the participants' experience in working through the prototype e-learning system that was developed for the study.

This chapter is divided into four sections. In Section 4.2, the participants who formed part of the study are discussed. A thematic data analysis technique was used in the study, and this is discussed in Section 4.3. The data analysis process led to the identification of requirements that were used to expand the conceptual theoretical model for the preservation of indigenous knowledge that was developed in Chapter 3; this is discussed in Section 4.4. How this chapter contributed to providing answers to the research questions is discussed in Section 4.5. The chapter concludes with a summary in Section 4.6.

## 4.2 Data collection and participant demographics

The participants in the study were students from the Namibia University of Science and Technology (NUST), called the Polytechnic of Namibia before being renamed in 2015. It is one of the public universities in Namibia. Statistics compiled in May 2018 and found on

the website [www.nust.na](http://www.nust.na) show that the institution has a student population of over 11 000 students (as indicated in Table 4.1). These students hail from all fourteen regions of Namibia, as well as from beyond the country.

The participants in this study were selected based on purposive and convenience sampling methods, as discussed in Chapter 2 (Section 2.4.4.3). Information from <https://www.statisticssolutions.com/qualitative-sample-size/>, where the issue of sample sizes in qualitative studies is explored, indicates that five to fifty participants are considered enough for a qualitative study, with thirty participants being the average sufficient number of participants. The suggested average sample necessary to reach saturation in a qualitative study is thirty-one participants (Mason, 2010).

**Table 4.1: Enrolment by faculty and gender (Department of Institutional Planning, 2018)**

Faculty	Number		
	Female	Male	Total
Computing and Informatics	332	871	1203
Engineering	328	988	1316
Health and Applied Sciences	565	405	970
Human Sciences	859	724	1583
Management Sciences	3010	2089	5099
Natural Resource & Spatial Science	439	625	1064
<b>TOTAL</b>	<b>5533</b>	<b>5702</b>	<b>11235</b>

To obtain the average number of participants required for a qualitative study, the researcher was initially provided with a list of sixty students' email addresses by the Institutional Planning Department of the Namibia University of Science and Technology. The list contained ten students from each of the university's Faculties (Computing and Informatics; Health and Applied Sciences; Management Sciences; Engineering; Natural Resources and Spatial Sciences; and Human Sciences). The researcher sent out emails to the sixty students to request their permission to participate in the study, but only two of them responded to the emails by agreeing to participate in the study.

To recruit additional participants for the study, the researcher approached lecturers from the six faculties. The researcher provided the lecturers with the ethical clearance letter from the institution (see Appendix F), a participant information sheet (see Appendix G),

and an ethics approval letter from UNISA (see Appendix I). The lecturers were requested to inform their students about the study and its intended objectives and to find out if any of them were interested and willing to participate in the study. The students approached from the Faculties of Engineering, Natural Resources and Spatial Sciences, and Human Sciences were not interested in participating, and this resulted in no participants being obtained from those faculties. The participants from whom data was collected came from the Faculties of Computing and Informatics, Health and Applied Sciences, and Management Sciences.

The total number of students who participated in the study was fifty-nine, consisting of the two students from the initial list and an additional fifty-seven that were obtained via the lecturers.

Table 4.2 shows the number of participants, twenty-one female and thirty-eight male, with the majority falling under the age group of 18 – 24 years.

**Table 4.2: Total number of study participants**

Faculty & age group	Gender						Total per faculty
	Female			Male			
	18 – 24	25 – 34	35 – 44	18 – 24	25 – 34	35 – 44	
Computing and Informatics	6	3	1	28	3	3	44
Health and Applied Sciences	7	1	-	2	-	-	10
Management Sciences	3	-	-	1	1	-	5
<b>Total number of participants</b>	<b>16</b>	<b>4</b>	<b>1</b>	<b>31</b>	<b>4</b>	<b>3</b>	<b>59</b>

The data was collected during the period of 14 January to 1 March 2019. The researcher provided the pre-system-use part of the questionnaire to the lecturers whose students indicated an interest in the study. The lecturers handed out the questionnaires to the interested students for completion. The students were requested to provide only their mobile numbers on the questionnaire and not their names. This enabled the researcher to contact the participants to enquire on their availability in order to form different lab sessions for completion of the post-system-use part of the questionnaire. Six interviewer-administered sessions took place in a computer lab at the participants' institution. During

the sessions, the participants logged onto and worked through the content presented on the prototype e-learning system. After working through the content, the participants completed the post-system-use part of the questionnaire. When the participants were done completing the questionnaire, they placed it in a box as they were exiting the computer lab.

Table 4.3 depicts the areas in which the participants grew up, with thirty having grown up in an urban area and the remaining twenty-nine in a rural area. Namibia is made up of fourteen regions, and Table 4.3 also shows that the participants covered the scope of all the regions that make up the country.

**Table 4.3: Regions of origin and areas grown up in**

Region of origin	Area participant grew up in		Total number per region
	Rural	Urban	
!Karas	-	2	2
Erongo	1	4	5
Hardap	1	-	1
Kavango East	2	1	3
Kavango West	-	1	1
Khomas	5	7	12
Kunene	1	-	1
Ohangwena	4	6	10
Omaheke	1	-	1
Omusati	5	4	9
Oshana	1	2	3
Oshikoto	6	1	7
Otjozondjupa	-	1	1
Zambezi	2	1	3
<b>Total number of participants</b>	<b>29</b>	<b>30</b>	<b>59</b>

Table 4.4 shows that all the participants indicated that they own at least one technological device, with the majority (39) owning both a smartphone and a laptop. According to Greyling and McNulty (2011), there has been an increase in the use of mobile devices and internet usage on the African continent and this is also evident in the data from the current study.

**Table 4.4: Devices that the participants own**

<b>IT Devices owned</b>	<b>Frequency</b>	<b>Percent</b>
Smartphone, Laptop	21	35.6%
Smartphone, Desktop Computer, Laptop	10	16.9%
Smartphone	10	16.9%
Laptop	7	11.9%
Smartphone, Desktop Computer, Laptop, Tablet	5	8.5%
Desktop Computer, Laptop	1	1.7%
Laptop, Tablet	1	1.7%
Smartphone, Desktop Computer	1	1.7%
Smartphone, Desktop Computer, Laptop, Tablet, Smartwatch	1	1.7%
Smartphone, Laptop, Smartwatch	1	1.7%
Smartphone, Laptop, Tablet	1	1.7%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants also have constant access to the internet, which they make use of with mobile data that is made available through their cell phone carriers, and by using Wi-Fi facilities at the university campus and at their residences, as indicated in Table 4.5. A majority of forty-three indicated that they access the internet using both Wi-Fi and mobile data. Having access to the internet is a necessity for connecting to an e-learning system, and these participants had both the devices and the internet connection that would allow them to make use of an e-learning system on Namibia's indigenous medicinal plants.

**Table 4.5: Methods used to access the internet**

<b>Internet access</b>	<b>Frequency</b>	<b>Percent</b>
Mobile data	7	11.9%
Wi-Fi	9	15.3%
Wi-Fi and mobile data	43	72.9%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The e-learning platform, Moodle, which was used to develop the prototype e-learning system in the current study, is accessible via web browsers and is also available as an app on both Android and iOS smartphones.

The next section describes the thematic technique that was used to analyse the data obtained in this study.

## 4.3 Data analysis

The Braun and Clarke (2006) six-phase thematic analysis method was used to analyse the data. The phases are:

- Phase 1: Familiarisation with the data
- Phase 2: Coding
- Phase 3: Theme development
- Phase 4: Reviewing themes
- Phase 5: Defining and naming themes
- Phase 6: Writing up and producing the report

In this section, the phases and how they were carried out in the analysis of the data are discussed. Phase 1, familiarisation with the data, is discussed in Section 4.3.1. The initial coding of the data, which is Phase 2, is discussed in Section 4.3.2. Phases 3 to 5, which are related to searching for, reviewing, defining and naming the themes, are discussed in Section 4.3.3. The final phase (Phase 6), which is a report on the themes that were found in the data, is discussed in Section 4.3.4. The model for preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform is presented and discussed in Section 4.4.

### 4.3.1 Phase 1: Familiarisation with the data

In the familiarisation phase, the purpose is for the researcher to get to know their data. The researcher reads and re-reads the data and organises it in a meaningful way. For example, if the data was collected through audio recordings, the researcher listens to the recordings and transcribes the data to get a general view of what the participants are saying.

The responses to the questions in this study were handwritten and the researcher initially read through the responses in their entirety and highlighted interesting words and expressions to form preliminary ideas about the data and get a general impression of what the participants were saying. The researcher then entered the handwritten responses from the questionnaires into an Excel sheet. The data entered into the Excel sheet was then imported into the MAXQDA software for analysis. MAXQDA is software that is used to assist with organising and managing data for qualitative data analysis (Kuckartz & Rädiker, 2019). The participants were given identifiers (P1 – P59) for

Participant 1 to Participant 59, named according to the rows in which their data was entered into the Excel sheet.

After completing Phase 1, which involved organising the data and finding interesting words and expressions that could be used for coding the data, the researcher then moved on to Phase 2 to generate and assign initial codes to the data.

### 4.3.2 Phase 2: Coding

Coding is the process of sorting and summarising collected data in order to create meaning from the data and assemble categories to it (Allen, 2017; Williams & Moser, 2019). Braun and Clarke (2013) discuss two methods of coding that can be used in thematic analysis. These methods are selective coding and complete coding:

- Selective coding – the coding process begins with the researcher identifying a list of predefined concepts, and instances of these concepts are looked for in the data.
- Complete coding – predefined concepts are not set prior to the coding of the data; the entire data is analysed and everything in the data that is relevant to providing answers to the research questions is coded.

In this study, the complete coding method was used. The data was first read in its entirety and the researcher noted interesting words and expressions in the data. The data was then entered into the MAXQDA software and codes were assigned to the data. The codes were later examined for similarities and then categorised. Diagrams were created in which similar codes were grouped and assigned the same colour. The codes and categories generated will be discussed in Sections 4.3.2.1 and 4.3.2.2.

#### 4.3.2.1 Participants' indigenous knowledge

The data discussed in this section was collected from the first questionnaire (Questionnaire 1) found in Appendix B. Questionnaire 1 assisted in providing answers to RQ2 of the study.

The questions in Questionnaire 1 explored whether the participants had any knowledge on Namibia's indigenous medicinal plants, the methods and tools by which the participants had gained this knowledge on Namibia's medicinal plants, whether they wanted to learn about the plants, the technological platforms they would prefer to make use of to gain knowledge about the plants and their perceptions on e-learning being used



as a medium to aid in the preservation of indigenous knowledge on Namibia’s medicinal plants.

The first questionnaire (Questionnaire 1) was divided into two sections. The questions in Section 1 of Questionnaire 1 were on the demographics of the participants and the findings are presented in Section 4.2 of this chapter. The data from Section 2 of Questionnaire 1 is coded and discussed below.

**Questionnaire 1: Section 2 - Indigenous knowledge information**

The questions in Section 2 of Questionnaire 1 were on the methods and tools by which the participants have obtained indigenous knowledge on Namibia’s medicinal plants, their experience with indigenous medicinal plants and their perceptions of using an e-learning system to preserve indigenous knowledge on Namibia’s medicinal plants. The questions comprised both open-ended and closed-ended questions.

***Question 2.1: Are you aware of Namibian indigenous plants that are used for medicinal purposes?***

The awareness of indigenous medicinal plants among the participants was very high, as indicated in Table 4.6, with 52 out of a total of 59 participants being aware.

***Table 4.6: Participants' awareness of Namibia's indigenous medicinal plants***

<b>Aware of Namibia's indigenous medicinal plants</b>	<b>Rural</b>	<b>Urban</b>	<b>Total</b>
No	1	6	7
Yes	28	24	52
<b>Total</b>	<b>29</b>	<b>30</b>	<b>59</b>

The participants’ responses in Table 4.6 were categorised into rural and urban because knowing the area the participants grew up in was important for the study, as an assumption was made at the beginning of the study that people who had grown up in a rural area were more knowledgeable about the country’s indigenous medicinal plants than their counterparts who grew up in urban areas. From the data, it emerged that the participants who grew up in rural areas and those who grew up in urban areas were equally aware of the country’s indigenous medicinal plants. This was in line with the findings from the pilot study (Amunkete et al., 2019), in which it was found that both types of participants were aware of indigenous medicinal plants, but the participants from the rural areas were more knowledgeable on the uses of the plants.

**Question 2.2: If yes to (2.1), how did you become aware of these plants?**

The methods by which the participants became aware of the plants are displayed in Table 4.7. The participants could select more than one method and it emerged that most of them became aware of the plants from their elders, or from both their elders and from printed books.

Of those who indicated they are aware of Namibia's indigenous medicinal plants, 22 learnt about the plants solely from an elder. Elders are a great source of knowledge on indigenous medicinal plants (Mawere & Mwanaka, 2015).

**Table 4.7: Method by which participants became aware of indigenous medicinal plants**

<b>Method of awareness</b>	<b>Number of participants</b>
From elders	22
From printed books, From elders	9
From printed books, From elders, By watching videos	6
From elders, By listening to audio recordings	1
From elders, By watching videos	2
From elders, By watching videos, By reading newspapers	1
From elders, By watching videos, School	1
From elders, From printed books	1
From elders, Knowing by testing them when I was herding livestock	1
From elders, TV documentary	1
From elders, watching videos	1
From printed books	1
From printed books, By watching videos	1
From printed books, From elders, Biology teacher	1
By watching videos	1
From printed books, From elders, By watching videos, By listening to audio recordings	1
My grandmother	1
<b>TOTAL</b>	<b>59</b>

**Question 2.3: Have you ever used indigenous medicinal plants to treat minor illnesses?**

In Table 4.7, it is indicated that 52 of the 59 participants were aware of indigenous medicinal plants. Table 4.8 shows that among those 52, 42 have used an indigenous plant to treat a minor illness.

**Table 4.8: Used indigenous medicinal plants**

Have used indigenous medicinal plant	Frequency	Percentage
No	10	19.2%
Yes	42	80.8%
<b>TOTAL</b>	<b>52</b>	<b>100%</b>

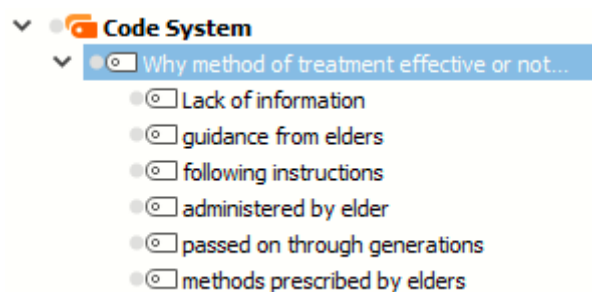
**Question 2.4: If yes to (2.3), were the indigenous medicinal plants effective in treating the minor illness for which you used them for?**

As shown in Table 4.9, 39 of the 42 indicated that the plants they had used were effective in treating the illness in question.

**Table 4.9: Effectiveness of treatment with indigenous medicinal plants**

Effectiveness of treatment with indigenous medicinal plants	Frequency	Percentage
No	3	7.1%
Yes	39	92.9%
<b>TOTAL</b>	<b>42</b>	<b>100%</b>

The 42 participants who have used an indigenous medicinal plant were asked to elaborate on why they say using the plants was effective or not. Figure 4.1 displays the codes that were generated from the participants' responses.



**Figure 4.1: Effectiveness of indigenous plants codes**

Six codes were generated from the participants' responses. An example of a participant quote supporting the code is provided below for each code.

Codes:

1. Lack of information: some participants found that the plants were not effective, as there was no information available to guide them on how to administer the plant for healing.

*"I don't feel as if I had a good understanding of the plant and how to apply it to the injury (cut on my hand)" P35*

2. Guidance from elders: participants who administered the plants with some guidance from an elder found the plants to have worked effectively.

*"It was effective because the elders would guide me on how to use the traditional medicine" P25*

3. Following instructions: some of the plants were effective because instructions on how to administer them were available to the participants. Some of the instructions were written down by the elders that have experience with using the plants.

*"Instructions were explained to me and at many times I observed the medicine being prepared and used it several times" P59*

4. Administered by elder: the administration of the plant to the participant was carried out by an elder.

*"It was effective because elders know the right amount of the medicine you must take for that specific minor illness" P28*

5. Passed on through generations: some plants were effective as their use and administration methods had been passed down orally from one generation to another.

*"Using indigenous plants that are found in my area have been helpful in treating minor illnesses like flu because it has been passed down from generation to generation of medicinal plants" P3*

6. Methods prescribed by elders: similar to codes 2 and 3, the participants found the medicinal plants to be effective as the methods they had used had been prescribed to them by the elders.

*"The methods described by the elders if used correctly can be very useful. You need to follow all their instructions" P46*

The effectiveness of indigenous medicinal plants is influenced by a person's knowledge and understanding of the plants and how they can be applied to treat a specific illness. The effectiveness of indigenous medicinal plants is therefore attributed to a person's knowledge of how to properly administer the plant for the illness.

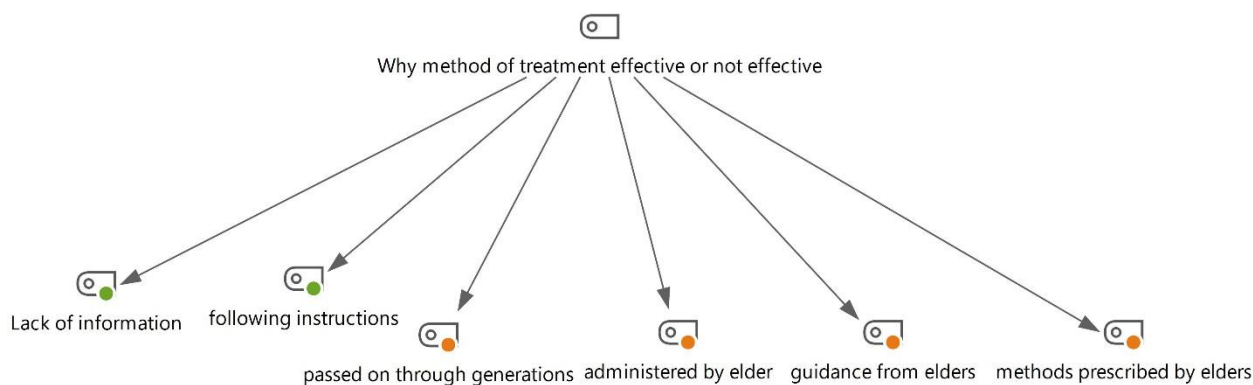
The participants who had made use of indigenous medicinal plants did not indicate the indigenous medicinal plants that they used to treat their minor illnesses, but the high awareness and effectiveness of the indigenous medicinal plants projected by the participants indicates that the plants are useful and that they play an important role in society. It also illustrates that elders have knowledge of a lot of the country's indigenous medicinal plants, and they are still using them to treat minor illnesses and are passing on the knowledge of the plants to the younger members of their families. Knowledge was better shared when the elders could physically show the younger ones the plants and the parts of the plants that are used and by the elders taking the younger ones through the preparation methods.

The importance of the awareness of indigenous medicinal plants is also highlighted by the following participant statements:

*"Some people probably have daily access to these plants, but do not know their usefulness" P26*

*"Some people don't know that some of the plants that they used to destroy are actually useful" P43*

People not being aware of what the indigenous plants look like and what their potential medicinal uses are can result in them destroying the plants and not harnessing the plants to their benefit. The codes seen in Figure 4.1 were combined to form categories, as displayed in Figure 4.2.



**Figure 4.2: Categorisation of codes from Questionnaire 1, Question 2.4**

Similar codes were combined to form the following categories:

- “Lack of information” and “following instructions” were combined into “Instructions for administering medicinal plants”
- The remaining four codes were combined and called “Information sharing by elders”

**Question 2.5: Do you want to learn about Namibia’s indigenous medicinal plants?**

Interest in learning about indigenous medicinal plants was high among the participants, as indicated in Table 4.10. Only three indicated that they do not want to learn about indigenous medicinal plants.

**Table 4.10: Want to learn about indigenous medicinal plants**

Want to learn about indigenous medicinal plants	Frequency	Percent
No	3	5.1%
Yes	56	94.9%
<b>TOTAL</b>	<b>59</b>	<b>100.0%</b>

The participants who were interested in learning about indigenous medicinal plants were further asked to select or list the means by which they wanted to learn about the plants.

**Question 2.6: If yes to (2.5), how would you prefer to learn more about indigenous medicinal plants?**

The participants were provided with a list of means through which they could learn about indigenous medicinal plants and were requested to select their preferred options. If their preferred option was not among the list, there was an option for them to add their own

preferred means. The participants could select and list more than one option. Table 4.11 displays the preferred means in their order of preference.

**Table 4.11: Preferred means of learning about indigenous knowledge of medicinal plants**

Means of learning	Number of participants who preferred it
E-learning	40
Watching videos	39
Listening to narrations by elders	30
Social media	26
Printed books	22
Learning-Based Game	19
Blog	15
Listening to audio recordings	7

Using an e-learning platform was selected as the preferred means to obtain indigenous knowledge of medicinal plants. The researcher notes that the participants’ selection of e-learning might have been influenced by the focus of the study being on e-learning and by the participants’ familiarity with e-learning.

E-learning enables people to have access to learning about indigenous knowledge on both their phones and computing devices such as laptops and desktop computers (Alhassan, 2016; Nurhudatiana et al., 2018). To this effect, a participant stated that:

*“Since technology is increasing so much these days and most of the people have smartphones, tablets and other devices that can be used to access the internet, e-learning will be a good platform to learn more about indigenous medicinal plants. Our elders who know more about these plants won’t stay in this world forever, but e-learning can be there forever” P16*

Watching videos was selected as the second most preferred means, with a participant stating that:

*“Videos, in my opinion, work best. If I could watch someone explain and demonstrate how to use the medicinal plants, it would be more effective and easier to understand” P41*

E-learning allows for the integration of videos onto a learning system (Wong, Tee, & Lim, 2015).

Of those who selected printed books, one participant stated that:

*“The information would reach a larger population if it was in the form of hardcopy (books, pamphlets, etc.)” P12*

Rural, low-resourced areas experience challenges with connecting to the internet (Rice et al., 2016), but some authors such as Chunwijitra, Tummarattananont, Khanti and Wutiwiwatchai (2017) have developed systems that allow users to efficiently access e-learning systems in areas with limited internet access.

