ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA

by

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ABSTRACT

The emergence of artificial intelligence and the potential it has, has caused changes in a number of industries by promising efficiency, precision, and creativity. Artificial intelligence has the potential to completely transform metadata services in library systems by providing more efficient methods for creation, extraction, and management. Metadata specialists have a critical opportunity to improve their processes and make library collections easier to access and manage by embracing artificial intelligence. The cooperation of artificial intelligence and metadata specialists is becoming more crucial as technology advances, leading libraries into a new phase of unparalleled information retrieval and efficiency. The purpose of this study is to investigate the adoption of artificial intelligence to improve metadata services in libraries at Institutions of Higher Education in Namibia. This study adopted the Technology Acceptance Model, Metadata Theory and Digital Transformation Model as the theories grounding this study. The researcher adopted pluralistic ontological and pragmatic epistemological worldviews as research paradigms in this study. The study deployed a mixed methods research approach as well as a convergent research design and opted for parallel sampling as the type of sampling method. The population of this study was made up of metadata specialists from the University of Namibia, Namibia University of Science and Technology, and International University of Management libraries, which are the largest Institutions of Higher Education in Namibia with metadata services. Data were collected through interviews, questionnaires and observation by the researcher. The findings were integrated to ensure the study's objectives were met. The findings of the study indicated that the Institutions of Higher Education in Namibia used manual and electronic means to manage metadata services, which produced inconsistencies, duplications, and errors. This study recommends a framework to adopt artificial intelligence to improve metadata services at Institutions of Higher Education in Namibia. The recommended artificial intelligence framework contributes significantly to the knowledge of metadata services in libraries. Furthermore, the study discusses the practical implications this study could have on IHEs in Namibia, such as library policies adopting AI for metadata services and theoretical implications, such as AI in metadata services being integrated in the education curriculum.

Keywords: artificial intelligence, robotic machine, library management system, metadata services, metadata records, Optical Character Recognition technology, IHEs, Namibia.

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“So do not fear, for I am with you; do not be dismayed, for I am your God. I will strengthen you and help you; I will uphold you with my righteous right hand” ~Isaiah 41:10.

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DEDICATION

I would like to dedicate this study to my daughter, Twayambekwa Magano Namutenya. Keep believing and smiling, little girl, the world is your oyster my Peanut.

DECLARATION

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Adoption of artificial intelligence to improve metadata services at Institutions of Higher Education in Namibia

I affirm that the above thesis is my project and all the sources I have utilised or cited have been indicated and acknowledged using complete references.

Furthermore, I affirm that I submitted the thesis to originality checking and that it falls within the accepted requirements for originality.

I also affirm that I have not recently submitted this project, or part of it, for examination at Unisa for another qualification or at any Institution of Higher Education.

Tissa Magano Titus Date: January 2025

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LIST OF ABBREVIATIONS

4IR	Fourth Industrial Revolution
AI	Artificial Intelligence
HTR	Handwritten Text Recognition
IHE	Institutions of Higher Education
IoT	Internet of Things
ISBN	International Standard Book Number
IUM	International University of Management
LIS	Library and Information Services
LMS	Library Management System
NLP	Natural Language Processing
NUST	Namibia University Science and Technology
OCLC	Online Computer Library Center
OCR	Optical Character Recognition
OPAC	Online Public Access Catalogue
RFID	Radio Frequency Identification
TAM	Technology Acceptance Model
UNAM	University of Namibia

CHAPTER ONE

INTRODUCTION: SETTING THE SCENE

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

Artificial intelligence (AI) plays an important role in the development of library and information services (LIS) by ensuring that quality metadata services are provided to the users in the Fourth Industrial Revolution (4IR) (Reiche 2023). Panda and Chakravarty (2022) state that since the inception and birth of the 4IR, the LIS sector has been using AI, robotics, the Internet of Things (IoT), big data analytics, data mining and AI-aided applications and software to provide quality and reliable metadata services. Hussain (2023) suggests that AI can be used to ensure quality service in metadata services by automating metadata functions. Examples of these services include the use of chatbots and robotic machines which provide metadata services, with the aid of AI infrastructure such as Radio Frequency Identification (RFID) and Natural Language Processing (NLP) in the 4IR (Pival 2023).

Ajani, Adefila, Olarongbe, Enakrire and Rabiu (2024) define the 4IR as the evolution and transformation of industries from manual labour and skills to digital and adaptable technologies with the aid of AI, computers, and big data. AI is a science that focuses on creating machines that imitate the behaviour patterns performed by humans (Hussain 2023). AI seeks to create “intelligent” machines that work and react more like humans and rely on deep learning, machine learning and NLP that help computers accomplish specific tasks by processing large amounts of training data to help the system recognise patterns, input data to drive predictions and feedback data for improving accuracy over time (Huang 2023). Studies by Barsha and Munshi (2024), Vijayakumar and Sheshadri (2019) examined the use of AI in libraries and concluded that AI is paramount in the future of the LIS field. Ali, Naeem and Bhatti (2020) explain that LIS and AI have been linked through various channels in both reference services and technical operations through robotics, chatbots, NLP algorithms, deep learning algorithms and machine learning algorithms.

AI is also paramount in the metadata services of libraries, as it can improve search and discoverability of materials on a library management system (LMS) through auditing of the metadata record and it can catalogue automatically to ensure accuracy in indexing of materials (Cox 2023). Chan, Zhang, Vermeij and Riemer (2024) describe library metadata services as services through which bibliographic information is created and saved to describe and locate materials. These services are critical to the performance of the information management systems, allowing metadata specialists to locate objects of interest, record critical information about them, and share such information with users (Chan et al 2024). According to Monyela (2024), the focus of bibliographic metadata is on precise descriptions of specific materials that help users to find them, which include books, manuscripts, recordings, films, or reference resources. Monyela (2024) further adds that an LMS software or programme, which consists of features such as digital media, e-books, e-journals, and an online public access catalogue (OPAC), best handles these materials.

The OPAC is a database of bibliographic material, which creates the ability to connect with networks of libraries along with machine-readable cataloguing standards on an online platform (Indraji & Dominic 2024). The Institutions of Higher Education (IHEs) in Namibia have libraries with OPACs that are used as a central unit utilised by all the students and staff members to search and locate materials (Shivoro 2018). However, libraries experience challenges in cataloguing such as spelling errors in bibliographic material, steady and slow process in cataloguing material manually, and inconsistencies in entering bibliographic material in the metadata system (Jabeen 2024). These challenges affect the information retrieval of bibliographic material from the OPAC, and students are unable to acquire accurate sources to complete their assignments on time (Chewe & Chitumbo 2018). The metadata specialists are then required to go back to the OPAC record to identify and rectify the errors and inconsistencies of the record, as well as to manually search for accurate sources for students who are struggling. Hence, the study intended to adopt AI for the improvement of metadata services at IHE in Namibia.

However, there is little literature and scholarly work on the application of AI in libraries and information management (Borgohain, Bhardwa & Verma 2024). Very few studies

focused on exploring AI in libraries, such as Monyela's (2024) focus on cataloguing library resources in a South African public library. Furthermore, Yao, Zhang and Chen (2015) developed a library robot called "Xiaotu" in China. "Xiaotu" is responsible for delivering library services to users efficiently and accurately. In South Africa, robots have been introduced to improve library operations. "Libby" from the University of Pretoria is responsible for delivering LIS to the students in the library (Mathibela 2019). At the National Library of South Africa, "Sifiso" is a library assistant robot that assists students and staff members with library information and queries (National Library of South Africa 2022). However, in the Namibian context, there is not yet any literature on the application of AI in libraries.

The adoption of AI in libraries provides high-quality access to the library's bibliographic records and ensures that issues of metadata records are handled adequately (Huang et al. 2023). The adoption of AI in IHEs in Namibia attempts to solve challenges such as the lengthy copy cataloguing process, entries with errors, and low-quality records in cataloguing. To scientifically address issues experienced in libraries such as poor metadata services in IHEs in Namibia, theories such as the Technology Acceptance Model (TAM), Metadata Theory, and digital transformation theory were used to conceptualise the study's framework. The conceptualisation of this study's framework employed concepts such as the metadata lifecycle, perceived ease of use, perceived usability, and technology infrastructure.

The University of Namibia (UNAM), Namibian University of Science and Technology (NUST), and International University of Management (IUM) libraries physically house material consisting mainly of academic textbooks, academic journals, and academic reference material. Being hybrid in nature, the libraries also established e-libraries to enable students to access their collections from the comfort of their homes. Capturing the metadata of the different materials into the LMS of the UNAM, NUST, and IUM libraries is done through original and copy cataloguing. It proved to be an exhausting and tiresome process that yields database errors such as duplication of records and inconsistent capturing of bibliographic records, leading to poor or no retrieval of these materials by metadata specialists and users (Maimela 2024). However, the use of AI-embedded

Optical Character Recognition (OCR) technology as part of AI-aided metadata services can be used for full-text searches to capture digital images of a portion of the text to be converted into computer-readable text (Gozali 2024). This reduces manual input, which is prone to human errors and improves data entry accuracy. Moreover, AI-embedded OCR technology can detect and fix formatting errors in metadata records, guaranteeing that users and metadata experts can easily access and retrieve contents. AI-embedded OCR technology benefits both users and metadata specialists by optimising the digitisation and metadata creation process. This increases bibliographic record quality while also increasing the overall effectiveness of information retrieval systems.