Listening to audio recordings was the least preferred method, as one cannot see what is taking place when the preparation of the indigenous medicinal plant is being discussed and this makes it difficult to relate to what is taking place.

***Question 2.7: Would you like to be tested on what you have learned about the indigenous medicinal plants?***

According to Morales-Martinez and Lopez-Ramirez (2016), being assessed on a certain topic helps to retain the knowledge that was learned, and it helps one determine how much of the information they are still able to remember. The participants were asked whether they would like to be tested on what they learn about indigenous plants. Table 4.12 indicates that 48 participants wanted to be tested on what they would be learning.

***Table 4.12: Want to be tested***

<b>Want to be tested</b>	<b>Frequency</b>	<b>Percent</b>
No	11	18.6%
Yes	48	81.4%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

Participants wanted to be tested to ensure that they have a better understanding of the uses of the plants. Testing would also help them to apply what they have learned from the system. A further reason for wanting to be tested was gaining confidence to share with others what has been learned from the e-learning system.

Testing would also help them know what they have grasped and what more they need to learn, as indicated by the following statements:

*“So that I can evaluate myself on how much I have learned” P31*

*“I would like to know if I have a better understanding of the indigenous medicinal plants. Being tested allows me to find out what I actually know and what more I need to learn” P33*

*“To see if I actually learned anything about indigenous medicinal plants and if so, how much. Also, so I could maybe start using these plants medically” P42*

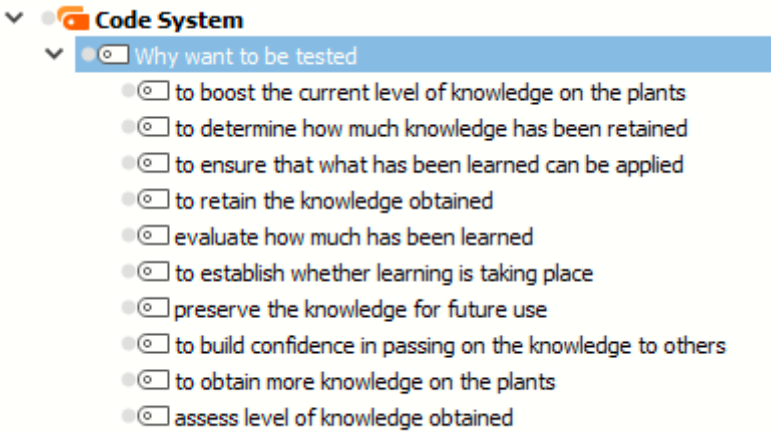


The participants also indicated that being tested would help them in retaining the information for future use:

*“I would like to know more about indigenous medicinal plants and the test will also hopefully correct misinterpretations that I might have” P18*

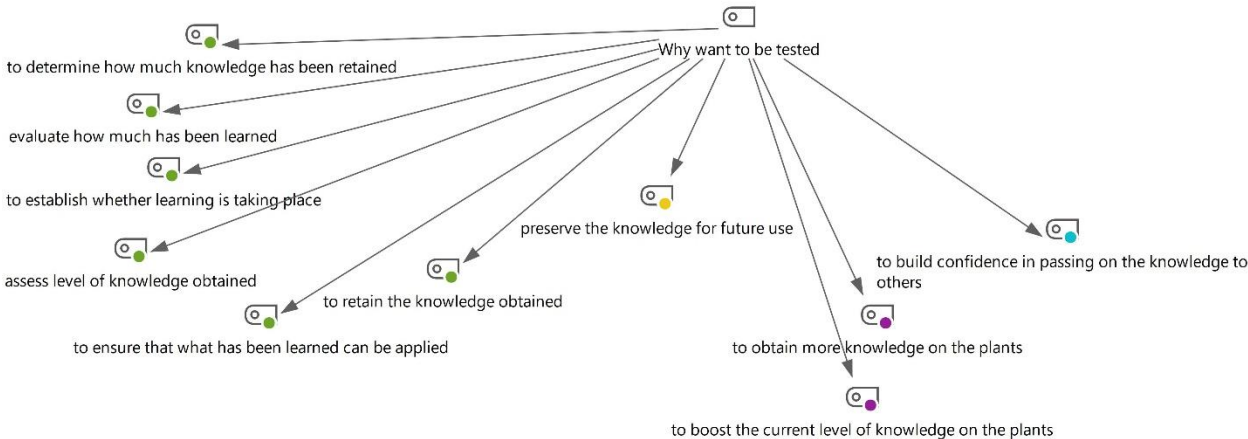
*“To help retain the information I have read, also to help my understanding so that even if I forget I will still have an understanding” P35*

Figure 4.3 displays the codes that were generated from the responses to Question 2.7.



**Figure 4.3: Why want to be tested codes**

Ten codes were generated, as presented in Figure 4.3. The codes that were found to be similar and addressing the same issue were combined to form categories.



**Figure 4.4: Categorisation of codes from Questionnaire 1, Question 2.7**

Four categories were generated from the codes, as highlighted in Figure 4.4:

- Assess level of knowledge retention
- Preservation of the knowledge
- Boost current level of knowledge
- Build confidence in passing on the knowledge to others

**Question 2.8: Do you think it will be useful to keep indigenous knowledge of medicinal plants on an e-learning system?**

Only 6 out of the 59 participants in the study expressed that they did not find it useful to keep indigenous knowledge of medicinal plants on an e-learning system, as displayed in Table 4.13.

**Table 4.13: Usefulness of keeping indigenous knowledge of medicinal plants on e-learning**

Useful to keep indigenous knowledge of medicinal plants on an e-learning system	Frequency	Percent
No	6	10.2%
Yes	53	89.8%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants highlighted that e-learning would allow for the documentation of indigenous knowledge on medicinal plants, thereby preserving it on the system and also in the people who make use of the system:

*“Documentation of traditional knowledge is key to preservation of culture, especially with this massive migration of the youth from villages to cities” P44*

E-learning allows for the archiving of information and contains a digital knowledge repository (database) on which the information can be archived and queried by users (Nurhudatiana et al., 2018).

The participants expressed that keeping indigenous knowledge on an e-learning system would assist in centralising the information and make it easily accessible as highlighted by the following quotes:

*“Because many people will be able to know more about the indigenous medicinal plants, because e-learning can be accessed by everyone and anytime, everywhere” P13*

*“E-learning would help by reaching a wide user base. It would also help in preserving the knowledge” P25*

*“E-learning allows the information to be in one place where it will be easily accessible” P30*

*“Centralising the information would allow more people to tap into it” P51*

Online platforms have become more popular, as highlighted by the following quotes:

*“To preserve it (indigenous medicinal plants) and encourage its use in the face of increasing digital technologies” P7*

*“Youth of today prefer learning about things online. Having these resources online would increase interest” P27*

The world is going digital and making more use of paperless platforms (DeSignore, Wolbrink, Zurakowski, & Burns, 2016). Many more people make use of the internet as compared to hard copy material.

Others felt that it would be a good platform to use in case of emergency:

*“It is a good platform especially in emergency cases where no medical doctor is available, but internet access is available and such plants are around” P44*

Others saw it as a means of engaging with others. The e-learning system can be a platform where they share and exchange ideas with others:

*“I came to a conclusion that e-learning is a good platform where people can engage with one another and learn from each other through formal discussions” P3*

*“So that I can get a chance to give my ideas on the indigenous medicinal plants that I know in order to give ideas too” P39*

*“Technology has a major impact on societal domains such as medicine. It outlines the areas in which e-learning is efficacious for learning indigenous medicinal plants so that people can share different ideas and learn from others” P47*

*“It is quite helpful as it provides a platform for people to interact and learn from each other by sharing different views, ideas and so forth” P54*

E-learning has multiple platforms, such as discussion forums and chat rooms, that allow for the sharing of information (Ngampornchai & Adams, 2016).

However, as indicated in Table 4.13, six participants did not find it useful to keep indigenous knowledge on medicinal plants on e-learning, with three of them stating that:

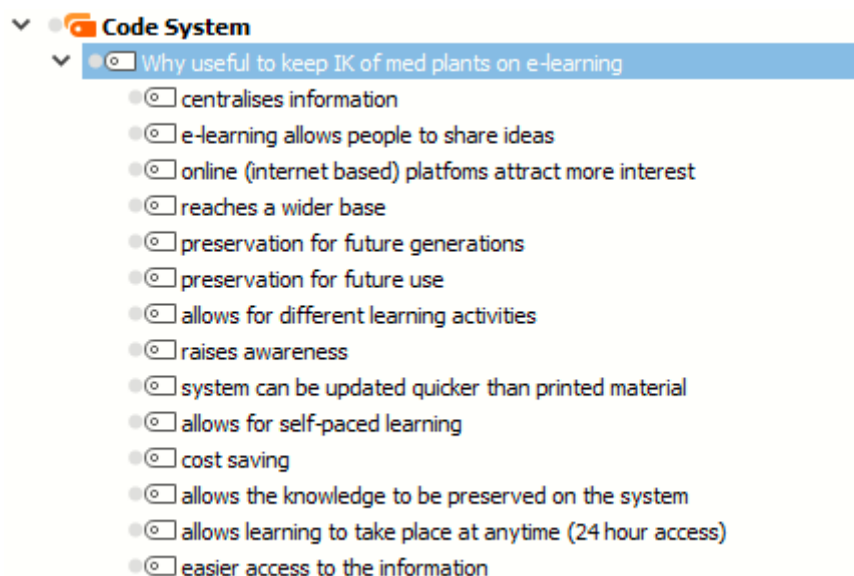
*“Not really useful, anyone can easily search off google on which medicinal plants are used on which specific illnesses” P10*

*“It would reach a larger population if it was in the form of a hardcopy (books, pamphlets)” P12*

*“Most of the information on indigenous medicinal plants is provided on other sources, for example when you want to find out where each of the indigenous plants are found, you can easily search on google” P23*

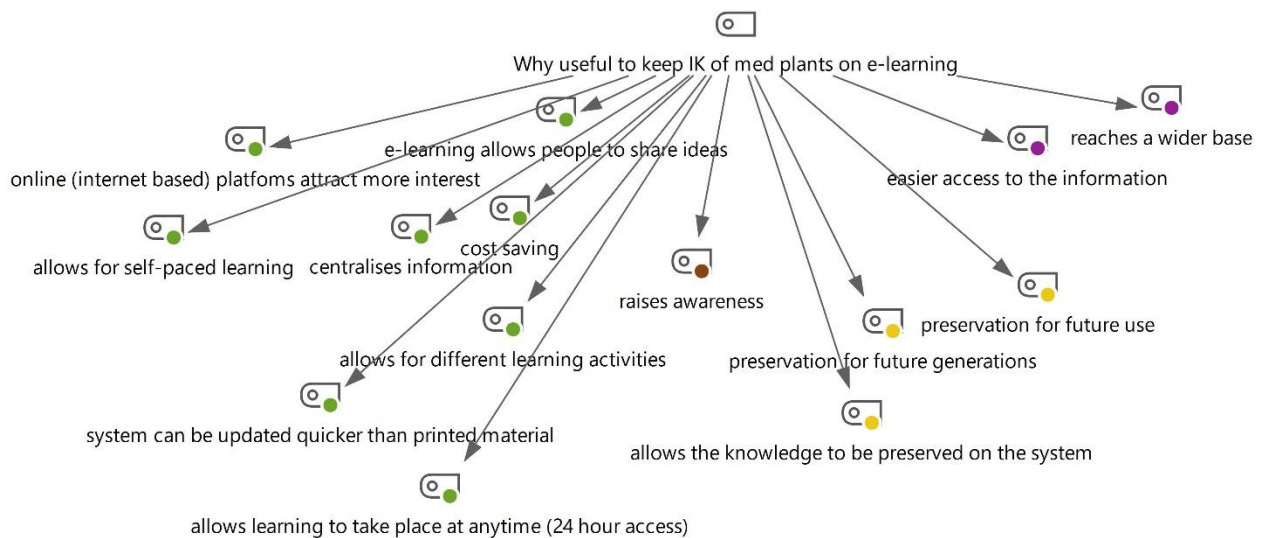
Printed material would be beneficial in areas with limited network infrastructures that could create barriers when accessing an e-learning system. Yet there is a limited number of resources on indigenous medicinal plants that are in a printed format and these resources are not easily available. Also, search engines are useful for information retrieval purposes, but the information is found in different locations and is not centralised.

Fourteen codes were generated from the responses to Question 2.8, as displayed in Figure 4.5.

- 
- Code System
    - Why useful to keep IK of med plants on e-learning
      - centralises information
      - e-learning allows people to share ideas
      - online (internet based) platfoms attract more interest
      - reaches a wider base
      - preservation for future generations
      - preservation for future use
      - allows for different learning activities
      - raises awareness
      - system can be updated quicker than printed material
      - allows for self-paced learning
      - cost saving
      - allows the knowledge to be preserved on the system
      - allows learning to take place at anytime (24 hour access)
      - easier access to the information

**Figure 4.5: Why useful to keep IK on e-learning codes**

The codes were further combined to form categories, as displayed in Figure 4.6.



**Figure 4.6: Categorisation of codes from Question 2.8**

Four categories were created from the codes:

- E-learning features and advantages (different learning activities, sharing of ideas, self-paced learning, anytime learning, centralising information, cost-effective, quicker updating of information)
- E-learning can create awareness of indigenous medicinal plants
- E-learning will allow for the preservation of knowledge
- E-learning allows for easier access to and availability of information

**Question 2.9: Please provide any additional comments you have on indigenous medicinal plant knowledge being preserved from engaging on an e-learning system?**

The preservation of indigenous knowledge on medicinal plants will prevent its extinction. Most elders in the communities are custodians of the indigenous knowledge on medicinal plants, and this knowledge needs to be documented and made available digitally for preservation:

*“Local communities in Namibia possess an in-depth knowledge of the use of medicinal plants and their environment. Medicinal plants contribute significantly to the intellectual property rights of poor local households in these local communities”*

P21

Most of the participants' sentiments on Question 2.9 were similar to those on Question 2.8. Seven codes were generated from the responses, as displayed in Figure 4.7.

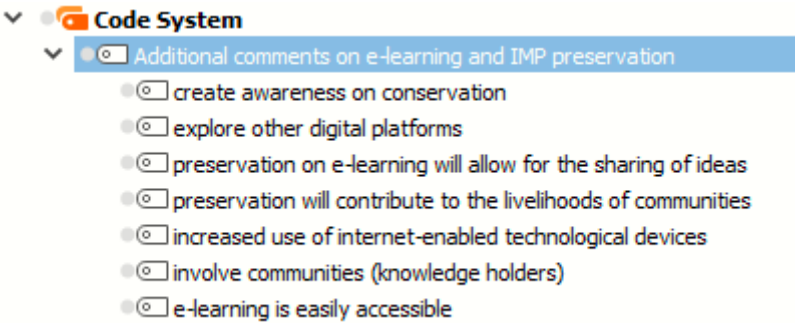


Figure 4.7: Additional comments on Questionnaire 1 codes

Four categories were created from the codes, as highlighted in Figure 4.8:

- Create awareness for conservation
- E-learning allows for sharing of ideas
- Community involvement is vital
- Increased usage and accessibility of digital platforms

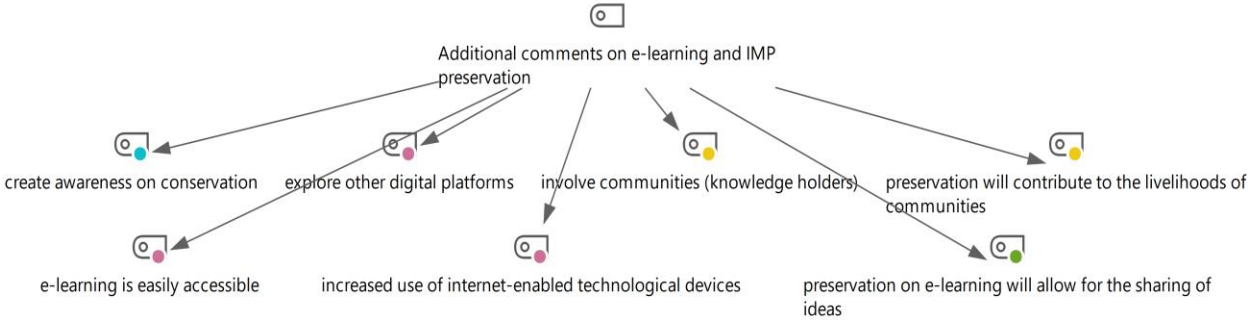


Figure 4.8: Categorisation of codes from Questionnaire 1, Question 2.9

**Conclusions from Questionnaire 1: Section 2**

The awareness of indigenous knowledge on medicinal plants was very high among the participants, with only 12% of the participants not being aware of the plants. Participants from the urban areas were equally aware of the plants as their counterparts from the rural areas. The usage and effectiveness of indigenous medicinal plants was also demonstrated to be high among the participants.

Ninety-five percent (95%) of the participants wanted to learn about the plants to preserve this knowledge for future use. Eighty-one percent (81%) wanted to be assessed on what

they learn on the system, one of the reasons being for them to evaluate whether they are learning from the system and how much of that knowledge they are retaining.

E-learning was perceived to be useful as a platform for preserving indigenous knowledge on medicinal plants, as it allows for the centralisation of information. E-learning also allows for information to be preserved within a system. After e-learning, videos were the second most preferred means of preservation, as the participants found it easier to learn from watching a demonstration than from reading text.

Elders are the predominant method of preservation of indigenous knowledge on medicinal plants, which suggests that they are the custodians of the knowledge. It emerged from the data that there is a lack of information technology usage in the preservation of indigenous knowledge on medicinal plants.

#### 4.3.2.2 Participants' perceptions of e-learning in preserving indigenous knowledge on medicinal plants

The data discussed in this section was collected from the second questionnaire (Questionnaire 2) found in Appendix C. Questionnaire 2 assisted in providing answers to RQ3 of the study.

Questionnaire 2 was based on the E-learning Success Model by Holsapple and Lee-Post (2006). The participants completed it after they had completed Questionnaire 1 and had worked through the content on Namibia's indigenous medicinal plants presented on the prototype e-learning system. The content presented on the prototype e-learning system was derived from the information on the selected thirty indigenous medicinal plants found in Appendix A. For each plant, the information displayed consisted of the scientific and common English name of the plant, an image of the plant and the illnesses the plant is used to treat.

The quality of the prototype e-learning system and the information presented on it, as well as the usefulness of the prototype system and its net benefits, were explored in Questionnaire 2. To find out how many of the participants held a certain perception, the questions were posed as closed-ended questions, with a choice of only Yes or No. For each closed-ended question, the participants were asked to elaborate on the choice that they had selected by providing responses to the questions.

Questionnaire 2 was divided into six sections. The findings from Questionnaire 2 will be discussed next.

## **Questionnaire 2: Section 1 - System Quality**

The questions in Section 1 of the questionnaire were on the prototype e-learning system's quality. The section was made up of three questions.

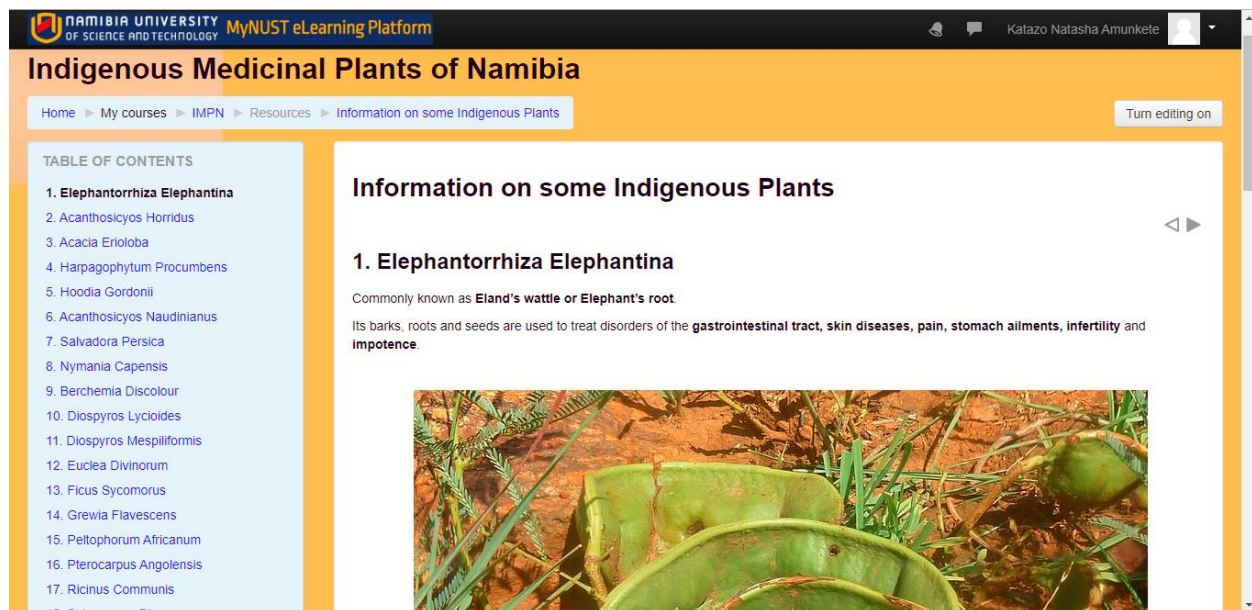
### **Question 1.1: Were you able to navigate through the system with ease?**

Fifty-six (56) participants found the system to be easy to navigate, as displayed in Table 4.14.

**Table 4.14: Ability to navigate**

<b>Ability to navigate</b>	<b>Frequency</b>	<b>Percent</b>
No	3	5.1%
Yes	56	94.9%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The information on the prototype e-learning system was presented in a table of contents format, as displayed in Figure 4.9.



**Figure 4.9: Screenshot of content display on the prototype e-learning system**

This format allowed the participants to browse between the different plants, using navigation bars and arrows.

Some participants found the system to be easy to navigate, as they had prior experience working on the system. This is highlighted by the following quotes:

*“Since I already know how to operate the e-learning system, it was quite easy for me to go about accessing the information” P8*

*“Because I am familiar with the system already, it was easy for me” P20*



The instructions provided on the system also helped the participants navigate through the system:

*“Instructions are given on the system on how to go through the information without difficulty” P25*

*“The instructions are clear and understandable” P48*

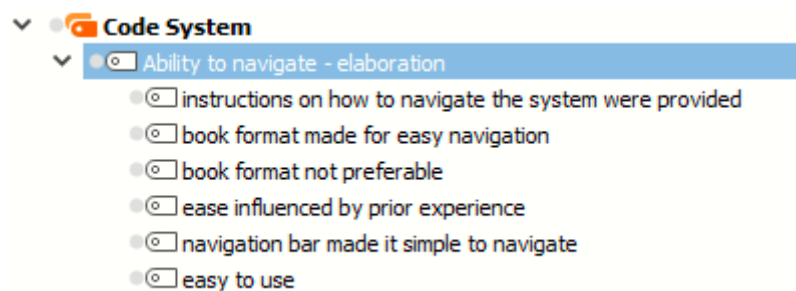
*“The instructions provided on the system clearly made it easy for me to navigate” P59*

One of the three participants who did not find the system easy to navigate had the following to say:

*One has to view one page at a time and going/navigating to pages beyond the current page became a waste of time and loss of interest P9*

For the participants who found the system difficult to navigate, the book format was viewed as a hindrance and they would have preferred more of a multimedia display.

Six codes were generated from the participants' responses, as displayed in Figure 4.10.



**Figure 4.10: Ability to navigate codes**

**Question 1.2: Were help functions available on the system?**

Table 4.15 shows that of the 59 participants in the study, only 31 knew that help functions were available on the system.

**Table 4.15: Availability of help functions**

Availability of help functions	Frequency	Percent
No	28	47.5%
Yes	31	52.5%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

Some participants expressed that they might not have seen the help functions, as they did not encounter any situation on the system in which they required assistance:

*“I didn't need any help functions, so it is possible that I just didn't see them” P37*

*“They were visible, but I didn't encounter any issues, so I didn't need them” P58*

Help functions would allow for further enquiry if a user was struggling with navigating through the system or when further assistance was required.

Other participants did not come across any help functions at all:

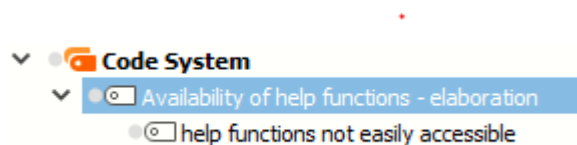
*“If I need more information, where do I go?” P3*

*“If there was, I didn't come across any help functions” P10*

*“Help functions were not available or rarely helpful like for instance having discussion about more plants on the system” P34*

According to Schultz and Correia (2015), help functions on an e-learning system should be well placed and easily accessible.

As displayed in Figure 4.11, only one code was generated from the responses.



**Figure 4.11: Availability of help functions code**

### **Question 1.3: Were you able to search for any information that you needed?**

Thirty-four (34) of the participants expressed awareness that there were search functions available on the system, as displayed in Table 4.16.

**Table 4.16: Availability of search functions**

Availability of search functions	Frequency	Percent
No	25	42.4%
Yes	34	57.6%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

Similar to the help functions, the search functions were also found not to be easily accessible. The participants who could find the search functions said they were not very helpful:

*“I was able to search for information although it was of little use and the information given was not detailed enough” P14*

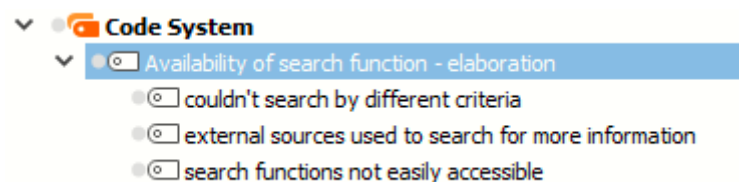
There was a need to search for plants that could treat any specific illness, with a participant stating that:

*“A search function will be useful where one can type in the medical problem, e.g. ‘cough’ and all the plants that can cure a cough will be displayed” P42*

Some participants responded that they had to consult external sources, such as search engines, for additional information which they could not find on the system:

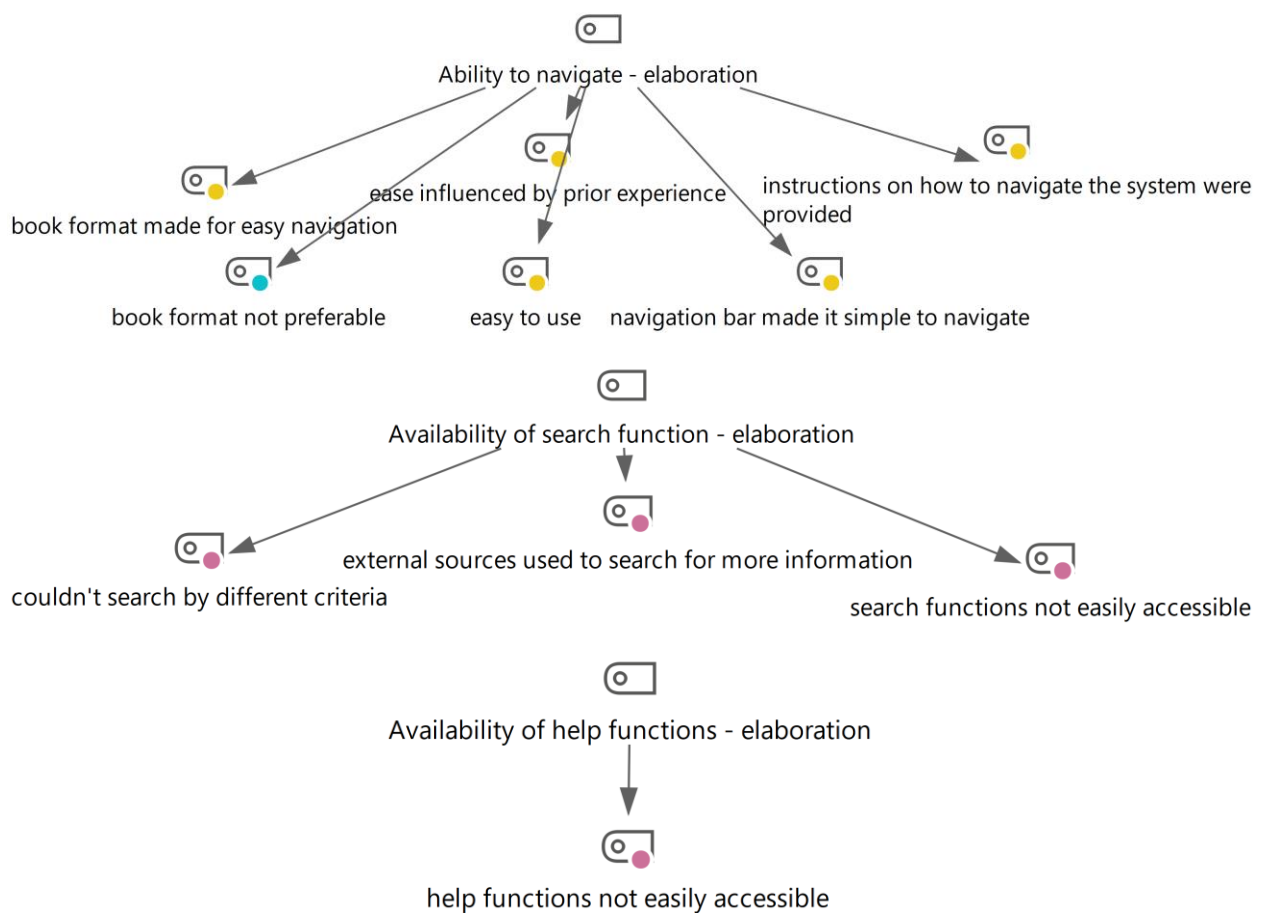
*“I had to search on Google Chrome to go deep into the content about the plants” P11*

Three codes were generated from the participants' responses, as displayed in Figure 4.12.



**Figure 4.12: Availability of search function codes**

The codes generated for Questions 1.1 to 1.3 were similar and have been categorised into three categories, as displayed in Figure 4.13.



**Figure 4.13: Categorisation of codes from Questionnaire 2: Section 1, Questions 1.1-1.3**

The categories are:

- Ease of navigation influenced by prior experience and availability of instructions
- Multimedia content preferable
- Navigation, help and search functions not easily accessible

### **Questionnaire 2: Section 2 - Information Quality**

Section 2 was on the quality of the information about indigenous knowledge that was presented on the prototype e-learning system. The section was made up of two questions.

#### **Question 2.1: Did the material on the e-learning system contribute to your knowledge on indigenous medicinal plants?**

Fifty-six (56) participants expressed that working through the content on the e-learning prototype system contributed to their knowledge, as displayed in Table 4.17.

**Table 4.17: Contribution to knowledge**

<b>Contribution to participants' knowledge from working through the material on the system</b>	<b>Frequency</b>	<b>Percent</b>
No	3	5.1%
Yes	56	94.9%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

Working through the content on indigenous medicinal plants created more awareness on the plants:

*“On the e-learning platform, there were some indigenous medicinal plants that are in the area where I grew up, but I didn’t know that they are used for medicinal purposes” P16*

*“I was not aware of some of the treatments the different indigenous plants could offer” P26*

*“I didn’t even know some of the plants are medicinal and I played with them as a kid” P46*

*“Most definitely. It was interesting because as I scrolled through the presentation, I came to realise that I have been living around these plants, but I was so ignorant and only realise their importance now” P51*

*“At first, I vaguely knew that some plants are used to treat various illnesses, wounds, etc. but now I know in-depth the actual significance of these plants” P53*

Some participants had knowledge of indigenous medicinal plants, but the material on the system still contributed to their existing knowledge base:

*“The information was useful, it added more to what I know. Now I have a broader knowledge about the indigenous medicinal plants. It made me realise that I only knew a small portion of it” P8*

*“I was able to know more about the medicinal plants I regularly see but didn’t have a clue about their value” P14*

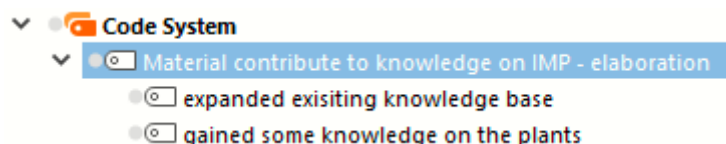
*“The information that I got was more than three times of what I had already known before” P16*

*“It provided thirty plants and I only knew three of them, I have learnt twenty-seven more medicinal plants from this system” P29*

*“I got to know new plants which I did not know in the past and learn more about the ones I already knew” P33*

*“It contributed effectively as I only knew the names of some of the indigenous medicinal plants but did not have any idea how they looked like and through this platform I was enabled to do so” P51*

Two codes were generated from the responses, as displayed in Figure 4.14.

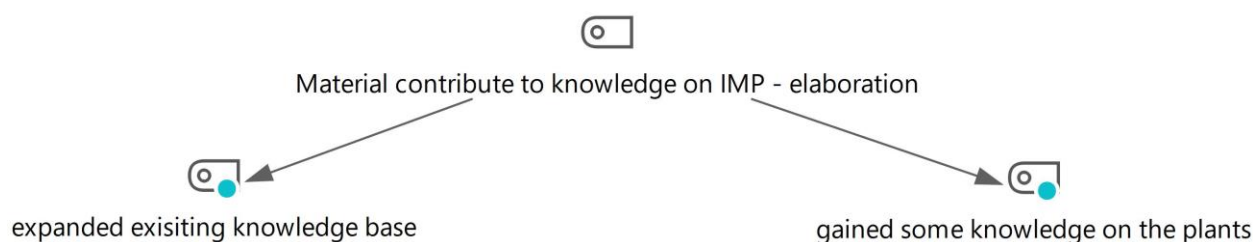


**Figure 4.14: Contribution of material to knowledge codes**

The codes generated were developed into one category, as highlighted in Figure 4.15.

This category is:

- Attainment of knowledge



**Figure 4.15: Categorisation of codes from Questionnaire 2: Section 2, Question 2.1**

### **Question 2.2: Was the presentation of the material organised in an effective manner?**

Fifty-one (51) participants expressed that the presentation of the material on Namibia’s indigenous medicinal plants was organised in an effective manner, as displayed in Table 4.18.

**Table 4.18: Effectiveness of presentation of material**

Presentation of the material effectively organised	Frequency	Percent
No	8	13.6%
Yes	51	86.4%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants noted that the material on the e-learning system was organised in an effective manner, and working through the content presented on the system contributed greatly to their knowledge of the plants and their uses.

The content was displayed in a book format; each plant was displayed on a separate page along with its image, and information on the illnesses that it treats:

*“It was easy to identify the plant from this system as under each plant name, came the photo and what the plant is used for as medicine” P29*

*“The table of contents showed all the different plants listed and there are navigation arrows on the right-hand side to go back and forth” P43*

*“Data on the indigenous plants was presented slide by slide in a book format, and alongside each plant, there was a corresponding picture with helped in avoiding confusion” P55*

Four of the eight participants who said the material was not effectively presented had the following to say:

*“There was no alphabetical order or most commonly known species, etc.” P16*

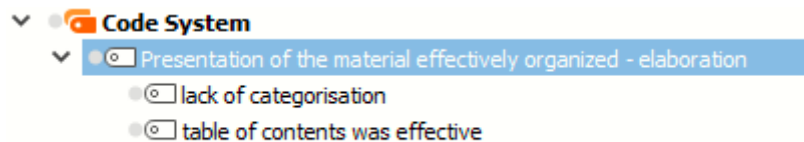
*“The presentation was supposed to be in order according to the plants’ location e.g. plants that are in the desert following each other then followed by those that are found in other areas and so on” P21*

*“The indigenous medicinal plants are mixed and it’s a bit confusing, especially to people that do not know where they could find some of the plants like the !Nara plant” P23*

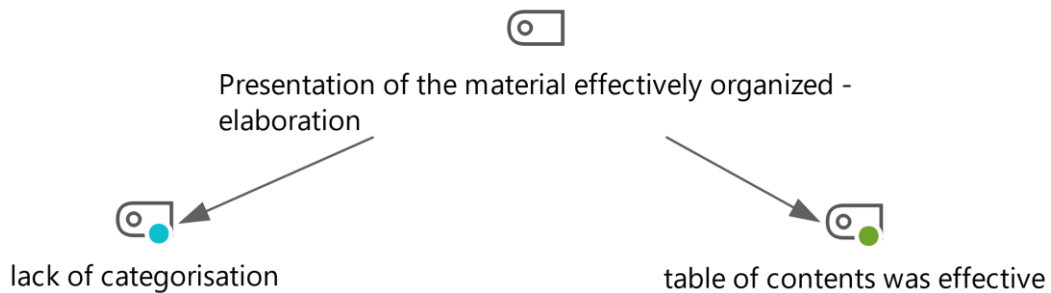
*“It’s kind of confusing regarding the organisation of the material, as you first find indigenous plant starting with letter E, A, A, H and the last with A. I recommend it to be organised in alphabetical order, this will give the reader a flow of information” P31*

The effective organisation of material on an e-learning system increases a user’s satisfaction and ensures continued use of the system (Navimipour & Zareie, 2015).

Two codes were generated from the responses, as displayed in Figure 4.16.



**Figure 4.16: Effective organisation of presentation of material codes**



**Figure 4.17: Categorisation of codes from Questionnaire 2: Section 2, Question 2.2**

The categories are the same as the codes that were generated from the responses for Question 2.2, as displayed in Figure 4.17.

The categories are:

- Lack of categorisation
- Table of contents was effective

### **Questionnaire 2: SECTION 3 - Use**

Section 3 was on the formats (text and images) that were used on the prototype e-learning system. This section was made up of one question.

#### **Question 3.1: Did the images and text on the e-learning system contribute to your understanding on the content on indigenous medicinal plants?**

The content on Namibia's indigenous medicinal plants that was presented on the prototype e-learning system consisted of images and text. Fifty-four (54) participants expressed that the images and text contributed to their understanding of the content, as displayed in Table 4.19. They would have preferred videos to supplement the images and text that were provided.



**Table 4.19: Images and text contribution**

<b>Images and text contribute to understanding the content on the system</b>	<b>Frequency</b>	<b>Percent</b>
No	5	8.5%
Yes	54	91.5%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants reported that the images helped them recognise plants from their communities. The text also helped them remember and preserve the information that they had read, as highlighted by the following quotes:

*“The fact that I only heard about some indigenous medicinal plants treating different diseases, I didn't really know what they looked like but the pictures that were provided gave me an understanding and more knowledge about them” P15*

*“Having images really improved my understanding and knowledge as I wouldn't have known the plants' scientific names” P22*

*“Once you have seen the images, the memory of seeing that indigenous medicinal plant comes back to you” P29*

*“Having a visual representation made me understand better and even retain what I have learned” P32*

*“Because some plants had names that I never heard of, and with the help of the pictures, I could easily recognise them” P42*

*“The images played a huge role because even if we did not know the name of the plant, the image would remind us. The text provided further information about the use of the plants, which was useful” P53*

However, the participants felt that using the English and scientific names of the plants was not useful, as they knew some of the plants but could not remember them by just reading the names and were mostly assisted in remembering the plants by the images displayed. The names were difficult to pronounce and remember, but the images provided some clarification:

*“The names of the plants are complicated to remember but the text helped in understanding the use of the plants” P3*

*“No difficult words used but the names of the plants are difficult to read and pronounce” P5*

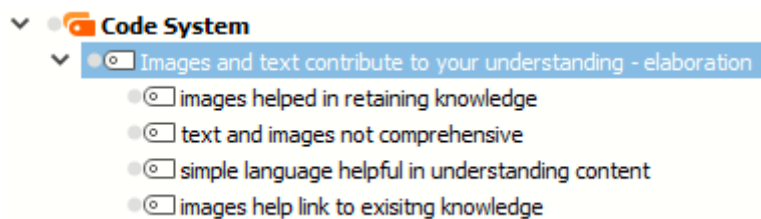
*“Although I wished they were in local languages because some of the plants I only recognised after a closer inspection of the images” P25*

The participants indicated that having the names of the plants in the local languages would have contributed more to their knowledge. Clear images with descriptions of the plants would also have helped in identifying the physical differences between the plants:

*“No that much helpful because of the pictures. The pictures should have been of the tree and not leaves or fruits. Showing only a part of the tree makes it difficult for me to learn” P18*

Using simple English words (no complicated technical and scientific terms) supplemented by an index or glossary with the names of the plants in both English and in indigenous local languages would assist in contributing to understanding the plants and their uses.

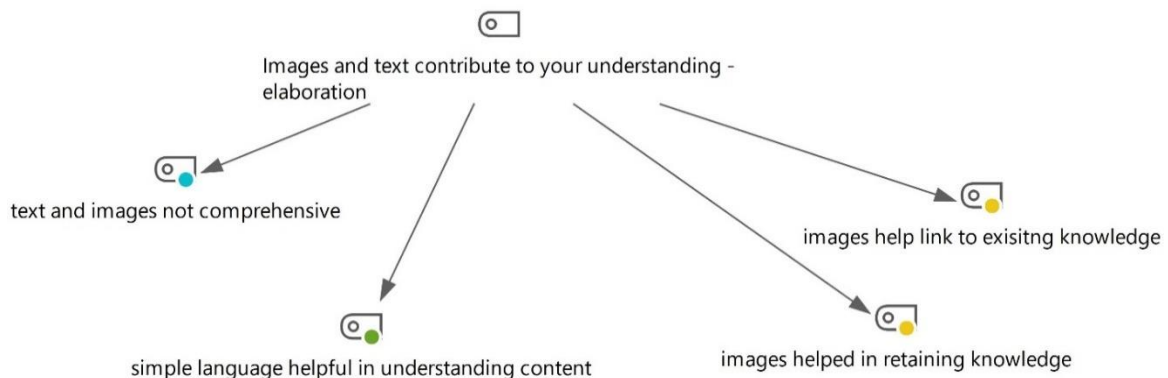
Four codes were generated from the responses, as displayed in Figure 4.18.



**Figure 4.18: Contribution to understanding from images and text codes**

Three categories were developed from the codes, as displayed in Figure 4.19:

- Text and images not comprehensive
- Use of simple terms and local indigenous languages
- Images contributed to knowledge



**Figure 4.19: Categorisation of codes from Questionnaire 2: Section 3, Question 3.1**

## **Questionnaire 2: Section 4 - User Satisfaction**

Section 4 was on the experience that the users had of the prototype system. The section was made up of three questions.

### **Question 4.1: Were you satisfied with the system?**

Table 4.20 shows that 43 participants perceived the prototype e-learning system to be satisfactory.

*Table 4.20: User satisfaction*

<b>Satisfaction with the system</b>	<b>Frequency</b>	<b>Percent</b>
No	16	27.1%
Yes	43	72.9%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The responses to this question were similar to those provided to the questions in Sections 1 to 3. The participants expressed that they gained new knowledge, and some expanded their existing knowledge on Namibia's indigenous medicinal plants. They also stated that they could retain the knowledge they gained for future purposes:

*"I got to know new plants that I did not know in the past and learn more about the ones I already knew" P33*

*"It taught me very much to the point where I can use the knowledge I obtained to my advantage, for instance, I know that if I get a headache I don't need to rush to the hospital but rather just treat myself with the seeds of a Bird Plum tree" P51*

Some of the participants who were not satisfied with the system had the following to say:

*"Not clear pictures of trees/plants (would prefer to see a tree including its stem). Too much information in scientific form, the system must speak to the locals" P5*

*"The layout was perfect, but my suggestion is to display videos even just one about how the plants are used to produce medicine" P13*

*"I still need to search other indigenous medicinal plants" P15*

*"They could at least have provided where exactly each plant can be found when one needs it" P17*

*"There should at least be test yourself questions which you can go and try out after you are done reading" P37*

*“The system does not offer the reader any platform to ask more information on the indigenous plants” P41*

*“There are no steps on how each plant is supposed to be prepared for their specific treatments” P49*

The use of English and scientific names was raised as an issue that impacted the satisfaction of the users. The participants indicated that they would have preferred to see the names in their indigenous languages. The lack of categorisation on the system was also highlighted as a factor that impacted the users' satisfaction. Another factor that came up was the lack of information on how to administer the indigenous medicinal plants for treatment. Due to the limited information on the system, some participants stated that they would still need to consult search engines for additional information and to call elders to verify the uses of some plants presented on the prototype e-learning system. Information on the location where the plants could be found was raised as another issue that influenced the users' satisfaction with the system. Lastly, participants would have preferred to be able to add additional information to the system or ask questions on the system when they did not understand some of the information presented.