OCR is defined as an AI-aided technology that is made up of systems that are able to perform identification, recognition, and capturing of metadata text from materials (Tella, Akanmu, Odunola & Wo 2023). In this study, improved metadata services were regarded as services where there is efficient and effective AI-embedded metadata services in place. Metadata services enable effective library services and save users' time from having to continuously searching for documents, hence improving library services. Therefore, this study intended to investigate the adoption of AI for the improvement of metadata services in libraries at IHEs in Namibia through AI-embedded OCR technology software and applications.

1.1.1 Context of the study

IHEs, also referred to as universities or colleges, are educational institutions that offer a variety of academic programmes and post-secondary education (Woyo, Rukanda & Nyamapanda 2020). These institutions provide chances for advanced learning, such as undergraduate and graduate degrees, which go beyond the high school curriculum (Ilonga, Ashipala & Tomas 2020). This study was undertaken in libraries at the following IHEs in Namibia: University of Namibia library (UNAM), Namibia University of Science and Technology (NUST), and International University of Management (IUM). The researcher considered these universities because the libraries of these universities are bigger and largely well equipped. Furthermore, the three universities have sizable staff

populations. A bigger pool of possible participants is often available at large universities, which improves the representativeness of the study's findings (Aithal 2022).

The UNAM library is a domestic information support organisation for providing access to eminent information and cognition necessary to support the strategic goals and prospectus of the university (UNAM 2022). The UNAM library was established by the University of Namibia Act 18 of 1992, in alignment with the university's deliberate goals of becoming a world-class institution of learning (UNAM 2022). With more than 25 000 students enrolled each year for the past five years, the UNAM library accommodates students' research and educational needs through physical and online spaces (Iyambo 2021). The library consists of nearly 100 databases of e-journals and e-book collections. In addition to that, the library also houses over 180 000 books and 300 print journal titles (UNAM 2022).

The NUST library is a significant support structure of the university's academic and research studies. To support the university's teaching, learning, and research activities, the library offers a vast array of information resources and services (NUST 2020). Established by the Act of Parliament (Act 7 of 2015), the university's library holds a sizable collection of books, journals, research papers, and online resources (NUST 2021). The university has enrolled thousands of students in the last decade who require both physical and online access to scholarly data (Iyambo 2021), which is provided through physical material and online databases (Shivoro 2018). Furthermore, the library consists of resources in the discipline of commerce, humanities, computing, informatics, health sciences, and engineering and spatial sciences (Najjuuko 2020).

The IUM was formally established as a private university in Namibia on October 2002, by HE Dr Sam Nujoma (IUM 2020). The IUM has established a state-of-the-art library dedicated to providing a comfortable and exciting learning environment for the students and employees (Kiana & Mabeifam 2020). To fulfil its objective of supplying library users with reliable, trustworthy sources of information to facilitate excellent instruction, the IUM library contains a broad collection that excels in scholarship and research (Kiana, Ujakpa, Iyawa, Osakwe & Iguna 2021). Furthermore, the collection is

made up of both physical and electronic materials with a vision of being a premier and technologically enabled academic library (Shivoro 2018). IUM has procured the Sirs Mandarin software, which allows library automation, and as a result, a digital area where users and students can access digital materials and services (Kiana & Mabeifam 2020).

Each library has an OPAC feature, which is readily accessible by students and staff members. It allows users to search for material housed in their library using bibliographic data of material such as the title, keyword, author, or barcode (Baba 2023). However, the researcher observed that although the libraries have reputable OPAC systems in place, the entries that are catalogued by the metadata specialists often have errors in spelling, duplication of entries of metadata, and inconsistencies in bibliographic data captured (Ajani & Sulyman 2023). Therefore, there is a need to explore possible AI software and applications to make the metadata specialist's cataloguing job faster, easier, and more accurate by capturing digital images of the bibliographic information of the material to be converted into computer-readable text (Mallikarjuna & Prabhakar 2021). Computer-readable text is data that are recognised, processed, and stored by computers to make information access easier and more efficient (Hussain 2023). Data are generated through innovations such as OCR/HTR (handwritten text recognition), born-digital material, computer vision and linked data (Romein et al. 2020).

1.2 PROBLEM STATEMENT

AI may contribute to adequate metadata services in academic libraries. AI can analyse large volumes of information and automatically extract metadata from a variety of material formats, including text, photos, and videos (Tella et al. 2023). AI guarantees accuracy and consistency across metadata services while lowering the amount of manual labour involved in metadata creation. By suggesting pertinent keywords, tags, and descriptors based on contextual analysis and semantic understanding, AI enhances user searchability and retrieval accuracy of metadata services in libraries (Faga & Yusuf 2023). The problem that led to this study was that metadata service processes might not be facilitated accurately and effectively due to the problems faced in manual and copy cataloguing materials in libraries at IHEs in Namibia. Hence, Ajani and Sulyman (2023)

state that original and copy cataloguing yields errors in records when done manually, reducing the quality of information retrieval.

IHEs in Namibia currently catalogue library materials through original cataloguing and copy cataloguing from remote databases such as the Online Computer Library Center (OCLC). Through this practice, metadata specialists experience challenges such as cataloguing entries with spelling errors, low-quality records, duplication of entries, and inconsistencies in manually cataloguing the print materials (Chewe & Chitumbo 2018). The steady process in cataloguing materials frustrates metadata specialists and causes them to skip and delay cataloguing records such as those with difficult writing/titles. Entries with errors, low quality of records and inconsistencies make information retrieval impossible because materials incorrectly catalogued are not displayed when a user or metadata specialist searches for it on the OPAC (Raju & Harinarayana 2021). This affects users because they do not find all the materials housed in the library, which makes the library incompetent and unable to support the students' educational and research needs. This means the library does not meet the needs of the users and the time of the user is wasted (Boloka, Jiyane & Mojapelo 2021). A poor OPAC system affects the progress of students in completing their studies by reducing the quality of information retrieval and increases the workflow of metadata specialists who are required to correct these errors and make a record easily accessible. Students may postpone graduation and possibly lose out on future academic and career possibilities if they are unable to finish their studies by the deadline because of a poor OPAC system that affects information retrieval.

However, the adoption of AI at the libraries at IHEs in Namibia could improve the current challenges faced by capturing bibliographic entries through AI-embedded OCR technologies. The AI-embedded OCR technology could find the original metadata in the source and output it to the library management software accordingly (Mallikarjuna & Prabhakar 2021). Asemi and Asemi (2018) and Yao et al. (2015) indicated that the application of AI can automatically detect and fix spelling errors in bibliographic entries. Furthermore, by comparing information throughout the database and finding redundant records, AI detects and eliminates duplicate entries (Ajuwon, Chigbundu, Omogbai & Agwu 2020). Hence, metadata specialists are deemed more efficient, as the library

catalogue does not have errors and duplications, and users are saved time in information retrieval (Wahid, Warraich & Tahira 2018). Therefore, this study intended to investigate the adoption of AI on improving metadata services in libraries at IHEs in Namibia.

1.3 PURPOSE OF THE STUDY

The purpose of this study was to investigate the adoption of AI to improve metadata services in libraries at IHEs in Namibia.

1.3.1 Objectives of the study

A research objective provides a clear description of what the study aims to achieve and accomplish and provides the direction for the study (Creswell 2014). Creswell (2014) further explains that it is used as a guide and pointer for relevant concepts that make up the study. In line with the conceptual framework, the researcher drafted the following objectives to guide the study:

- Evaluate the current state of metadata services at Institutions of Higher Education in Namibia.
- Examine the perceptions of metadata specialists on adopting AI to improve metadata services in libraries at Institutions of Higher Education in Namibia.
- Determine the usability of AI to improve metadata services in libraries at Institutions of Higher Education in Namibia.
- Identify the AI infrastructure needed to improve metadata services in libraries at Institutions of Higher Education in Namibia.
- Propose a framework for adoption of AI to improve metadata services in libraries at Institutions of Higher Education in Namibia.

1.3.2 Research questions

The following were the research questions of the study:

- What is the current state of metadata services at the Institutions of Higher Education in Namibia?

- What are the perceptions of the metadata specialists on adopting AI to improve metadata services at Institutions of Higher Education in Namibia?
- How can AI be used to improve metadata services at Institutions of Higher Education in Namibia?
- Why is AI infrastructure needed to improve metadata services at Institutions of Higher Education in Namibia?