The codes generated from the responses to this question were the same as the codes for Questions 5.2 and 6.2 found in Questionnaire 2. Question 5.2 was on whether the participants found it a positive experience engaging with the e-learning system, while Question 6.2 asked for additional comments. The categories generated for all three questions (4.1, 5.2 and 6.2) will be discussed under Question 6.2.

#### **Question 4.2: Would you recommend the system to others?**

Fifty-five (55) participants would recommend the system to others, as displayed in Table 4.21, since they think that it will be of value to the general public.

*Table 4.21: Recommend to others*

<b>Would recommend the system to others</b>	<b>Frequency</b>	<b>Percent</b>
No	4	6.8%
Yes	55	93.2%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants viewed the system as a means of gaining more knowledge that everyone with an interest should have access to. They indicated that the system being internet-based would allow for easier access to the information and would help raise awareness of indigenous medicinal plants:

*“Because it is helpful, and everyone must know or have knowledge about these plants for first aid purposes and in case there is no time to go to the hospital” P11*

*“Most people are familiar with these indigenous medicinal plants and they are close to them, but the fact that they don’t know their roles they sometimes cut down or remove these plants instead of keeping them” P15*

*“I would recommend it in order to share knowledge so we can start using this important raw material for treatment” P19*

*“They can access the system from any remote location” P26*

*“It is important that other young people know of a platform where they can read about our medicinal plants, without looking for hard copies” P35*

*“Some people have the tendency of touching things that they do not know, and this would help them” P46*

*“The information displayed on the system is very important and can be of great help to anyone. It can also serve individuals to be aware of these plants and to comprehend and acknowledge the significance of their existence” P53*

*“They need to know that there are various ways to treat diseases, other than the artificial ones, there’s also the natural ways” P59*

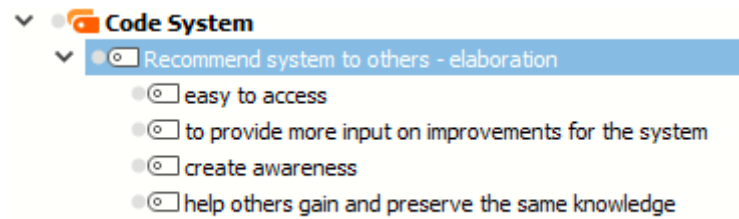
Due to the factors that hindered the participants to be satisfied with the system, some participants stated that they would recommend it to others if improvements were done to it and also for other people to provide their views on the system:

*“But only for them to suggest improvements. In its current form, it is not really helpful” P5*

*“It will need further updating though, e.g. how to prepare the medicine” P44*

Provision should be made on the system for people to add their comments and suggest any improvements.

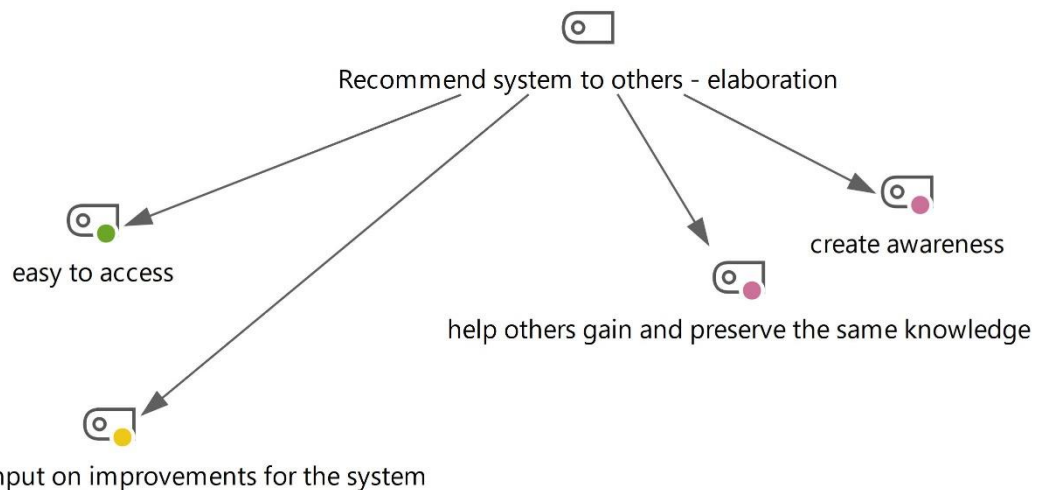
Four codes were generated from the participants' responses, as displayed in Figure 4.20.



**Figure 4.20: Codes for recommend to others**

Three categories were generated from the codes, as displayed in Figure 4.21:

- Recommend system due to easy access
- Recommend for suggestions on improvement
- Create awareness for preservation



**Figure 4.21: Categorisation of codes from Questionnaire 2: Section 4, Question 4.2**

### **Question 4.3: Who do you think this system will be of value to?**

The participants perceived that the system would be of value to everyone, especially the local inhabitants of Namibia:

*“Mostly every person that works with computers, such as students and learners”  
P2*

*“It could be hugely helpful to everyone including me and the future generation of researchers can also benefit from it” P5*

*“I think all Namibians, whatever tribe they belong to. Everyone needs or wants to live a healthy life” P11*

*“I think it will be of value to everyone because they are having these indigenous plants in their surroundings and everyone can experience an illness which can be treated with these plants” P15*

*“Most of the locals where the plants are located. It can also be useful to everyone else as they will know more about the plants if they ever come across it” P18*

*“It will benefit everyone, because we all experience health issues treatable by the indigenous medicinal plants” P29*

*“Everyone because infections are everywhere and not everyone can afford treatment from hospitals and some illnesses do not require to be treated at the hospital” P50*

People living in rural areas were identified to benefit from a system for the preservation of indigenous knowledge on medicinal plants. Most people living in rural areas live very far from a medical facility or are unable to afford the cost of professional medical services. These people might be living in an area that is surrounded by indigenous medicinal plants that could assist in helping them to manage and treat some minor illnesses:

*“People in rural areas as they do not have the resources to buy medicines from pharmacies. They can access these plants in the areas for free” P41*

*“To everyone but more to the people that stay kilometres away from public hospitals and campers” P44*

*“People in rural areas as they do not have the resources to buy medicine from pharmacies. They can access these plants in their areas for free” P55*

People in rural areas can live several kilometres away from the nearest health facility (Chinsembu, Cheikhyoussef et al., 2015).

Young people and people in the academic environment and health fields were also identified as a group that could possibly benefit from the system:

*“Students and learners because they should be open to learning. It would also be of value to people in the science field” P3*

*“The system will be of value to all health professionals and students studying medicine. It is more valuable to health information management students” P4*

*“The people studying science and nature conservation as their courses as they are related to these. I still think everyone who can read and write could value this system and learn from it” P10*

*“It will be of great help to doctors and scientist that can develop medicine from indigenous plants. Low-income earners can also use the medicinal plants because it is a cheaper alternative to pharmaceutical medication” P22*

*“Those studying medicine, traditional leaders and practitioners as well as anyone willing to go outdoors into the wild” P32*

*“The young people, so they obtain the knowledge that they need about our plants as many elders are already aware of their existence” P35*

*“To the youth because the youth don't know much about indigenous plants and if they get this knowledge, they can pass it on to future generations” P39*

*“In Grade 10, we had a section on indigenous plants in our life science course and the information I found on e-learning would have helped them” P51*

Learners in high school are taught about different plants in the life sciences courses and the system could assist them in finding extra content to read. Teachers could also use the system as a course delivery and assessment tool.

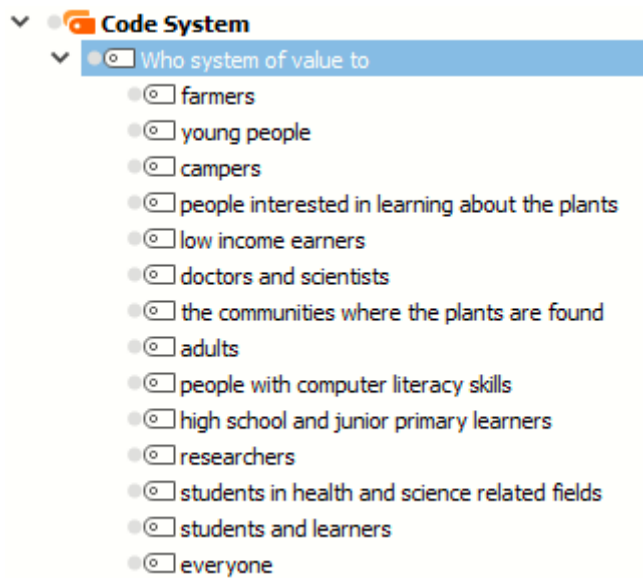
Campers are sometimes very far from medical establishments and may face an emergency that could be alleviated by an indigenous medicinal plant. The area they are in might have internet reception and there might be indigenous medicinal plants in the vicinity that can alleviate the problem:

*“I am part of a scout group that goes camping regularly, having this knowledge could help in the wild” P46*

Indigenous medicinal plants might also be available on a farm without a farmer's knowledge, while some of the plants are actually useful in treating illnesses that affect farm animals.

Fourteen codes were generated from the participants' responses, as displayed in Figure 4.22.

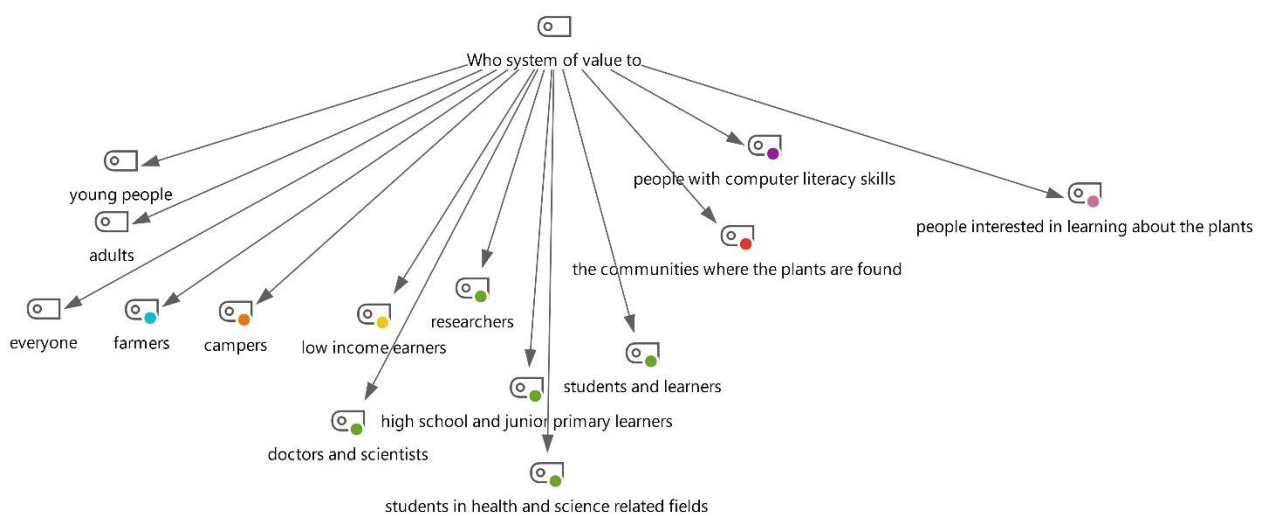




**Figure 4.22: System of value to codes**

Seven categories were generated from the codes, as displayed in Figure 4.23:

- Farmers
- Campers
- Low-income earners
- People in the education and health sectors
- Local communities
- Computer literate people
- Other interested people



**Figure 4.23: Categorisation of codes from Questionnaire 2: Section 4, Question 4.3**

## **Questionnaire 2: Section 5 - Net Benefits**

Section 5 was on the negative and positive net benefits that users derived from the prototype e-learning system and the content presented on it. Section 5 was made up of three questions.

### **Question 5.1: Did using the e-learning system encourage you to read or learn further on the topic of Namibia's indigenous medicinal plants?**

After working through the content on Namibia's indigenous medicinal plants presented on the prototype e-learning system, 49 participants indicated that they have been encouraged to read further on indigenous medicinal plants, as displayed in Table 4.22.

**Table 4.22: Encouraged to read further**

<b>Encouraged to read further on indigenous medicinal plants</b>	<b>Frequency</b>	<b>Percent</b>
No	10	16.9%
Yes	49	83.1%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants expressed eagerness and curiousness to learn more about indigenous medicinal plants, as highlighted by the following statements:

*"It has encouraged me to search for and even read more about my country's indigenous plants, so that I will be able to teach other people in my community about the importance of these plants" P1*

*"It made me curious to know more and find out about other plants that are not on the system" P21*

*"Yes, I want to learn more about the medicine, like how to prepare it" P27*

*"While going through the information on the system, I made a note to call some elders to confirm the uses of some of the plants such as the figs. I'd really like to learn more about our medicinal plants" P29*

*"Learning that I have all these plants around me and what they can do for me made me want to learn more" P32*

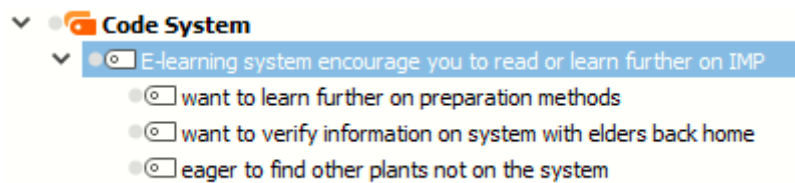
*"I am eager to find other plants not on the system" P45*

*"While going through the plants, I ended up doing more research on a plant I couldn't pronounce and learned about its uses other than its medical purposes and this has encouraged me to go search on other plants as well" P50*

*“It boosted and provoked me to learn further as it only gave the important facts about the plants, so it made me search for things like the discovery of certain plants” P58*

Interest in learning more about indigenous medicinal plants was high, which shows that a platform that presents information on the plants could be beneficial.

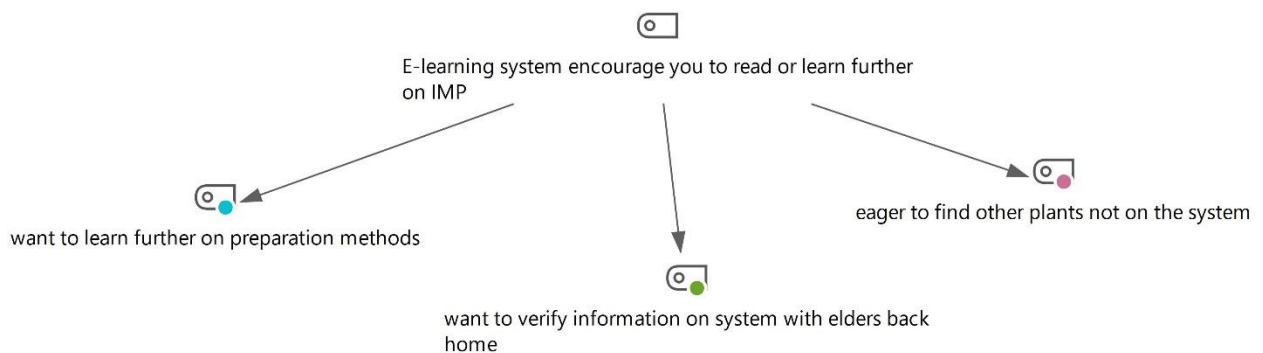
Three codes were generated from the participants' responses, as displayed in Figure 4.24.



**Figure 4.24: Encouraged to read or learn further by e-learning codes**

As displayed in Figure 4.25, three categories were generated from the codes:

- Provide information on the preparation methods of indigenous medicinal plants
- Ensure the evaluation of information on the system by the knowledge custodians
- Comprehensive information should be presented on the system



**Figure 4.25: Categorisation of codes from Questionnaire 2: Section 5, Question 5.1**

**Question 5.2: Did you find it to be a positive experience engaging with the e-learning system on indigenous medicinal plants?**

Fifty-six (56) participants found it a positive experience, as indicated in Table 4.23.

**Table 4.23: Positive experience on prototype e-learning system**

Positive experience working through the content on the e-learning system	Frequency	Percent
No	3	5.1%
Yes	56	94.9%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants indicated that they gained knowledge from using the system, and they became aware of indigenous medicinal plants that they could use to treat minor illnesses. They perceived the information to be useful and a source of knowledge:

*“I retained some of the things I learnt, and I can still recall the names and uses of some plants that I only learned about today” P7*

*“Now that I understand the significance of these plants, I'll be more cautious outdoors and encourage my peers to do the same” P13*

*“It has expanded my thinking and knowledge” P16*

*“It was a contribution towards my knowledge” P25*

*“I only used to hear about some of these indigenous plants but didn't know them, but with the information from the system, I realise that I have seen some of the plants presented but did not know that they are medicinal” P37*

*“Because it is showing how the old age (the indigenous plants) and the new age (e-learning) come together to educate people on an important issue” P41*

*“All indigenous medicinal plants are available at one place and I can read through without having to search somewhere for the names of the plants” P45*

*“I gained valuable knowledge from engaging with the system” P56*

Three participants did not find it a positive experience, due to the use of English and scientific names for the plants, as highlighted by the following quote:

*“Too scientific (localise system even on a per regional distribution of a certain plant. E.g. If the plant predominantly occurs in the Kunene Region, the local names in*

*that area's vernacular could be combined with the scientific names to promote friendly usage)” P5*

As stated in the discussion under Question 4.1, the codes generated from the responses to this question (5.2) were the same as the ones for 4.1 and 6.2. Question 4.1 was whether the participants were satisfied with the prototype e-learning system, while Question 6.2 was on additional comments that the participants had regarding their experience with the system. The categories for the three questions will only be developed under Question 6.2.

**Question 5.3: Do you intend to use the system in future?**

Fifty-three (53) participants intend to use the system in future, as displayed in Table 4.24.

*Table 4.24: Use system in future*

<b>Make use of the system in future</b>	<b>Frequency</b>	<b>Percent</b>
No	6	10.2%
Yes	53	89.8%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants expressed an eagerness to use the system in future:

*“Reading on e-learning was a good experience for me because it is much better than paging through books which wastes time. Digital reading is the way to go” P33*

*“I intend to use it more in the future as I am positive that it will teach me a lot and broaden my knowledge and give me a whole new outlook on indigenous medicinal plants” P49*

The participants indicated that they intended to use the system in future to learn about any new plants that might have been added and to check up on information that they might have forgotten:

*“Whenever am travelling in the wild, I will need to read through just in case anything happens” P16*

*“To learn more on other plants maybe still to be added on the system and refer to it whenever I am sick” P20*

*“Yes, I foresee that there might be improvements in the system in terms of forth bringing the information as well as additional information” P27*

*“Hopefully, it will contain more information and richer interactive content” P39*

*“Just in case I forget the information that I have learned so far that is on the system”  
P43*

*“Because there might be new discoveries and I would like to be informed about them” P50*

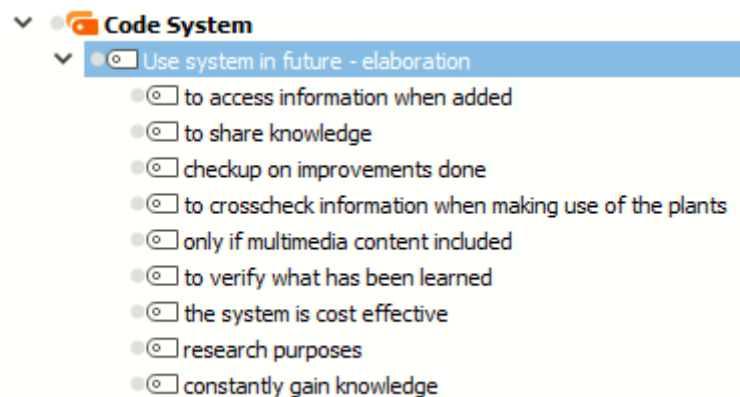
*“I can't recall everything that I have read, so I will have to use it in the future or in case of emergency” P56*

The participants also indicated that they intend to use the system in future as it offers easy access and is cost-effective:

*“It cuts costs as there is no need to print out or make copies and buy books” P31*

*“Because this system is cheap, and it offers a very fast and convenient way to access information” P58*

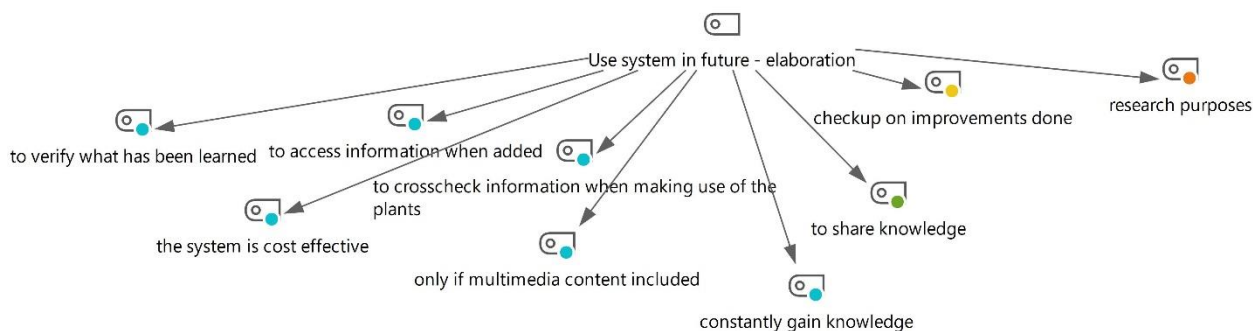
Nine codes were generated from the participants' responses, as displayed in Figure 4.26.



**Figure 4.26: Use system in future codes**

Four categories were generated from the codes, as shown in Figure 4.27:

- To access information when needed (for example, information verification and to assess level of knowledge retention)
- To share knowledge on the system
- To check up on improvements made to the system (for example, the inclusion of multimedia content)
- For research purposes



**Figure 4.27: Categorisation of codes from Questionnaire 2: Section 5, Question 5.3**

### **Questionnaire 2: Section 6 - Additional Comments**

Section 6 was on the participants' overall perception of the prototype e-learning system and any other additional comments that they had. Section 6 was made up of two questions.