1.3.3 Research dashboard

Objective	Research question	Models	Methodologies	Data collection
Evaluate the current state of metadata services at Institutions of Higher Education in Namibia.	What is the current state of metadata services at Institutions of Higher Education in Namibia?	Metadata Theory	Qualitative method	Interviews, observation
Examine the perceptions of librarians on adopting AI to improve metadata services at Institutions of Higher Education in Namibia.	What are the perceptions of the librarians on adopting AI to improve metadata services at Institutions of Higher Education in Namibia?	TAM (Perceived ease of use)	Qualitative methods	Interviews

Determine consideration in the usefulness of AI to improve Institutions of Higher Education in Namibia.	How can AI be used to improve metadata services at Institutions of Higher Education in Namibia?	TAM (Perceived usefulness)	Quantitative and Qualitative method	Questionnaire and Interviews
Establish the AI infrastructure needed to improve metadata services at Institutions of Higher Education in Namibia.	Why is AI infrastructure needed to improve metadata services at Institutions of Higher Education in Namibia?	Digital Transformation Theory	Qualitative method	Interviews and Questionnaires

1.4 JUSTIFICATION OF THE STUDY

The researcher may demonstrate and emphasise how the study helps to further scholarly research and literature in the topic of study (Creswell 2014). Justifying a study explains how and why a specific study is being done. The goal of this research was to assess the possibility of adopting AI for improving metadata services of IHEs in Namibia. The researcher chose metadata services in libraries as the area of research because of the challenges faced by metadata specialists during the process of originally cataloguing and copy cataloguing records from OCLC. These include entries with spelling errors, inconsistences in entering data in the respective fields and the slow process of cataloguing manually. If properly implemented, IHEs in Namibia can effectively catalogue and retrieve the materials on the OPAC because AI, such as OCR technology, is able to find bibliographic metadata, scan, and catalogue materials automatically (Mallikarjuna 2020). This makes information retrieval fast, efficient, accurate, and highly reliable on the three universities' OPAC systems. The research encourages libraries in Namibia to explore using AI in metadata services in libraries and to identify similar or related gaps in

libraries that can be aided by AI. Furthermore, through its framework, the results of this study may be valuable for the IHEs in Namibia because the adoption of AI for the improvement of metadata services would ensure that metadata records are automatically created, saved, and smoothly retrieved through a chatbot connected to the library catalogue. The results of this study would also add value to the body of knowledge in the field of LIS. UNAM's School of Humanities, Society and Development in Namibia should also consider incorporating the adoption of AI for the improvement of library services in the LIS curriculum. Although the study focused on IHEs in Namibia, all other related organisations may benefit from the findings and recommendations of this study.

1.5 SCOPE OF THE STUDY

The scope of a study described how far the research area was being investigated in the work and what parameters were used (Akanle, Ademuson & Shittu 2020). The study focused on adopting AI to improve metadata services at IHEs in Namibia. If the library catalogue is not properly managed, users of the library are not able to access the collection smoother and quicker. This study was conducted at the IHEs in Namibia. The researcher chose these libraries because they were recognised as the main libraries of the biggest universities in Namibia (Shivoro 2018; Iyambo 2021). Furthermore, the chosen IHEs in Namibia were also responsible for the technical services at their respective branch libraries across the country. The researcher chose IHE instead of other type of libraries as other types of libraries such as i.e., public and ministerial libraries are still cataloguing and recording records manually and do not have systems in place. The researcher focused on metadata services because these services are crucial to the success of IHEs in Namibia to provide accurate information to students at all times (Iyambo 2021).

1.6 DEFINITION OF KEY CONCEPTS

Below, the researcher defines and explains the meaning of different keywords identified, as well as concepts of great significance that are crucial to the study.

1.6.1 Artificial intelligence

AI refers to the ability of machines to do particular tasks in the image and at the pace of humans, or faster. It refers to the process through which computer systems simulate human intelligence, including perception, learning, reasoning, problem-solving, and decision-making (Omame & Alex-Nmecha 2020). AI has proven to improve the LIS sector in studies such as those of Yao et al. (2015) and Mathibela (2019). AI replicates the work of a human in a faster and more accurate manner. This shows that the IHEs in Namibia can improve their services by employing AI to improve metadata services. In the context of this study, AI is an embedded OCR technology that is designed to identify, capture, save, and enhance information retrieval of metadata records in library catalogues.