#### **Question 6.1: Would you like to add or remove anything from the e-learning system to make it more useful?**

Forty-two (42) participants indicated that they would like to make some changes to the system, as shown in Table 4.25.

**Table 4.25: Add or remove anything from system**

<b>Add or remove anything from the e-learning system</b>	<b>Frequency</b>	<b>Percent</b>
No	17	28.8%
Yes	42	71.2%
<b>TOTAL</b>	<b>59</b>	<b>100%</b>

The participants did not indicate anything that they would like to be removed, but they did indicate certain things to be added to the prototype e-learning system.

The participants indicated that they would have preferred to see information on the places where the plants can be found:

*“It would be very nice to add the specific locations of where the plants can be found, in case anybody wants to use it or see it. Also include if the plant can be dangerous in any way, for example, some plants roots can be used but the fruits it bears cannot be used at all” P9*

*“Medicinal plants must be classified according to their location and it must show whether it's the plant's fruits, seeds, leaves or roots that can be used to heal the illnesses for people to know how to use it” P15*

*“Add the location (where you can find the plants). Which ones are mostly used? Provide statistics on the productivity and improvement in health from usage of the plants” P26*

*“I would emphasise that more information about the location and how they are used for medicinal use is added so that it can be easily used without endangering that specific plant species” P41*

Functionality that allows for searching and interactivity was also indicated to be of importance:

*“Categories on the types of diseases that plants can cure could do. I want to use the system to search for a plant to cure a certain disease, to search by diseases and not by plants would make it easy” P6*

*“Add a help forum. Add a search tab. Add a discussion forum” P7*

*“Provide an option where we can ask questions about certain plants” P13*

*“Add a search function where one can type in the medical problem, e.g. 'cough' and all the plants that can cure cough will display. Also, add which part of Namibia each plant can be found” P19*

*“I would strongly advice that add a forum where users can easily interact with each other” P25*

*“Add a forum on the system. Add a chat room on the system. Add a self-administered test yourself questions on the system. Add a calendar on the system to show us upcoming events” P31*

*“I would add a Q&A section where the user of the e-learning system could ask questions about the plants as the site does not really give a lot of information such as where the plants are found” P35*

*“Add a search bar to find information faster. Add a map to show the specific location of each plant. Add more details on how to use the plants or prepare them if you want to use them for treatment, perhaps even make videos” P46*



*“Adding a search button, for example, if one wants to search what can treat stomach-ache a lot of options have to come up. Secondly, I would also like to add on the instructions of how each plant is prepared for a certain treatment. Thirdly, adding the side effects of each and every plant must be made applicable for users” P49*

*“Having discussion forums to allow different people to upload or contribute what they know and teach the young generations. Have videos of elders preparing and explaining the different plants that are useful in curing different problems” P59*

Multimedia content would be preferred over text and images:

*“To add videos demonstrating how to use these plants. To add information on how to care for the indigenous medicinal plants for future use and to teach people how to plant them. What are their side effects, who can use which type of plant and when to use it, for example, can I use Thurnberg's Amaranthus if I am pregnant, will my foetus be safe?” P10*

*“Videos would definitely make things more interesting. Demonstrations on how the plants are used (the whole process) would also be a bonus” P27*

*“The name of each plant was in a good font size, making it clear. I do however think that if there was a voice note that could pronounce each name, that would be helpful” P36*

*“If possible, I would like there to be added step by step videos on how medicinal plants are used starting from their roots, their discovery and all the way down to how some of them are processed into certain pills and medication that is sold in shops” P51*

Including comprehensive information on each plant was also indicated. The participants expressed that more information should be added on all the parts of a plant that are used for medicinal purposes, as well as detailed information on preparation methods:

*“I will add more information on some of the indigenous medicinal plants by putting more pictures and modifying them well” P11*

*“The e-learning system was very engaging but adding local names of plants and methods of preparation will make it even more fun” P18*

*“The information was very limited and was only about what sickness they treat. I would have liked to have more information on how to prepare the medicine” P23*

*“While going through the information, I did more research about a plant because it was not on the e-learning platform and I wouldn't want anyone to go through the same difficulties” P45*

*“I would like to add some few things on quality control of the system, so it runs under most adverse circumstances. Add video programs so the audience have time to get the information” P48*

Integrating local languages into the system was also indicated as something to be added:

*“Remove scientific names or combine them with local names. Include more accurate pictures” P3*

*“It would be best if the scientific names could be complemented by indigenous names of the plants to aid with identification and verification of accuracy” P16*

*“I would have added native language translations to the system” P22*

*“Add local names of indigenous plants. Explain in more detail about the indigenous plants” P50*

Information on issues of conservation, the legality of using the plants, and accessibility for the disabled was indicated to be of importance to the system:

*“It should be mentioned on the e-learning system whether the plant is endangered or protected to bring awareness” P8*

*“What is provided is useful, but things should be added such as how medicine is prepared, whether it's legal to use them, the danger of their extinction and the locations where the plants are found” P29*

*“Although the plants are useful to many as traditional medicine, I believe it is wise to preserve them to prevent extinction” P37*

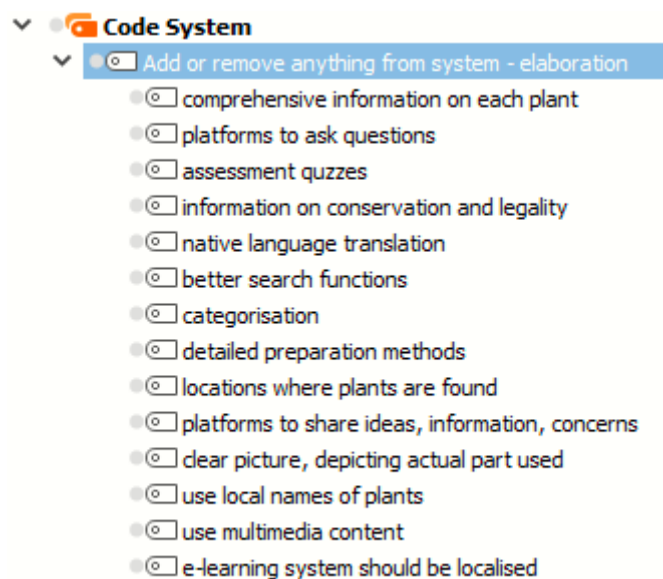
According to Chinsebu (2015), medicinal plants need to be protected against depletion and from being patented by pharmaceutical companies.

Functionality to enable the participants to add or modify the content was also indicated as something to be added:

*“If I believe certain information on certain plants is incorrect, I would like to be able to correct it. Also, if I want to add a certain plant that is not on the system, I would love to be able to do that, especially if the plant is from my culture and I have experience with it” P32*

*“I'd like to be able to add additional information that is left out on this system, such as the different parts of the plants that are used and how these parts are used” P53*

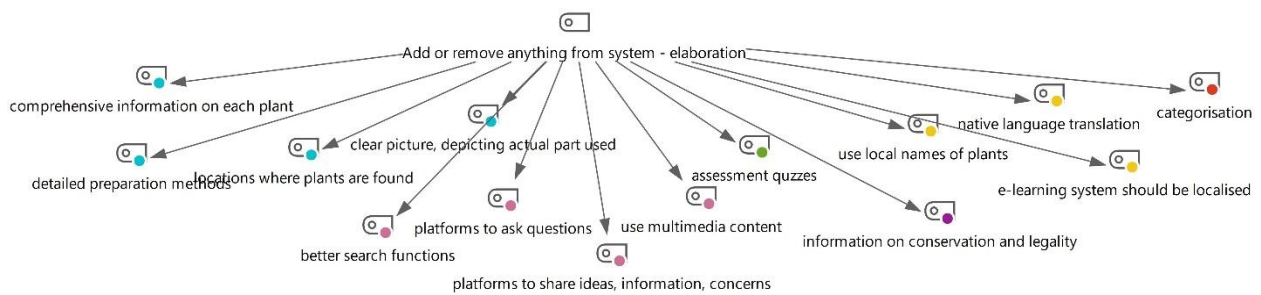
Fourteen codes were generated from the participants' responses, as displayed in Figure 4.28.



**Figure 4.28: Add or remove anything from system codes**

Six categories were generated from the codes, as displayed in Figure 4.29:

- Comprehensive information on each plant on the system (for example, the inclusion of preparation methods and areas where the plants are found)
- Assessment platforms such as quizzes
- Interactivity on the system (platforms to share ideas, search capabilities and multimedia content)
- Information on conservation and legality
- Use of local indigenous languages on the system
- Categorisation of plants



**Figure 4.29: Categorisation of codes from Questionnaire 2: Section 6, Question 6.1**

**Question 6.2: Please provide any comments on your overall experience with engaging with the e-learning system on indigenous medicinal plants?**

The participants expressed having had an overall satisfactory experience with working through the content on the prototype e-learning system. They noted that they learnt a lot from engaging with the system:

*“People should use e-learning system to study more about the indigenous medicinal plants because sometimes we go to hospitals while we could have treated some of the minor illnesses using this type of medicinal plants” P1*

*“The e-learning system was very helpful, and I would exactly read it again every day, so I do not forget what I have learned. I will educate and recommend it to my fellow classmates. Am sure my mother will also enjoy reading about indigenous plants” P9*

*“Some pictures are very interesting and clear. The system is a first of its kind. It was easy to navigate. The content was well organised” P12*

*“It was educative and insightful. It is very helpful, especially to people in rural areas” P17*

*“I like this because it is out of the ordinary, providing information about things we use or see but know nothing about” P24*

*“I gained more knowledge on indigenous medicinal plants from using the e-learning system, how the plants are used and how they solve our daily problems in life” P35*

*“I learned a lot which I also want to share with others who don't have access to the system” P59*

The participants expressed that the system was too westernised:

*“Looks a step in the right direction but too western targeted very much to the scientific community than local knowledge experts such as traditional leaders, healers, elders, etc.” P4*

*“It is important to have the local names of the plants, methods of preparation as well as demos on how to use these plants” P28*

The issue of a lack of multimedia content on the system was raised again, with the participants indicating that they would have preferred the content to be diversified:

*“I was a little bit disappointed with the navigation format, but the information was clear and very educative, and would recommend personalised pages in the future. Just to make it standard and attractive, because that's the part I felt was missing when using the system” P52*

*“I would like for there to be variety in the delivery of the information” P26*

The participants indicated that there was a need for the information presented on the system to be evaluated and validated by the custodians of the knowledge:

*“Include information on whether the plant can be dangerous in any way, for example, some plants' roots can be used but the fruits it bears cannot be used at all” P5*

*“Whatever is presented on the e-learning system should be extensively validated and verified for accuracy” P10*

*“Indigenous communities must be involved in the process of putting the knowledge on the e-learning system. Misrepresentation should be avoided” P19*

*“I would like to know if it is illegal to use these plants and whether some of them are endangered” P23*

*“The information that will be shared should be tried and tested. Not all plants are for medicinal purposes” P29*

*“Could some plants have possible side effects in pregnant women” P49*

Indigenous medicine has not been validated, which creates a challenge in putting its use into the public domain (Chinsebu, 2015).

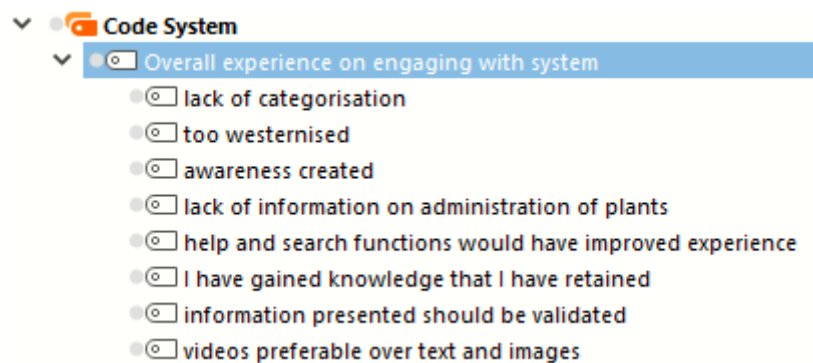
Some participants felt that efforts to preserve indigenous knowledge on medicinal plants should be explored on other digital platforms, and accessibility to the information should be inclusive to all:

*“The preservation should not be limited to the e-learning system but to more online platforms such as websites, e-books, etc.” P30*

*“Consider a way to make the system accessible to people with disabilities” P41*

*“Not everyone has come across these indigenous medicinal plants, so it sounds better if we promote a campaign. We need to give a chance for these older who know the plants well and have experience, to present them on TV's and at health centres” P46*

The responses to Question 6.2 were similar to the ones provided for Questions 4.1 and 5.2. Question 4.1 was on whether the participants were satisfied with the prototype e-learning system while Question 5.2 was on whether the participants found it to be a positive experience engaging with the prototype e-learning system. The same codes were assigned to the three questions, and eight codes were generated from the responses, as displayed in Figure 4.30.

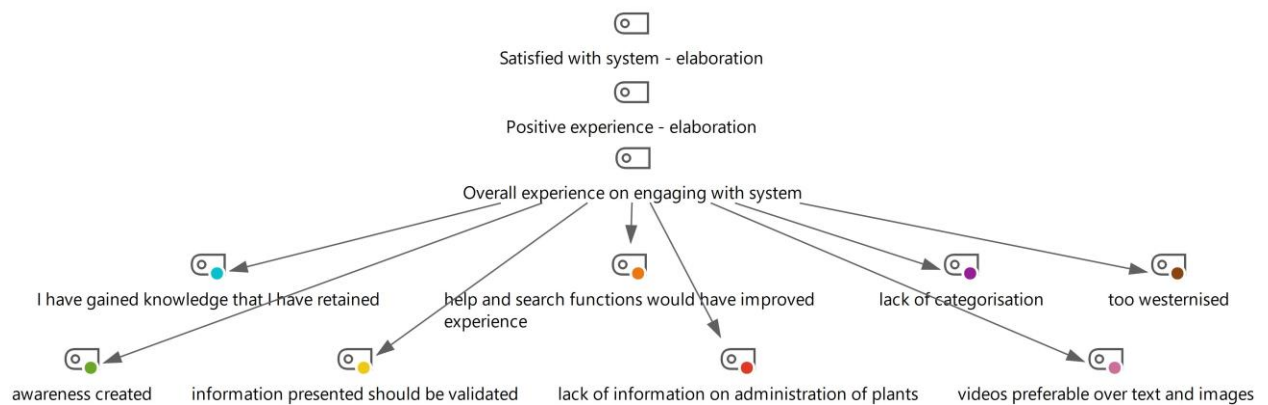


**Figure 4.30: Overall experience codes**

Eight categories were generated from the codes, as displayed in Figure 4.31:

- Knowledge was gained
- System raises awareness on indigenous medicinal plants
- Validation of information required
- Lack of help and search functions
- Lack of comprehensive information on the plants

- Videos preferred
- Lack of categorisation
- System too westernised



**Figure 4.31: Categorisation of codes from Questionnaire 2: Questions 4.1, 5.2 and 6.2**

### **Conclusions from Questionnaire 2**

The participants expressed high satisfaction with the prototype e-learning system; 72.9% indicated that they were satisfied. They indicated that working through the presented content resulted in them gaining new knowledge and also expanding their existing knowledge on indigenous medicinal plants. However, they indicated that navigation, search and help functions were not easily accessible, which hampered their experience with the system.

Information on indigenous medicinal plants was presented using images and text. The participants indicated that the images and text were useful, but videos and other multimedia content would have been preferable. They also indicated that the system should cater to local communities by integrating indigenous languages. The content on the system would also need to be evaluated, which is in line with the evaluation phase in the Tripartite Digitisation Model (TDM) by Rodil and Rehm (2015).

An e-learning system for indigenous knowledge on medicinal plants was perceived by the participants to be useful to everyone that has an interest in learning about the plants, such as people in the academic environment and people from the local communities where the plants are found. The participants expressed an eagerness to continue learning about the plants, as 89.8% indicated that they have intentions of using the system in future.

The following additions were suggested to be included on the system:

- Information on the location of where the plants are found
- Functionality for searching, categorisation and interaction
- Multimedia content
- Comprehensive information on the plants
- Integration of local indigenous languages
- Information on legal issues regarding the plants and their conservation
- Ability for users of the system to be able to contribute their knowledge on indigenous medicinal plants

In the next section, the discussion will be on the themes that were generated from the categories that were developed from the responses to both Questionnaire 1 and 2.

### **4.3.3 Phase 3 - 5: Identification of themes**

The categories generated in Section 4.3.2 were organised and developed into themes. Table 4.26 displays the codes that were generated from the responses to the first questionnaire (Questionnaire 1).



**Table 4.26: Categories generated from Questionnaire 1**

<b>Questionnaire1 Section 2 - Indigenous Knowledge Information</b>	<b>Categories generated</b>
	<b><i>Predominant methods used to preserve indigenous knowledge of medicinal plants</i></b>
	<ul style="list-style-type: none"> <li>• Elders</li> <li>• Printed books</li> <li>• Watching videos (local television documentaries)</li> </ul>
	<b><i>Effectiveness of treatment</i></b>
	<ul style="list-style-type: none"> <li>• Instructions for administering medicinal plants</li> <li>• Information sharing by elders</li> </ul>
	<b><i>Need for assessing what has been learned</i></b>
<ul style="list-style-type: none"> <li>• Assess level of knowledge retention</li> <li>• Preservation of the knowledge</li> <li>• Boost current level of knowledge</li> <li>• Build confidence in passing on the knowledge to others</li> </ul>	
<b><i>Usefulness of e-learning in the preservation of indigenous knowledge on medicinal plants</i></b>	
<ul style="list-style-type: none"> <li>• E-learning features and advantages (different learning activities, sharing of ideas, self-paced learning, anytime learning, centralising information, cost-effective, quicker updating of information)</li> <li>• E-learning can create awareness of indigenous medicinal plants</li> <li>• E-learning will allow for preservation of knowledge</li> <li>• E-learning allows for easier access to and availability of information</li> </ul>	
<b><i>Additional comments from Questionnaire 1</i></b>	
<ul style="list-style-type: none"> <li>• Create awareness of conservation</li> <li>• E-learning allows for sharing of ideas</li> <li>• Community involvement is vital</li> <li>• Increased usage and accessibility of digital platforms</li> </ul>	

Similar codes were grouped to form the themes from Questionnaire 1 as displayed by Table 4.27.

**Table 4.27: Themes from Questionnaire 1**

Theme	Categories
A lack of digital tools for preserving indigenous knowledge of medicinal plants	<ul style="list-style-type: none"> <li>• Elders</li> <li>• Printed books</li> <li>• Watching videos (local television documentaries)</li> </ul>
Assessments contribute to knowledge retention	<ul style="list-style-type: none"> <li>• Assess level of knowledge retention</li> <li>• Preservation of the knowledge</li> <li>• Boost current level of knowledge</li> <li>• Build confidence in passing on the knowledge to others</li> </ul>
Perceived advantages of using e-learning in the preservation of indigenous knowledge on medicinal plants	<ul style="list-style-type: none"> <li>• E-learning features and advantages (different learning activities, sharing of ideas, self-paced learning, anytime learning, centralising information, cost-effective, quicker updating of information)</li> <li>• E-learning can create awareness of indigenous medicinal plants for preservation</li> <li>• Create awareness of conservation</li> <li>• E-learning will allow for preservation of knowledge</li> <li>• Community involvement is vital</li> <li>• Increased usage and accessibility of digital platforms</li> </ul>

Questionnaire 2 comprised six sections. Table 4.28 displays the categories that were generated from the responses provided for those sections.

**Table 4.28: Categories generated from Questionnaire 2**

<b>Questionnaire 2 Sections</b>	<b>Codes generated</b>
Section 1 – System Quality	<p><b><i>Navigation, search and help functions</i></b></p> <ul style="list-style-type: none"> <li>• Ease of navigation influenced by prior experience and availability of instructions</li> <li>• Multimedia content preferable</li> <li>• Navigation, help and search functions not easily accessible</li> </ul>
Section 2 – Information Quality	<p><b><i>Contribution of the material on the system</i></b></p> <ul style="list-style-type: none"> <li>• Attainment of knowledge</li> </ul>
	<p><b><i>Effectiveness of presentation</i></b></p> <ul style="list-style-type: none"> <li>• Lack of categorisation</li> <li>• Table of contents was effective</li> </ul>
Section 3 – Use	<p><b><i>Effectiveness of images and text</i></b></p> <ul style="list-style-type: none"> <li>• Text and images not comprehensive</li> <li>• Use of simple terms and local indigenous languages</li> <li>• Images contributed to knowledge</li> </ul>
Section 4 – User Satisfaction	<p><b><i>Recommend to others</i></b></p> <ul style="list-style-type: none"> <li>• Recommend system due to easy access</li> <li>• Recommend for suggestions on improvement</li> <li>• Create awareness for preservation</li> </ul>

Questionnaire 2 Sections	Codes generated
	<p data-bbox="808 209 1240 236"><b><i>Who system will be of value to</i></b></p> <ul data-bbox="837 256 1435 580" style="list-style-type: none"> <li data-bbox="837 256 987 284">• Farmers</li> <li data-bbox="837 304 999 331">• Campers</li> <li data-bbox="837 352 1144 379">• Low-income earners</li> <li data-bbox="837 400 1435 427">• People in the education and health sectors</li> <li data-bbox="837 448 1122 475">• Local communities</li> <li data-bbox="837 496 1200 523">• Computer literate people</li> <li data-bbox="837 544 1182 571">• Other interested people</li> </ul>
Section 5 – Net Benefits	<p data-bbox="808 596 1178 624"><b><i>Encouraged to learn more</i></b></p> <ul data-bbox="837 644 1921 772" style="list-style-type: none"> <li data-bbox="837 644 1895 671">• Provide information on the preparation methods of indigenous medicinal plants</li> <li data-bbox="837 692 1921 719">• Ensure the evaluation of information on the system by the knowledge custodians</li> <li data-bbox="837 740 1697 767">• Comprehensive information should be presented on the system</li> </ul> <p data-bbox="808 788 1375 815"><b><i>Intention to use the system in the future</i></b></p> <ul data-bbox="837 836 1921 1075" style="list-style-type: none"> <li data-bbox="837 836 1921 900">• To access information when needed (for example, information verification and to assess level of knowledge retention)</li> <li data-bbox="837 920 1581 948">• To share their (participants') knowledge on the system</li> <li data-bbox="837 968 1921 1032">• To check up on improvements made to the system (for example, the inclusion of multimedia content)</li> <li data-bbox="837 1053 1173 1080">• For research purposes</li> </ul>

Questionnaire 2 Sections	Codes generated
Section 6 – Additional Comments	<p><b><i>Things to add and remove from the system</i></b></p> <ul style="list-style-type: none"> <li>• Comprehensive information on each plant on the system (for example, the inclusion of preparation methods and areas where the plants are found)</li> <li>• Assessment platforms such as quizzes</li> <li>• Interactivity on the system (platforms to share ideas, search capabilities and multimedia content)</li> <li>• Information on conservation and legality</li> <li>• Use of local indigenous languages on the system</li> <li>• Categorisation of plants</li> </ul>
	<p><b><i>Any comments on overall experience</i></b></p> <ul style="list-style-type: none"> <li>• Knowledge was gained</li> <li>• System raises awareness on indigenous medicinal plants</li> <li>• Validation of information required</li> <li>• Lack of help and search functions</li> <li>• Lack of comprehensive information on the plants</li> <li>• Videos preferred</li> <li>• Lack of categorisation</li> <li>• System too westernised</li> </ul>

Table 4.29 displays the themes that were generated from the categories displayed in Table 4.28.

**Table 4.29: Themes from Questionnaire 2**

Theme	Categories
Search and categorisation capabilities crucial for knowledge retention and preservation	<ul style="list-style-type: none"> <li>• Ease of navigation influenced by prior experience and availability of instructions</li> <li>• Accessibility of navigation, help and search functions</li> <li>• Categorisation of plants</li> </ul>
Multimedia content and interactivity may impact the usage of the system	<ul style="list-style-type: none"> <li>• Multimedia content preferable</li> <li>• Table of contents was effective</li> <li>• To share their (participants') knowledge on the system</li> <li>• Assessment platforms such as quizzes</li> <li>• Interactivity on the system (platforms to share ideas, search capabilities and multimedia content)</li> </ul>
Continuity of the system	<ul style="list-style-type: none"> <li>• System recommended</li> <li>• Potential users (farmers, campers, low-income earners, people in the education and health sectors, local communities, computer literate people, researchers and other interested people)</li> <li>• To access information when needed (for example - information verification and assess level of knowledge retention)</li> <li>• To check up on improvements made to the system (for example, the inclusion of multimedia content)</li> </ul>

Theme	Categories
Localisation and evaluation of content by knowledge custodians	<ul style="list-style-type: none"> <li>• Use of local indigenous languages on the system</li> <li>• Ensure the evaluation and validation of information on the system by the custodians of indigenous knowledge on Namibia's medicinal plants</li> </ul>
A need for comprehensive information	<ul style="list-style-type: none"> <li>• Comprehensive information on each plant should be presented on the system (for example, the inclusion of preparation methods and areas where the plants are found)</li> <li>• Information on conservation and legality</li> </ul>

The development of the themes was guided by RO2 and RO3, which are:

- To identify and determine the current information technology tools being used to preserve indigenous knowledge of medicinal plants. (RO2). The survey focused specifically on participants' knowledge regarding current information technology tools being used to preserve the indigenous knowledge of Namibia's medicinal plants.
- To determine the requirements that should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants. (RO3).

The themes will be discussed in the next section.

#### 4.3.4 Phase 6: Writing up and producing the report

The final phase, Phase 6, was concerned with writing up the data; from discussing the participants from whom the data was collected, to how the data was organised and coded for analysis; and what themes were generated from the findings. The discussion of the participants was the focus of Section 4.2, while the organisation of the data and coding were the focus of Sections 4.3.1 and 4.3.2. The themes that were generated from the findings were presented in Section 4.3.3. The discussion in the current section will be focused on writing up the findings of the data by relating the themes to the research questions of the study.

##### 4.3.4.1 Themes from Questionnaire 1

Three themes were generated from the responses to the questions in Section 2 of the first questionnaire.

The themes were developed to achieve RO2 of the study.

#### **Theme 1 – A lack of digital tools for preserving indigenous knowledge of medicinal plants**

Indigenous knowledge of Namibia's medicinal plants has been passed on using different methods. Three predominant methods were indicated, which are:

- elders passing down their indigenous knowledge
- indigenous knowledge gained from reading printed books
- watching videos (documentaries on the local television channels)



Elders pass on preparation methods to younger generations by treating them with the indigenous plants and showing them which part of the plant to use and how to prepare that part for medicating. Most of the elders in local communities are the custodians of the indigenous knowledge of that community (Grandinetti, 2014; Mawere & Mwanaka, 2015).

Printed books on indigenous medicinal plants are very rare, and the books are mostly housed in local primary and high school libraries (Chinsembu, Cheikhyoussef et al., 2015). Some of the books are only available in the native language of the community in which they are found.

Local television channels occasionally broadcast documentaries about the different communities, showing how they make use of indigenous medicinal plants to treat minor illnesses. These documentaries show how people harvest these plants and prepare them for administering. According to Dlamini (2017), television reaches populations without or with limited access to the internet.

The methods that have been used pose a lot of challenges, as most of them have time and place constraints. Most elders remain in the rural areas, with knowledge they are no longer able to share, as the younger people move to urban areas (Pirker, Haselmair, Kuhn, Schunko, & Vogl, 2012; Vandebroek & Balick, 2012). The elders in the urban areas are also not effectively sharing their knowledge of indigenous medicinal plants, as the plants are mostly found in the rural areas of the country and they find it hard to pass on the knowledge if they cannot show younger people the plants and take them through the preparation methods.

Printed books on indigenous medicinal plants are very hard to find, and they are place-bound, with some people being unable to access the places in which they are housed, such as local rural community school libraries.

Television documentaries are screened randomly on different days and times, and the people who might want to watch them might not be in front of a television when they are being screened.

## **Theme 2 – Assessments contribute to knowledge retention**

In Moodle, quizzes can be created to assess whether the knowledge obtained from the e-learning system is being retained. Quizzes help people determine whether they have learned from the content on the e-learning system, and what they still need to learn.

### **Theme 3 – Perceived advantages of using e-learning in the preservation of indigenous knowledge on medicinal plants**

E-learning allows information to be accessed from a central point. The platform is cost-effective and is available at any time from any location. Different learning activities are available on e-learning systems, allowing participants to learn at their own pace.

#### **4.3.4.2 Themes from Questionnaire 2**

Five themes were generated from the responses to Questionnaire 2.

The themes were developed to achieve RO3 of the study.

### **Theme 1 – Search and categorisation capabilities crucial for knowledge retention and preservation**

Help, search and navigation facilities have been identified to be of importance to an e-learning system. Search capabilities allow for searches to be done based on illnesses and symptoms. Content should be structured in a way that allows it to be searched by users for the information they require (Rodil & Rehm, 2015). Help facilities can allow users to make enquiries on the system of e-learning which they might be struggling with.

Knowing the location where the plants are found increases interest in the system, as the participants are eager to locate the plants. Google Maps can be embedded into the Moodle e-learning system (Torsani, 2016), which may help people to know where in the country the different indigenous medicinal plants are located.

### **Theme 2 – Multimedia content and interactivity may impact the usage of the system**

Interactive multimedia content and games would enhance the quality of the information on the e-learning system. After e-learning, videos emerged as the second most preferred means by which the participants wanted to learn about indigenous medicinal plants. Videos allow users to both hear and see what is taking place when an indigenous medicinal plant is being prepared. Videos can be integrated into social media, blogs, e-learning and learning-based games, making them popular with users. According to Dlamini (2017), videos are already used in capturing indigenous knowledge. E-learning systems comprise a combination of text, video and graphics for content delivery (Ramírez-Correa, Rondan-Cataluña, Arenas-Gaitán, & Alfaro-Perez, 2017). Videos are a great means of transferring and preserving knowledge on indigenous medicinal plants, as they allow people to better engage with the content and retain the information for future purposes.

The sharing and exchanging of ideas on indigenous medicinal plants was highly encouraged, as the participants wanted to share what they know and hear some ideas from others. Sharing and exchanging ideas on e-learning platforms allow users to gain new knowledge and preserve it for future use (Abel, 2015; Pattnayak & Pattnaik, 2016). E-learning allows for collaboration and exchanging of information, as well as interactivity (Wu, Lin, Wen, Perng, & Hsu, 2016).

The chat rooms and discussion forum facilities available on e-learning systems allow people to learn from each other and share ideas on their experiences with indigenous medicinal plants. Having these facilities will also help with enhancing the level of retention of the knowledge obtained from the e-learning system. Popular plants, testimonies of using the plants, and negative experiences with using the plants could also be highlighted on the discussion forums. Although an e-learning system is not intended to be facilitator-driven, chat facilities do enable users to engage with knowledgeable people when they have queries.

### **Theme 3 – Continuity of the system**

The system will require regular updates, as highlighted by the participants. Periodic updating of information should be made to the system and the knowledge custodians should be involved in validating the information that has been updated.

### **Theme 4 – Localisation and evaluation of content by knowledge custodians**

Localisation of the system is of great importance. The use of scientific names and common English names on an e-learning system intended to preserve knowledge on indigenous medicinal plants makes learning harder, as some local users might not be familiar with the names and might lose interest in the system. According to Hikwa and Maisiri (2017), the preservation of indigenous knowledge might be compromised if local languages are not considered. The common English and scientific names will, however, be important for other users, such as global researchers. Native-language support is highly useful. This feature will enhance local users' experience and increase the success of the e-learning system. Ensuring native-language support can help people remember a plant if they only know it in their native language. The names of the plants should be available in both English and all the local languages in the country. This will also require translators from all the local languages to provide the local names and also to translate the uses of the plants to the native languages.

For the validity of the information presented on the e-learning system, it is recommended for the system to be co-designed with the indigenous communities. The custodians of indigenous knowledge on medicinal plants will be instrumental in creating and evaluating the content that is added to the e-learning system. People in the local communities should be included in the design and development of technological tools that involve the preservation of their indigenous knowledge (Tharakan, 2015). The preparation methods and parts of the indigenous medicinal plants to be used were not included on the e-learning system in this study, as there is a lack of information on this in the public domain. Being passed on by elders was indicated as the predominant method of preserving indigenous knowledge. It will be useful to engage with elders and others that are knowledgeable on the plants and their methods of preparation. Videos and step-by-step narrations of the procedures, from collecting the part of the plant and preparing it to its administration, can be captured and included as content on the e-learning system. Translators are needed for this exercise, as not all knowledge custodians of indigenous knowledge on medicinal plants are proficient in English. Clear close-up images of the plants should also be captured and provided on the system.

#### **Theme 5 – A need for comprehensive information**

Comprehensive information should be provided on the system. On the prototype system, preparation methods were not included, and the participants indicated how this impacted the satisfaction they got from working through the content on the system. Information regarding whether plants are endangered, their possible side-effects and what legal requirements need to be met to use some of them should also be provided.

### **4.4 Model to guide the design of an e-learning system to facilitate the digital preservation of indigenous knowledge of Namibia's medicinal plants**

In Chapter 3 (Section 3.8), a conceptual theoretical model for the preservation of indigenous knowledge was developed. This conceptual theoretical model was then extended using the requirements that were identified in the survey, as will now be shown. The extension of the conceptual theoretical model resulted in a model for preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. The extended model is presented in Figure 4.32.

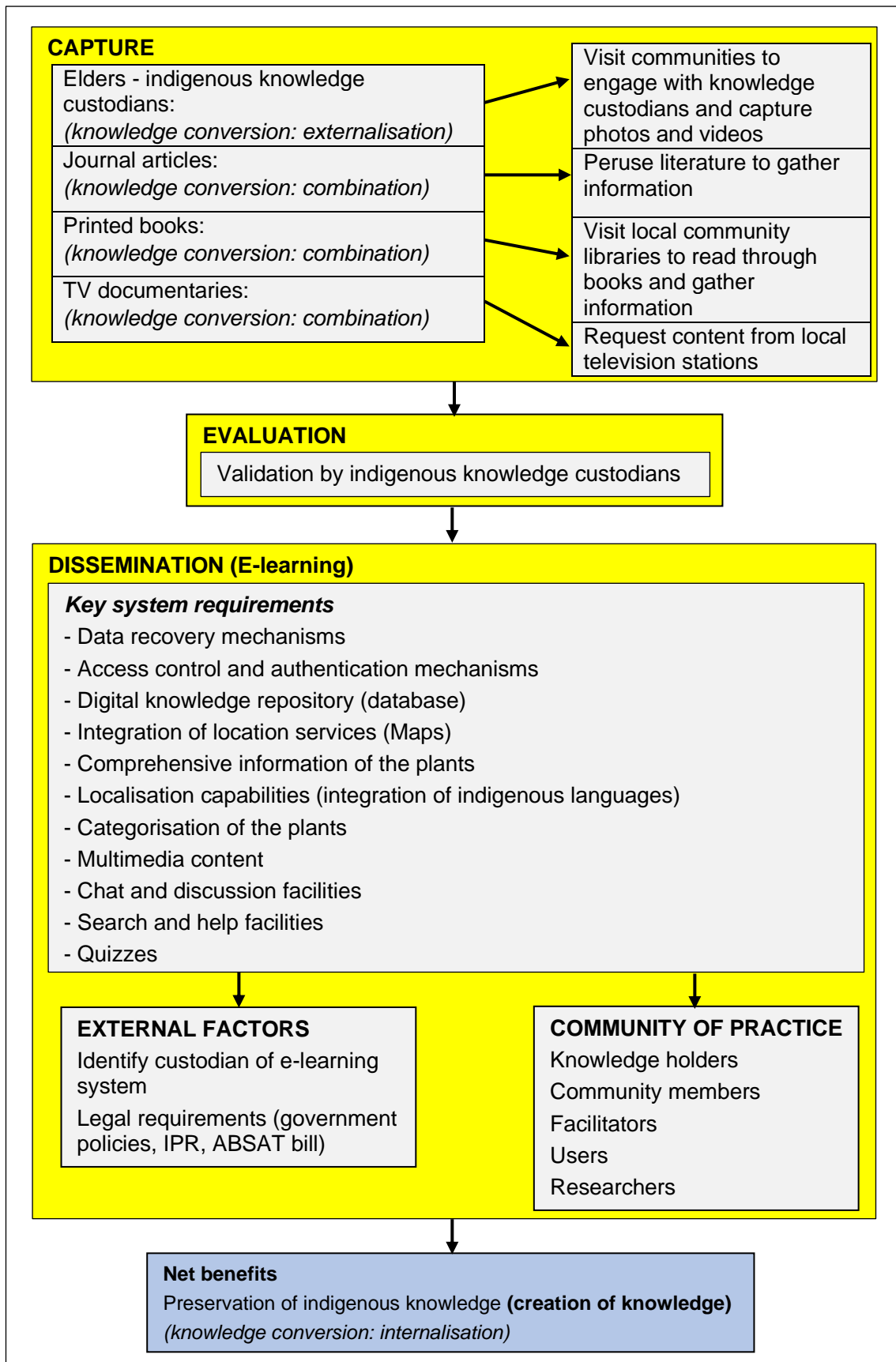


Figure 4.32: A model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning

As discussed in Chapter 3 (Section 3.8), the conceptual theoretical model for the digital preservation of indigenous knowledge comprised five components; capture, evaluation, dissemination, external factors and a community of practice.

Based on the survey data, the capture and dissemination components were updated.

Under the capture component:

- Two additional sources for capturing data were added. The participants indicated that they had obtained indigenous knowledge of medicinal plants from elders, from printed books found in local libraries and from watching television documentaries. Printed books and television documentaries were added to the capture methods.

Under the dissemination component:

- Participants stated that knowing the location where the medicinal plants are found would help them locate the plants and make use of them when necessary. Thus, a requirement called integration of location services was added to the component.
- A requirement for presenting comprehensive information on indigenous medicinal plants was added. The participants expressed a need to have comprehensive information about each plant, such as on harvesting and preparing the plants into medicinal preparations. Users should not feel the need to consult other sources due to information not being available on the e-learning system.
- The use of English and scientific names hindered the participants from learning; it is thus important to complement the English language with the local native languages. A requirement called Localisation capabilities (integration of indigenous languages) was included.
- Some form of categorisation was required to aid in searching for information about specific plants; categorisation could be by illnesses treated, or by the locations where the plants are found.
- Multimedia content would enhance knowledge preservation as the content would be more engaging. For example, videos demonstrating how the plants are prepared and administered for treatment would be important for knowledge retention and preservation.
- Sharing ideas between the users of the system would enhance their knowledge and they would gain additional knowledge that is not presented in the system's content. Chat and discussion facilities on the e-learning system would make interaction among the users possible.

- A requirement for search and help facilities was included, as it was found from the survey data that it was important to be able to search for information in the e-learning system's data repository. It was also important to have help facilities to guide with their use of the system and any other enquiries they might have.
- The participants expressed a need to be evaluated on what they learn from the e-learning system. Quizzes could assist in evaluating whether the knowledge obtained is being retained by the users of the system.

In line with the requirements from the literature, the participants also expressed that the information presented on the e-learning system would need to be validated by knowledge custodians before it is made available for public consumption.

Table 4.30 provides a summary of the requirements that were identified from both the literature review and the survey.

**Table 4.30: Summary of the requirements identified for the model for preserving indigenous knowledge of Namibia's medicinal plants via e-learning**

<b>Requirement to include</b>	<b>Identified from the literature</b>	<b>Identified from the survey</b>	<b>Type of knowledge</b>	<b>Knowledge transformation process</b>
Methods and tools to capture indigenous knowledge	✓ - Elders - Journal Articles	✓ - Elders - Printed books - Television documentaries	Explicit knowledge	- Socialisation - Externalisation - Combination - Internalisation
Tools to disseminate the data (E-learning key system requirements)	✓ - Digital knowledge repository (database) - Data recovery mechanisms - Access control and authentication mechanisms	✓ - Digital knowledge repository (database) - Integration of location services (Maps) - Comprehensive information of the plants - Localisation capabilities (integration of indigenous languages) - Categorisation of the plants - Multimedia content - Chat and discussion facilities - Search and help facilities - Quizzes	Explicit knowledge	- Externalisation - Combination - Internalisation
Co-designing with and validation by indigenous communities	✓	✓	Tacit knowledge	- Socialisation - Externalisation
Legal requirements	✓	✓		
Identification of stakeholders	✓	✗		
Community of practice	✓	✗		



In Table 4.30, the ticks represent requirements that were found from the specific data collection tool, either from the literature review or from the survey data. A cross indicates that a requirement was found in the literature review but did not form part of the data collected from the survey. The requirements that were only found in the literature review formed part of the conceptual theoretical model and were thus included in the final model as they form an integral part of the requirements identified.

## **4.5 Contribution of Chapter 4 to research questions**

This chapter contributed to providing answers to RQ2 and RQ3 of the study. This contribution will be discussed in Sections 4.5.1 to 4.5.2.

### **4.5.1 RQ2: What information technology tools are currently used to preserve indigenous knowledge of medicinal plants?**

From the survey, it was found that there is a lack of information technology tools that are aimed at preserving indigenous knowledge of the country's medicinal plants. The survey only revealed the methods and tools used by the participants of the study. The current methods and tools used in Namibia are: knowledge passed on by elders, printed books, and documentaries that are screened on television.

The predominant method of preservation is through oral communication by the elders who are the custodians of the knowledge. Of the methods and tools that were indicated, only the television can be considered as an information technology tool. The current preservation tools are very difficult to access and provide a lot of barriers such as space and time. People need to be at a certain place and at a certain time in order for them to be able to learn from these tools, which are thus not very effective at ensuring the preservation of indigenous knowledge on medicinal plants.

### **4.5.2 RQ3: What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants?**

In the survey, it was found that the following requirements are important when using e-learning in the preservation of indigenous knowledge on medicinal plants:

- Involving the knowledge custodians in capturing and presenting their knowledge
- Allowing the knowledge custodians to evaluate and validate the knowledge that is presented on the e-learning system

- Providing information on the location of the indigenous medicinal plants
- Providing comprehensive information about the plants to avoid users having to consult multiple sources for information
- Integrating local languages into the system
- Categorising the plants by some criteria
- Making use of multimedia content such as videos
- Providing platforms for interactivity and the sharing of ideas
- Ensuring that users are able to search for the information they require, and that help is available on the system
- Setting up quizzes for users to assess whether they are obtaining knowledge from the system and whether they are preserving it for future use

## 4.6 Summary and conclusion

Chapter 4 provided information on the study's participants. It was found that awareness of the country's indigenous medicinal plants is very high among the participants, which could be an indication of a generally high awareness among the citizens of the country. Despite this high awareness, the participants were not very knowledgeable about what the plants look like and how they are used in medicinal preparations. A lack of awareness results in the indigenous plants not being widely used, and it also results in people destroying them or showing a disregard for them due to ignorance of their uses. The participants expressed that they were eager to learn more about indigenous medicinal plants and would recommend the system to others. They did, however, feel that the system was too westernised and not catering to the local community.

The participants had a positive experience working through the content presented on the e-learning system. They noted elements that they felt were missing, especially localising the system to the indigenous groups of Namibia. E-learning was viewed as being easily accessible. The participants also indicated a need to be assessed on the e-learning system, in order to improve and retain their knowledge of the plants.

The participants felt that navigating the prototype e-learning system was effortless and the system was easy to use. They also found the presentation of the material on indigenous medicinal plants to be orderly and informative. Although the participants were satisfied with the prototype e-learning system and had a positive experience working through the content on the system, they felt that the information on the system was too limited. They would have preferred that more plants be included.

The thematic analysis method used in the study revealed eight themes that were closely linked to research objectives RO2 and RO3 of the study. In the survey, the methods currently used to preserve indigenous knowledge on Namibia's medicinal plants were identified as knowledge passed down from elders, printed books, and television documentaries. Elders have been found to be an important source of knowledge on indigenous medicinal plants, and their inclusion in the development of an e-learning system to preserve indigenous medicinal plants is imperative. The methods and tools discussed showed that there was a lack of information technology tools being used to preserve knowledge on Namibia's indigenous medicinal plants.

The analysis of the data collected helped in identifying key requirements for an e-learning system that facilitates the preservation of indigenous knowledge on medicinal plants. The conceptual theoretical model developed in Chapter 3 was extended to include the requirements that were identified using the survey results. A model for preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform was developed.

The next chapter focuses on providing a summary of the dissertation, highlighting how the research questions of the study were answered, and discussing the contributions, recommendations and limitations of the study.

## CHAPTER 5

# CONCLUSIONS, CONTRIBUTIONS AND RECOMMENDATIONS

### **Chapter 5: Conclusions, Contributions and Recommendations**

- 5.1 Introduction
- 5.2 Summary of the research process
- 5.3 How the research questions were answered
- 5.4 Contributions and limitations of the study
- 5.5 Conclusion and recommendations for future work
- 5.6 Personal reflection

## 5.1 Introduction

The problem that led to this study is a lack of information technology tools that are aimed at preserving and disseminating indigenous knowledge. This qualitative study focused on the preservation of indigenous knowledge of medicinal plants in Namibia specifically. Data was collected through a literature review and a survey. The literature review contributed to the development of a conceptual theoretical model for preserving indigenous knowledge, identifying a model to guide in the construction of the second questionnaire used in the survey and the subsequent development of a prototype e-learning system. Additional data collected from the survey was used to extend the conceptual theoretical model.

In the previous chapter, an analysis of the data was presented. The analysis resulted in the extension of the conceptual theoretical model for preserving indigenous knowledge developed in Chapter 3 (Section 3.8).

In Chapter 5, the study is concluded. A recapitulation of the research process is provided in Section 5.2. The answers to the research questions are reiterated in Section 5.3, and the contributions and limitations of the study are provided in Section 5.4. The conclusion to the study and recommendations for further research are presented in Section 5.5. A personal reflection is provided in Section 5.6.

## 5.2 Summary of the research process

At the beginning of the study, the main research question was formulated as:

- What components are necessary in a model used to guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants?

The following secondary research questions assisted in answering the main research question:

1. What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants? (RQ1)
2. What information technology tools are currently used to preserve indigenous knowledge of medicinal plants? (RQ2)
3. What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants? (RQ3)

The process of answering these research questions was documented in this dissertation, which comprised five chapters. A summary of each chapter follows.

The dissertation started with Chapter 1, in which a brief background of digital preservation and indigenous knowledge were provided. The problem leading to the study was also discussed. Research objectives and questions were formulated to assist in addressing the problem identified.

Chapter 2 focused on the research methodology employed in the study. The study was of an inductive nature and centred on interpretivist and qualitative practices. A prototype e-learning system was developed to assist in identifying requirements to include in the model. Data was collected through a literature review and a survey. The survey was conducted using two questionnaires. The literature review and data collected assisted in identifying requirements that were used to develop a model for digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. The study was a cross-sectional one, and the data collected was analysed using the thematic analysis approach.

In Chapter 3, existing models for digitally preserving indigenous knowledge that were found in the literature were explored to assist in identifying requirements for the model for

digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. Information technology tools that have already been used to preserve indigenous knowledge were identified to determine if information technology is in fact being used for this purpose. The chapter assisted in contributing to answering RQ1, RQ2 and RQ3. The major outcome of Chapter 3 was a conceptual theoretical model for digitally preserving indigenous knowledge.

In Chapter 4, the survey data collected using the questionnaires was presented and analysed. Eight themes were generated from the data. The themes assisted in identifying the requirements to include in a model for digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. The chapter contributed to providing answers to RQ2 and RQ3. The conceptual theoretical model for preserving indigenous knowledge developed in Chapter 3 was extended using the requirements that were identified during the survey.

In Chapter 5, the conclusion to the dissertation is now provided. This includes information on how the research questions were answered, contributions to the field, and recommendations for further research.

### 5.3 How the research questions were answered

In this section, the researcher discusses how the research questions of the study were answered.

#### **Secondary Research Question 1: What models exist that are used in the digital preservation of indigenous knowledge of medicinal plants?**

The literature review carried out for this study revealed five models and frameworks that are used to digitally preserve indigenous knowledge. These are:

- The Tripartite Digitisation Model
- The Digital Indigenous Knowledge Preservation Framework
- The Traditional Wood Carvers Database Framework
- The National Indigenous Knowledge Management System Software Architecture Framework; and
- The E-Cultural Heritage and Natural History Framework.

None of the five models was specifically developed for digitally preserving indigenous knowledge of medicinal plants. Components from these models and frameworks were used to identify requirements that would be used to develop a conceptual theoretical

model for digitally preserving indigenous knowledge. In this study, it was found that requirements not found in the existing models and frameworks are required to digitally preserve indigenous knowledge of Namibia's medicinal plants.

**Secondary Research Question 2: What information technology tools are currently used to preserve indigenous knowledge of medicinal plants?**

From the literature review, it was found that information technology tools have been used to capture, store and disseminate indigenous knowledge. These tools are discussed in Chapter 3 (Section 3.2.4). Not all of these tools mention what type of indigenous knowledge they capture, store or disseminate. Some tools capture indigenous knowledge of cultural dances, rituals and tribal ceremonies, and cultural homesteads. Digital libraries and online databases have specifically been used to preserve indigenous knowledge of medicinal plants.

The survey data revealed that indigenous knowledge of medicinal plants in Namibia has been preserved through information and demonstrations by elders who possess the knowledge, through printed books, and through television documentaries. Of these, only television can be considered as a form of information technology.

**Secondary Research Question 3: What requirements should be considered when using e-learning systems in facilitating the preservation of indigenous knowledge of Namibia's medicinal plants?**

The following requirements were obtained from the literature:

- Determining the methods that will be used to capture the indigenous knowledge data.
- Identifying the Learning Management Software (LMS) that will be used to disseminate the knowledge.
- Ensuring data recovery mechanisms, access control and authentication mechanisms and a digital knowledge repository on the disseminating tool.
- Identifying the stakeholders of the e-learning system.
- Adhering to the legal requirements that relate to capturing and disseminating indigenous knowledge.
- A community of practice comprising the necessary stakeholders required for the functioning of the e-learning system.

From the survey on the prototype e-learning system, the following requirements were obtained:

- Information on where in Namibia the plants are located.
- Comprehensive information on each of the plants.
- Indigenous language integration.
- Categorisation of the plants.
- Availability of multimedia content.
- Interaction among users.
- Availability of search and help functions.
- Assessments such as quizzes.

The requirement of involving knowledge custodians to evaluate and validate the knowledge that is presented appeared in both the literature and the survey.

**Main research question: What components are necessary in a model to guide the design of an e-learning system that is aimed at facilitating the digital preservation of indigenous knowledge of Namibia's medicinal plants?**

Five components were identified and discussed in Chapter 3 (Section 3.8). The components are:

- Capture – the methods for capturing the indigenous knowledge data.
- Evaluation – ensuring that the knowledge custodians of indigenous medicinal plants evaluate and validate the information that is presented.
- Dissemination – the information technology tool that will be used to disseminate the indigenous knowledge.
- External factors – factors that are outside the e-learning system, such as identifying the custodian of the e-learning system and any legal requirements to adhere to.
- A community of practice – identifying the stakeholders of the system and their roles and responsibilities.

The final model for preserving indigenous knowledge of Namibia's medicinal plants, which was developed in Chapter 4 (Figure 4.32 in Section 4.4), included these five components. The net benefit to be derived from using such an e-learning system is the internalisation of tacit knowledge on medicinal plants from that is obtained from the explicit knowledge presented on the system.



## 5.4 Contributions and limitations of the study

The study contributed to the theoretical body of knowledge on e-learning and the digital preservation of indigenous knowledge through the development of a model for digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform. A conference paper, Amunkete et al., (2019), presented at the IST-Africa Conference in May 2019 in Nairobi, Kenya, was published in this regard.

The practical contribution of this study was the prototype e-learning system for indigenous knowledge of Namibia's medicinal plants that was developed, showing that it is possible to use an e-learning system to capture and preserve indigenous knowledge of medicinal plants, not only from Namibia, but worldwide.

The study was limited to indigenous knowledge of medicinal plants in Namibia and did not look at the preservation of other types of indigenous knowledge. Only a sample of thirty indigenous medicinal plants appeared on the prototype e-learning system. The study focused only on participants from one institution of higher learning in Namibia and only investigated the participants' knowledge about the preservation of Namibia's medicinal plants. Using an e-learning system as a searchable database is also a limitation in this study, since it may not necessarily be well-structured.

## 5.5 Conclusion and recommendations for future work

This study aimed to contribute to the efforts of digitally preserving indigenous knowledge for future generations. The outcome of the study was a model for digitally preserving indigenous knowledge of Namibia's medicinal plants via an e-learning platform.

The study revealed that in Namibia there is a lack of information technology tools that are aimed at preserving and disseminating indigenous knowledge. Tools have been developed, but are mostly used by indigenous communities to collect their indigenous knowledge. This knowledge is not being disseminated so that it can be internally preserved. A personal conversation between the researcher and a colleague who has been involved in indigenous knowledge research for over 10 years revealed that this could be due to policies and a means of protecting indigenous communities from possible exploitation. At the time of this study, information technology tools for specifically preserving indigenous knowledge of Namibia's medicinal plants were not found. There is, however, a need to digitally preserve indigenous knowledge, because most of the elders who are the custodians of the indigenous knowledge of their communities are advancing

in age and dying. The participants of this study portrayed a high interest in learning about Namibia's medicinal plants.

There is a need to validate the developed model and extend it as needed. Other types of data collection tools, such as interviews, should be explored to see if additional data can be obtained. Possible hindrances to implementing the model, such as legal requirements, should be investigated. Models aimed at ensuring that information technology tools are not used to exploit the knowledge of indigenous communities should be explored. The preservation of indigenous knowledge of medicinal plants should not be confined to e-learning alone, but other digital platforms such as serious games can be investigated for their suitability for preserving knowledge.

It would be useful to carry out a study similar to the current study, but with participants who are not familiar with e-learning and who live in areas with limited information technology resources, to determine what other tools might be suitable for them and whether they might have different requirements for their knowledge preservation needs. It would also be useful to carry out a study with e-learning expert evaluators and designers to determine what is lacking in the current e-learning system and what other requirements need to be taken into consideration.

Other types of indigenous knowledge should be investigated to determine whether they can be preserved on an e-learning system and what requirements would be necessary. With reference to the integration of indigenous knowledge into educational curriculums discussed in Chapter 3 of this study, further studies could explore whether an e-learning system could be adopted for such integration endeavours.

Future development of the model could include true e-learning strategies, such as assessments and incorporating the use of Artificial Intelligence to the e-learning system.

## **5.6 Personal reflection**

When the researcher began this study, she made the assumption that people who grew up in the urban areas of Namibia were less knowledgeable about the indigenous medicinal plants of Namibia. It was a surprise to find out that people that grew up in urban areas were equally knowledgeable about the plants as their rural counterparts. Neither group was, however, knowledgeable about their use and what illnesses these plants can treat.

It was also surprising to learn that young people are eager to learn about the medicinal plants that have been used in Namibia's communities for generations. Digital learning has truly transformed, and it can offer diverse ways of learning and preserving indigenous knowledge.

The researcher started this journey with minimal research skills and with help from her supervisors, this study honed her analytical and reasoning abilities. The study also enhanced the researcher's data handling, decision making and presentation skills. The most difficult part of this journey was organising the data and mastering the use of the MAXQDA qualitative analysis software, which in the end was a very rewarding process. The researcher acknowledges that taking an interview approach as opposed to conducting a survey would have collected even richer qualitative data. It would also have been good to interact with the custodians of the indigenous knowledge of Namibia's medicinal plants.

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## APPENDICES

### Appendix A: Namibia's indigenous medicinal plants

Ethnobotanical studies on Namibia's indigenous medicinal plants have been carried out, and, in this section, the researcher will provide images (Figure A1-45) of the plants and a brief discussion of the minor illnesses that they alleviate.

Thirty plants were identified from the studies and will be referred to by their scientific names. All the images presented in this section were sourced from the Internet<sup>2</sup> on the webpages of Wikipedia<sup>3</sup>, the South African National Biodiversity Institute<sup>4</sup> and Useful Tropical Plants<sup>5</sup>.



**Figure A1: *Elephantorrhiza Elephantina***

Figure A1 displays the indigenous medicinal plant *Elephantorrhiza Elephantina*, commonly known as Eland's wattle or Elephant's root. The plant is used to treat disorders of the gastrointestinal tract, skin diseases, pain, stomach ailments, infertility and impotence (Maroyi, 2017).

*Acanthosicyos Horridus* (Figure A2) is used to treat nausea, stomach-ache, venereal diseases, kidney problems, arteriosclerosis and chest pains and heal wounds, sore throats and for fungal infections (Nauyoma, 2015). It is known by its common name, the !Nara plant.

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<sup>3</sup> <https://www.wikipedia.org/>

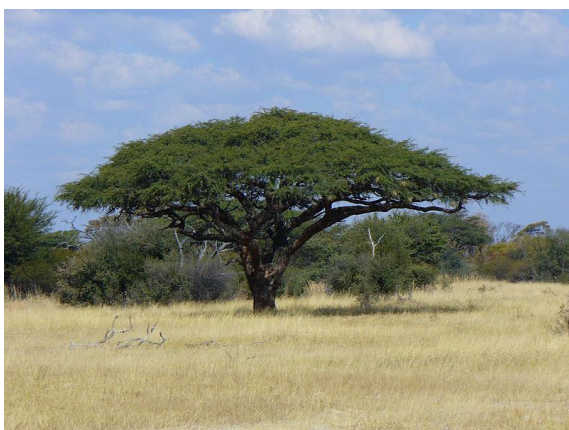
<sup>4</sup> <https://www.sanbi.org/>

<sup>5</sup> <http://tropical.theferns.info/>



**Figure A2: *Acanthosicyos Horridus***

*Acacia Erioloba* (Figure A3), commonly known as the Camelthorn tree, has pods (Figure A4) that are used to treat herpes zoster (Chinsembu, Hjarunguru, & Mbangu, 2015; Chinsembu, Hedimbi, & Mukaru, 2011).

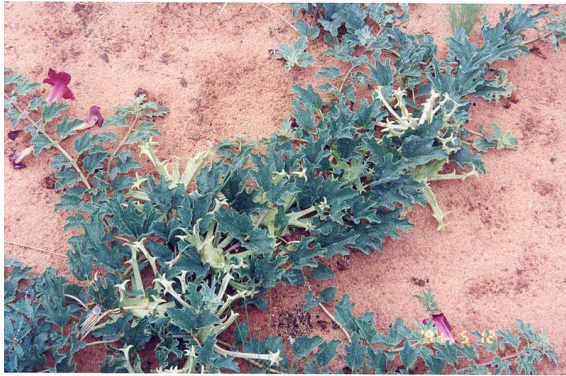


**Figure A3: *Acacia Erioloba***



**Figure A4: Camelthorn pods**

Figure A5 illustrates the *Harpagophytum Procumbens*. Its common name is Devil's claw or the grapple plant. The fruits of the grapple plant are dried, as illustrated by Figure A6, and used to cure digestive disorders, fever, sores, ulcers, boils and relieve pain (Mncwangi, Chen, Vermaak, Viljoen, & Gericke, 2012). It is also used as an anti-inflammatory and analgesic in joint diseases, back pain, and headaches (Dushimemaria, Mumbengegwi, & Bock, 2015; Mahomoodally, 2013).



**Figure A5: *Harpagophytum Procumbens***



**Figure A6: A dried fruit of the Devil's claw**

Hoodia Gordonii (Figure A7), which goes by the common name of Bushman's hat is used to manage high blood pressure (Denver, Gibson, & Johnson, 2016) and as a weight-loss suppressant (Pereira, Pereira, & Corrêa, 2010; Vermaak, Hamman, & Viljoen, 2011).



**Figure A7: *Hoodia Gordonii***

The Acanthosicyos Naudinianus, illustrated by Figure A8, is used to treat skin rashes in animals (Chinsemu, Negumbo, Likando, & Mbangu, 2014). The plant is known by its common name, the Gemsbok cucumber.



**Figure A8: *Acanthosicyos Naudinianus***

Figure A9 is a photo of the *Salvadora Persica*. It goes by the common names of toothbrush tree, mustard tree or mustard bush. The plant is used to cure rheumatism, leprosy, gonorrhoea, scurvy, tumours and dental diseases (Anthony & Timothy, 2015), inflammation and ulcers (Alshibly, 2017).



**Figure A9: *Salvadora Persica***

*Nymania Capensis* (Figure A10) is known as the Chinese Lantern, it has pods (Figure A11) that hold seeds that are used to treat alcoholism and constipation (Hulley & Van Wyk, 2018).



**Figure A10: *Nymania Capensis***



**Figure A11: A Chinese Lantern pod**

Figure A12 is the *Berchemia Discolour* plant, it is used to cure flu, colds, nose bleeding, skin itching (Cheikhoussef, Naomab, Potgieter, Kahaka, Raidron, & Ashekele, 2010; Maroyi & Cheikhoussef, 2015), cough and vomiting (Chinsembu, Hjarunguru et al., 2015). It is commonly known as the Bird plum tree. Figure A13 displays a close-up picture of the Bird plum fruit.



**Figure A12: *Berchemia Discolour***



**Figure A13: Bird plum fruit**

*Diospyros Lycioides* (Figure A14), commonly known as the Bluebush plant, is used to manage bleeding, high fever (Cheikhoussef et al., 2011), toothache (Maroyi & Cheikhoussef, 2015), oral candidiasis, tooth decay, gonorrhoea and syphilis (Chinsembu, Hjarunguru et al., 2015) and pain (Dushimemaria et al., 2015).



**Figure A14: *Diospyros Lycioides***

*Diospyros Mespiliformis*, displayed by Figure A15, is commonly known as the Jackal-berry plant and is used to cure male dysfunction (Cheikhoussef et al., 2011; Maroyi & Cheikhoussef, 2015), pneumonia, syphilis, malaria, skin infections (Chinsembu, Hjarunguru et al., 2015), ringworm, leprosy, fever, dysentery and wounds (Dushimemaria et al., 2015).



**Figure A15: *Diospyros Mespiliformis***

Figure A16 is a display of *Euclea Divinorum*, it goes by the common name of Magic Guarri and is used to treat snake bites (Kipkore, Wanjohi, Rono, & Kigen, 2014), bleeding (Cheikhoussef et al., 2011; Maroyi & Cheikhoussef, 2015) skin sores, rashes (Chinsembu, Hjarunguru et al., 2015), malaria, fevers and venereal diseases such as syphilis (Chinsembu et al., 2011). A close-up of the plant's fruits is displayed in Figure A17.



**Figure A16: *Euclea Divinorum***



**Figure A17: Magic Guarri fruit**

The *Ficus Sycomorus* plant (Figure A18), has fruits, displayed by Figure A19, that called sycamore figs and are used to cure constipation, dermatitis (Cheikhoussef, Mapaure, & Shapi, 2011), tooth decay, toothache (Chinsembu, Hjarunguru et al., 2015), coughing, digestion problems and anaemia (Chinsembu et al., 2011). Its common name is the Sycamore Fig tree.





**Figure A18: *Ficus Sycomorus***



**Figure A19: Sycamore Fig**

Figure A20 is the *Grewia Flavescens*, known by its common name, the Sandpaper raisin plant. Its fruits (Figure A21) are used to treat the symptoms of coughs, diarrhoea (Maroyi & Cheikhyoussef, 2015) and gonorrhoea (Urso, Signorini, Tonini, & Bruschi, 2016).



**Figure A20: *Grewia Flavescens* plant**



**Figure A21: Sandpaper raisins**

*Peltophorum Africanum* (Figure A22) is known by the common name, Weeping Wattle. It is used in treating painful leg cramps (Maroyi & Cheikhyoussef, 2015), food poisoning, diarrhoea, pregnancy troubles, impotence (Urso, Signorini, Tonini, & Bruschi, 2016) and indigestion (Maema, Mahlo, & Potgieter, 2016).



**Figure A22: *Peltophorum Africanum***

Figure A23 is a display of *Pterocarpus Angolensis*. The plant is used to stop bleeding and cure coughing, swollen legs (Maroyi & Cheikhoussef, 2015), ringworms, eye problems and stomach problems (Chinsamy & Koitsiwe, 2016). It is commonly known as the Wild Teak.



**Figure A23: *Pterocarpus Angolensis***

The *Ricinus Communis* is used for treating epilepsy (Abdul, Hajrah, Sabir, Al-Garni, Sabir, Kabli, Saini, & Bora, 2018), swelling, gout, skin diseases, joint and knee pain (Ziaei, Sahranavard, Gharagozlou, & Faizi, 2016) and as a pain reliever (Dushimemaria et al., 2015). The plant is displayed by Figure A24 and is commonly known as the Castor Oil plant. Figure A25 is a close-up image of the plant's fruits.



**Figure A24: *Ricinus Communis***



**Figure A25: Castor oil fruits**

Figure A26 is the *Sclerocarya Birrea*, commonly known as the Marula tree. Its fruits, displayed by Figure A27 are used for healing coughs (Cheikhyoussef & Embashu, 2013), ear infection, epilepsy, heartburn, tonsillitis, toothache (Cheikhyoussef & Embashu, 2013), diarrhoea and oral candidiasis (Chinsembu et al., 2011; Chinsembu, Hjarunguru et al., 2015).



**Figure A26: *Sclerocarya Birrea***



**Figure A27: Fresh Marula fruits**

*Securidaca longepedunculata* (Figure A28) is commonly known as the Violet tree and is used in treating stroke (Cheikhyoussef et al., 2011; Maroyi & Cheikhyoussef, 2015) gonorrhoea, syphilis, meningitis, coughs and tuberculosis (Chinsembu, Hjarunguru et al., 2015). Figure A29 is a closer image of the Violet tree.



**Figure A28: *Securidaca longepedunculata***



**Figure A29: A closer look at the Violet tree**

Figure A30 is the *Strychnos Cocculoides*, which is commonly known by the name of corky-bark monkey-orange tree. The plant is mainly used to treat gonorrhoea (Chinsembu, Hjarunguru, et al., 2015). Figures A31 and A32 show a closer look at the leaves and flowers of the tree.



**Figure A30: *Strychnos Cocculoides***



**Figure A31: Corky-bark Monkey-orange leaves**



**Figure A32: Corky-bark Monkey-orange blooming flowers**

Vangueria Infausta (Figure A33), is commonly known as the Wild Medlar. It is used in the treatment of dermatitis (Cheikhoussef et al., 2011; Cheikhoussef & Embashu, 2013; Maroyi, 2018) and coughs (Chinsembu, Hjarunguru et al., 2015). It is also used as a remedy for flu in children and is effective in healing wounds, by roasting the seed kernels and crushing and applying them directly to the wound (Dan, McHombu, & Mosimane, 2010). Figure A34 shows the fruit of the Wild Medlar in which the seeds are found.



**Figure A33: Vangueria Infausta**



**Figure A34: The Wild Medlar fruit**

Figure A35 displays the Ximenia Americana, which is commonly known as the Tallow wood plant. The plant is used to treat constipation, scoliosis (Cheikhoussef et al., 2011), gonorrhoea, malaria (Chinsembu, Hjarunguru et al., 2015), tonsillitis, throat infection, malaria, dysmenorrhoea, skin rashes (Chinsembu et al., 2011) and pain (Dushimemaria et al., 2015).



**Figure A35: *Ximenia Americana***

*Ximenia Caffra*, illustrated by Figure A36 is commonly known as the Large sourplum plant. It is used to treat infertility, gonorrhoea (Maroyi, 2016; Maroyi & Cheikhyoussef, 2015), scoliosis, stomach-ache and pregnancy complications (Chinsembu, Hjarunguru, et al., 2015). The kernels are used for preparing a valued ointment for healing wounds and a root decoction can also be taken to treat chest ailments (Dan et al., 2010).



**Figure A36: *Ximenia Caffra***

*Ziziphus Mucronata* (Figure A37) is commonly known as the Buffalo thorn plant and the ripened fruit, illustrated by Figure A38 are used to manage the following ailments; gonorrhoea (Maroyi & Cheikhyoussef, 2015), skin allergies and rashes (Mabona & Van Vuuren, 2013), chlamydia, diarrhoea and dysentery (Chinsembu, Hjarunguru et al., 2015).



**Figure A37: *Ziziphus Mucronata***



**Figure A38: Ripe Buffalo thorn fruits**

*Amaranthus Thunbergii* (Figure A39) is used to treat eczema (Chinsembu, Hjarunguru et al., 2015), internal bleeding, diarrhoea, ophthalmia and convulsions in children (Achigan-Dako, Sogbohossou, & Maundu, 2014). It is commonly known as the Thunberg's Amaranthus.



**Figure A39: *Amaranthus Thunbergii***

*Lannea discolor* (Figure A40) is commonly known as the Live-Long tree and is used to heal diarrhoea and wounds (Chinsembu, Hjarunguru et al., 2015).



**Figure A40: *Lannea discolour***

Figure A41 displays the *Carissa Edulis* which is used to cure various ailments, such as diarrhoea (Semenya & Maroyi, 2012). The plant is commonly known as the Simple-spined carissa.



**Figure A41: *Carissa Edulis***

*Lannea Schweinfurthii* (Figure A42), commonly known as the False-marula is used to treat herpes, skin infections, tuberculosis and chronic diarrhoea (Chinsembu, 2015).





**Figure A42: *Lannea Schweinfurthii***

Figure A43 is the *Dicerocaryum eriocarpum*, with the common name, Devil's thorn. The plant is used for the treatment of abdominal pain resulting from malaria (Dushimemaria et al., 2015).



**Figure A43: *Dicerocaryum Eriocarpum***

*Adansonia Digitata* (Figure A44) is commonly known as the Baobab tree and is used for treating headaches (Kasanda & Kapenda, 2015). Figure A45 shows the fruit of the Baobab tree.



*Figure A44: Adansonia Digitata*



*Figure A45: A Baobab fruit*

# Appendix B: Questionnaire 1 - Pre-system use



## A Model for the Digital Preservation of Indigenous Knowledge on Medicinal Plants in Namibia via an E-Learning Platform

### Part 1: Pre-system use questionnaire

Please answer the questions below, truthfully and to the best of your abilities.  
Please indicate your answers by marking a cross (X) in the relevant boxes and where a space is provided, please write down your answer.

#### SECTION 1: Background information

1.1 Please indicate the range in which your age falls

18-24	25-34	35-44	45+

1.2 Please indicate your gender

Male	Female

1.3 Which Faculty do you belong to?

Faculty of Computing and Informatics	
Faculty of Engineering	
Faculty of Health and Applied Sciences	
Faculty of Human Sciences	
Faculty of Management Sciences	
Faculty of Natural Resources and Spatial Sciences	



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1.4 Which region do you belong to?

!Karas	
Erongo	
Hardap	
Kavango East	
Kavango West	
Khomas	
Kunene	
Ohangwena	
Omaheke	
Omusati	
Oshana	
Oshikoto	
Otjozondjupa	
Zambezi	

1.5 In which area did you grow up?

Rural	
Urban	

1.6 Which of the following devices do you have access to? Select all that apply.

Smartphone	
Desktop Computer	
Laptop	
Tablet	
Other	Please specify:

1.7 What type of connection do you use to access the internet? Select all that apply.

Wi-Fi	
Mobile data	
Other	Please specify



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**SECTION 2: Indigenous Knowledge Information**

2.1 Are you aware of Namibian indigenous plants that are used for medicinal purposes?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

2.2 If yes to (2.1), how did you become aware of these plants? **Please select all that apply**

From printed books	<input type="checkbox"/>
From elders	<input type="checkbox"/>
By watching videos	<input type="checkbox"/>
By listening to audio recordings	<input type="checkbox"/>
Other	Please specify:
N/A	<input type="checkbox"/>

2.3 If yes to (2.1), have you ever used indigenous medicinal plants to treat minor illnesses?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

2.4 If yes to (2.3), were the indigenous medicinal plants **effective** in treating the minor illness for which you used them for?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....

2.5 Do you want to **learn** about Namibia's indigenous medicinal plants?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>



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2.6 If yes to (2.5), how would you prefer to learn more about indigenous medicinal plants and why? **Please select all that apply**

Social media	
Blogs	
E-learning	
Learning-based Game	
Printed books	
Listening to narrations by elders	
Watching videos	
Listening to audio recordings	
Other	Please specify:

Please elaborate why

.....

.....

.....

2.7 Would you like to be tested on what you have learned about the indigenous medicinal plants?

Yes	No

Please give reasons for your answer

.....

.....

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.....



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2.8 Do you think it will be useful to keep indigenous knowledge of medicinal plants on an e-learning system?

Yes	No

Please give reasons for your answer

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2.9 Please provide any additional comments you have on indigenous medicinal plant knowledge being preserved from engaging on an e-learning system?

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**Part 1 ends here.**

***Please provide your cell phone number for you to be contacted to engage in and navigate through the e-learning system on which information on the indigenous medicinal plants will be presented.***

***Cell phone number:***



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# Appendix C: Questionnaire 2 - Post-system use

## Part 2: Post-system use questionnaire

Dear Participant,

Now that you have engaged with the e-learning system on Namibia's indigenous medicinal plants, you are hereby invited to complete the second part of the survey.

Part 2 will be used to collect data on how you found the system to be; e.g. how easy it was to use, its usefulness at preserving indigenous medicinal plant knowledge, etc.

**Please answer the questions below, truthfully and to the best of your abilities.  
Please indicate your answers by marking a cross (X) in the relevant boxes and where a space is provided, please write down your answer.**

**SECTION 1: System Quality**

1.1 Were you able to navigate through the system with ease?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....

1.2 Were help functions available on the system?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....



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1.3 Were you able to search for any information that you needed?

Yes	No

Please elaborate

.....  
.....  
.....

**SECTION 2: Information Quality**

2.1 Did the material on the e-learning system contribute to your knowledge on indigenous medicinal plants?

Yes	No

Please elaborate

.....  
.....  
.....

2.2 Was the presentation of the material organized in an effective manner?

Yes	No

Please elaborate

.....  
.....  
.....



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**SECTION 3: Use**

3.1 Did the images and text on the e-learning system contribute to your understanding on the content on indigenous medicinal plants?

Yes	No

Please elaborate

.....  
.....  
.....

**SECTION 4: User Satisfaction**

4.1 Were you satisfied with the system?

Yes	No

Please elaborate

.....  
.....  
.....

4.2 Would you recommend the system to others?

Yes	No

Please elaborate

.....  
.....  
.....

4.3 Who do you think this system will be of value to?

.....  
.....  
.....



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**SECTION 5: Net Benefits**

5.1 Did using the e-learning system encourage you to read or learn further on the topic of Namibia's indigenous medicinal plants?

Yes	No

Please elaborate

.....  
.....  
.....

5.2 Did you find it to be a positive experience engaging with the e-learning system on indigenous medicinal plants?

Yes	No

Please elaborate

.....  
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.....

5.3 Do you intend to use the system in future?

Yes	No

Please elaborate

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.....



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**SECTION 6: Additional comments**

6.1 Would you like to add or remove anything from the e-learning system to make it more useful?

Yes	No

Please elaborate

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6.2 Please provide any comments on your overall experience with engaging with the e-learning system on indigenous medicinal plants?

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***THANK YOU VERY MUCH FOR YOUR PARTICIPATION. IT IS HIGHLY APPRECIATED.***



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## Appendix D: Pilot Questionnaire



### Questionnaire 1: The use of E-learning to Preserve Indigenous Medicinal Plant Knowledge: A Case Study of Namibia

Please answer the questions below, truthfully and to the best of your abilities.  
Please indicate your answers by marking a cross (X) in the relevant boxes and where a  
space is provided, please write down your answer.

---

#### SECTION 1: Background information

1.1 Please indicate the range in which your age falls

18-24	25-34	34-44	45+
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1.2 Please indicate your gender

Male	Female
<input type="checkbox"/>	<input type="checkbox"/>

1.3 Which tribe do you belong to?

Ovahimba	<input type="checkbox"/>
San	<input type="checkbox"/>
Ovawambo	<input type="checkbox"/>
Damara>Nama	<input type="checkbox"/>
Otjiherero	<input type="checkbox"/>
Caprivian	<input type="checkbox"/>
Kavango	<input type="checkbox"/>
Other	Please specify:

1.4 In which area did you grow up?

Rural	<input type="checkbox"/>
Urban	<input type="checkbox"/>



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1.5 Which mobile technology devices do you have access to? Select all that apply.

Smartphone	
Desktop Computer	
Laptop	
Tablet	
Other	Please specify:

1.6 What type of connection do you use to access the internet? Select all that apply.

Wi-Fi	
Mobile data	
Other	Please specify

---

**SECTION 2: Indigenous Knowledge Information**

2.1 Are you aware of Namibian indigenous plants that are used for medicinal purposes?

Yes	No

2.2 Do you want to **learn** about Namibia's indigenous medicinal plants?

Yes	No

2.3 If yes to (2.1), how did you become aware of these plants? **Please select all that apply**

From printed books	
From elders	
By watching videos	
By listening to audio recordings	
Other	Please specify:
N/A	



2.4 Would you say the methods you specified in (2.3) have been effective in allowing you to use these plants to treat any minor ailments?

Yes	No

Please elaborate

.....

.....

.....

2.5 On which electronic platform(s) would you prefer to learn more about indigenous medicinal plants? **Please select all that apply**

Social Media	
Blogs	
E-learning	
Learning-based Game	
Other	Please specify:

2.6 Would you like to be tested on what you have learned about the indigenous medicinal plants?

Yes	No

Please give reasons for your answer

.....

.....

.....



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2.7 Do you think it will be useful to keep indigenous medicinal plant knowledge on an e-learning platform?

Yes	No

Please give reasons for your answer

.....  
.....  
.....

2.8 Please provide any additional comments you have on preserving indigenous knowledge on e-learning?

.....  
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.....

***THANK YOU VERY MUCH FOR YOUR PARTICIPATION. IT IS HIGHLY APPRECIATED.***



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# Appendix E: Pre-test Questionnaire



## Questionnaire 2: The use of E-learning to Preserve Indigenous Medicinal Plant Knowledge: A Case Study of Namibia

Please answer the questions below, truthfully and to the best of your abilities. Please indicate your answers by marking a cross (X) in the relevant boxes and where a space is provided, please write down your answer.

### SECTION 1: System Quality

1.1 Were you able to navigate through the course with ease?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....

1.2 Were help functions available on the platform?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....



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1.3 Were you able to search for any information that you needed?

Yes	No

Please elaborate

.....  
.....  
.....

**SECTION 2: Information Quality**

2.1 Did the material on the e-learning platform contribute to your knowledge on indigenous medicinal plants?

Yes	No

Please elaborate

.....  
.....  
.....

2.2 Was the presentation of the material organized in an effective manner?

Yes	No

Please elaborate

.....  
.....  
.....



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**SECTION 3: Use**

3.1 Did the images and text on the e-learning platform contribute to your understanding on the content on indigenous medicinal plants?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....

**SECTION 4: User Satisfaction**

4.1 Were you satisfied with the course?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....

4.2 Would you recommend the course to others?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Please elaborate

.....  
.....  
.....



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4.3 Who do you think this course will be of value to?

Yes	No

Please elaborate

.....

.....

.....

**SECTION 5: Net Benefits**

5.1 Do you think it is useful to keep indigenous medicinal plant knowledge on an e-learning platform?

Yes	No

Please elaborate

.....

.....

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5.2 Did the course encourage you to read further on the topic of Namibia's indigenous medicinal plants?

Yes	No

Please elaborate

.....

.....

.....



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5.3 Did you find it to be a positive experience engaging with the e-learning system on indigenous medicinal plants?

Yes	No

Please elaborate

.....  
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.....

5.4 Do you intend to use the platform in future?

Yes	No

Please elaborate

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**SECTION 6: Additional comments**

6.1 Was there anything missing on the course that would make it successful?

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6.2 Please provide comments on your overall experience with engaging with the e-learning platform/course?

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***THANK YOU VERY MUCH FOR YOUR PARTICIPATION. IT IS HIGHLY APPRECIATED.***



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# Appendix F: Permission from the Namibia University of Science and Technology to use their students as participants



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OF SCIENCE AND TECHNOLOGY**

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Private Bag 13388  
Windhoek  
NAMIBIA

T: +264 61 207 2118  
F: +264 61 207 9118  
E: registrar@nust.na  
W: www.nust.na

**Office of the Registrar**

18 October 2018

Ms Katazo Natasha Amunkete  
Windhoek  
NAMIBIA

Dear Ms Amunkete

**RE: CONSENT TO CONDUCT YOUR RESEARCH WITH THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY STAFF AND STUDENTS**

Your email received on 16 October 2018, UNISA, has reference.

Approval is hereby granted for you to conduct the research on "*The use of E-Learning to preserve indigenous medicinal plant knowledge: A Case study of Namibia*" in the Namibia University of Science and Technology. Any information gathered during the research is to be used for the purpose of the study only and must be treated as confidential. The results of the study should be shared with the University. Individual information of staff and students will not be made available, nor will biographical information of students be made available in such a way that individual students can be identified.

You are advised to contact the Acting Director: Teaching and Learning Unit, Mr Maurice Nkusi, to compile a list of possible respondents to your data collection instrument.

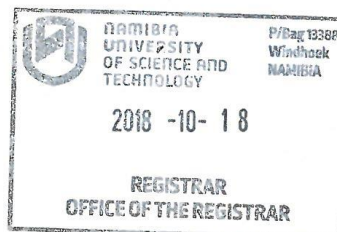
I wish you all the best with your research.

Yours sincerely,

**Mr Maurice Garde  
REGISTRAR**

CC:

Acting Director: TLU  
Deputy Vice-Chancellor: Academic Affairs  
Assistant Registrar



# Appendix G: Participant information sheet



## PARTICIPANT INFORMATION SHEET

Ethics clearance reference number:

Research permission reference number (if applicable):

**12 November 2018**

**Title:** The Use of E-learning to Preserve Indigenous Medicinal Plant Knowledge: A Case Study of Namibia

**Dear Prospective Participant**

My name is Katazo N. Amunkete and I am doing research with Dr Corne J. van Staden and Dr Marthie A. Schoeman, both Senior Lecturers in the School of Computing, towards an MSc: Computing at the University of South Africa. We are inviting you to participate in a study entitled "The Use of E-learning to Preserve Indigenous Medicinal Plant Knowledge: A Case Study of Namibia".

### **WHAT IS THE PURPOSE OF THE STUDY?**

This study is expected to collect important information that could help in informing whether e-learning will be successful at preserving knowledge on indigenous medicinal plants. Indigenous knowledge is the knowledge that is unique to a set of people, such as a tribe. E.g. farming practices, medicinal plants, cultural dances and objects. The survey is focused on indigenous medicinal plants, which are plants that are used for medicinal purposes by a group of people within a community. The expected outcome is having Namibia's indigenous medicinal plant information presented on an e-learning system from which people can learn about it and thereby having it preserved.

### **WHY AM I BEING INVITED TO PARTICIPATE?**

You were selected to participate in this survey because you are a student at the Namibia University of Science and Technology and the study is currently being piloted on students from the institution.



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#### **WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?**

You will be required to complete a questionnaire and engage with an e-learning system. The questionnaire is made up of 2-parts and in part 1 of the survey, data will be collected on your background information as well as your knowledge and opinions on indigenous medicinal plants. After you have completed part 1 of the survey, you will be engaged in using an e-learning system on which information on Namibia's indigenous medicinal plants will be presented. When you are done engaging with the e-learning system, you will then complete part 2 of the survey. Part 2 will contain questions pertaining to the experience you had when you engaged with the system. The study will take up no more than 60 minutes of your time.

#### **CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?**

Participating in this study is voluntary and you are under no obligation to consent to participation, there is no penalty or loss of benefit for non-participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason, if you choose to withdraw, the questionnaire will be destroyed in your presence.

#### **WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?**

You will not benefit from your participation as an individual, however, it is envisioned that the findings of this study will ensure that young people have a digital learning platform which is publicly available and where they can learn about their indigenous medicinal plants, to ensure that the knowledge on these plants does not become extinct.

#### **ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?**

We do not foresee that you will experience any negative consequences by participating in this study.

#### **WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?**

The researchers undertake to keep any information provided herein confidential. You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.



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**HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?**

The questionnaire will be kept in a locked drawer for five years for audit purposes where after it will be permanently destroyed with a shredding machine.

**WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?**

You will not be reimbursed or receive any incentives for your participation in this interview.

**HAS THE STUDY RECEIVED ETHICS APPROVAL?**

This study has received written approval from the UNISA School of Computing Ethics Review Committee. A copy of the approval letter can be obtained from the researcher if you so wish.

**HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?**

If you would like to be informed of the final research findings, please contact Katazo N. Amunkete on +264811491066 or email: kamunkete@gmail.com.

Should you have concerns about the way in which the research has been conducted, you may contact Dr Corne J. van Staden on telephone: +27 11 670 9429 email: vstadcj1@unisa.ac.za or Dr Marthie A. Schoeman on telephone: +27 11 670 9178 email: schoema@unisa.ac.za. Contact the research ethics chairperson of the UNISA School of Computing Ethics Review Committee on [socethics@unisa.ac.za](mailto:socethics@unisa.ac.za) if you have any ethical concerns. Alternatively, you can report any serious unethical behaviour at the University's Toll Free Hotline 0800 86 96 93.

Thank you for taking time to read this information sheet and for participating in this study.



Katazo N. Amunkete



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# Appendix H: Consent to participate in this study



## CONSENT TO PARTICIPATE IN THIS STUDY

I, \_\_\_\_\_ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the questionnaire data.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname..... (please print)

Participant Signature.....Date.....

Researcher's Name & Surname **Katazo Amunkete**

Researcher's signature 

Date **12/11/2018**



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# Appendix I: Ethical clearance from UNISA



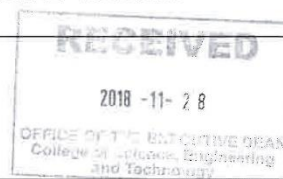
## UNISA COLLEGE OF SCIENCE, ENGINEERING AND TECHNOLOGY'S (CSET) RESEARCH AND ETHICS COMMITTEE

23 November 2018

Ref #: 086/KNA/2018/CSET\_SOC  
Name: Mrs Katazo Natasha Amunkete  
Student #: 60687509

Dear Mrs Katazo Natasha Amunkete

**Decision: Ethics Approval for 3 years  
(Humans involved)**



**Researchers:** Mrs Katazo Natasha Amunkete, P. O. Box 25614, Windhoek,  
[60687509@mylife.unisa.ac.za](mailto:60687509@mylife.unisa.ac.za), +264 81 212 8604

**Project Leader(s):** Dr CJ van Staden, [vstadcj@unisa.ac.za](mailto:vstadcj@unisa.ac.za), +27 11 670 9429  
Dr MA Schoeman, [schoema@unisa.ac.za](mailto:schoema@unisa.ac.za), +27 11 670 9178

### Working Title of Research:

The Use of E-learning to Preserve Indigenous Medicinal Plant Knowledge: A Case Study of Namibia

**Qualification:** MSc in Computing

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee for the above-mentioned research. Ethics approval is granted for a period of three years, from 23 November 2018 to 23 November 2021.

1. The researcher will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.



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The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.

3. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
4. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
5. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
6. No field work activities may continue after the expiry date (23 November 2021). Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.
7. Field work activities may only commence from the date on this ethics certificate.

*Note:*

*The reference number 086/KNA/2018/CSET\_SOC should be clearly indicated on all forms of communication with the intended research participants, as well as with the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee.*

Yours sincerely



Dr. B Chimbo

Chair: Ethics Sub-Committee SoC, College of Science, Engineering and Technology (CSET)



Prof I. Osunmakinde

Director: School of Computing, CSET



Prof B. Mamba

Executive Dean: CSET



Approved - decision template – updated Aug 2016

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## Appendix J: Proof of language editing

21 Scholtz Road  
Somerset West  
7130  
SOUTH AFRICA

1 February 2020

To whom it may concern,

### **EDITOR'S DECLARATION**

I, Jolette Roodt, professional language practitioner, hereby declare that I have edited the thesis of Master's student Katazo Amunkete.

Sincerely,



JOLETTE ROODT

jolette.roodt@gmail.com