1.6.2 Robotics

A robot is a programmable machine that is created to carry out tasks without much assistance from humans (Javaid, Haleem, Singh & Suman 2021). It is designed to carry out particular tasks, adhere to rules, or come to decisions, depending on its surroundings and detectors (Pasquale 2020). Robots exist in a variety of shapes and sizes, and they are used in a wide range of settings, including homes, offices, and even space. Robotics in libraries refers to the use of robots or other machines to perform tasks and offer services inside a library (Folorunso & Momoh 2020). This can entail tasks like book retrieval and shelving, reference services, inventory tracking, security upkeep, metadata services, and even digitising library materials (Omeiza & Lanre 2020). The goal is to increase output, simplify procedures, and provide better services to library users. A number of libraries have acquired automated technology that can identify and reshelve books on their own, in order to free up staff time for other tasks (Folorunso & Momoh 2020). In the context of this study, robotics is the process of combining AI algorithms with automated systems to automate metadata services. This comprises autonomously extracting, analysing, and enriching metadata from several sources, including scanned documents or digital content, using robotic process automation (RPA). In this context, robotics decreases human labour, increases metadata quality, and facilitates better information retrieval for library users.

1.6.3 Optical Character Recognition technology

OCR technology converts scanned images or text-filled documents into computer-readable formats (Martoglia, Sala, Vanzini & Vigliermo 2021). These systems use image processing techniques and pattern recognition algorithms to identify and extract textual content from images and documents, such as scanned papers, photos, or screenshots (Kichuk 2015). OCR technology facilitates the digitisation of paper-based documents, improves text searchability, and enables the automation of data entry tasks. In the context of this study, AI-embedded OCR technology refers to the integration of AI algorithms and deep learning models within OCR systems to accurately recognise and extract textual information from images or documents to identify metadata items.

1.6.4 Metadata services

The term metadata is commonly used in the field of computer science. As libraries evolved and became technologically advanced, the experts in the library and information science field adopted the term and refer to metadata as “data about data” (Riley 2017). Any data used for identifying, describing, and locating networked electronic resources are referred to as metadata (Wijesundara & Sugimoto 2018). Metadata services are also referred to as cataloguing, which is the capturing of bibliographic data for information storage and retrieval (Riley 2017). In the context of this study, metadata services are the capturing, storage, and retrieval of bibliographic information of the materials housed in the libraries.

1.7 CONCEPTUAL FRAMEWORK

Creswell and Creswell (2018) define a conceptual framework as a network of interconnected concepts and ideas that provides an understanding of a phenomenon. Ngulube (2020) describes it as a framework comprising of different philosophies underpinning a research study. Conceptual frameworks ground research studies and serve as the basis of foundation of a study. The study employed one theory and two models to ground this research study, namely the Technology Acceptance Model (TAM) by Davis (1989), the Metadata Theory by Avram (1986), and the Digital Transformation

Model in libraries as discussed by Verina and Titko (2019). The research adopted two concepts from the TAM theory, including perceived ease of use and usability, to determine the application of AI in making the metadata process more efficient and accurate, and how it would make it easier for the metadata specialists at IHEs to accept and make use of AI in cataloguing their materials. The Metadata Theory was adopted by the study to identify and evaluate the current state of library services being provided at IHEs in Namibia. Additionally, this study adopted the Digital Transformation Model to identify and establish the AI infrastructure needed to ensure the improvement and smooth operation of metadata services through adopting AI at IHEs in Namibia.

1.8 RESEARCH METHODOLOGY

Research methodology is defined as the procedures that researchers follow in doing their study to describe and explain phenomena (Creswell & Creswell 2018). Creswell and Plano Clark (2018) add that research methodology as method is used in the field of research to solve a problem. Ngulube (2020) explains that it is a procedure that may involve several research methods to validate the research. The research methodology of this study constituted of the following sections: research paradigm, research method, research design, population, sampling procedure, data collection, data analysis, reliability, validity of the study, and the ethical considerations. In this study, the researcher followed Ngulube's (2020) perspectives on the types of paradigms. The researcher adopted pluralistic ontology and pragmatic epistemology as research paradigms in this study. The study deployed a mixed methods research approach as well as a convergent research design and chose parallel sampling as the type of sampling method.

The study consisted of a population of 20 metadata specialists from the HIE libraries in Namibia with expertise in metadata services. Of the total population, six metadata specialists were from the UNAM library. This included the senior metadata specialist (responsible for overseeing technical functions within the department), metadata specialist (responsible for the curation and accessibility of digital collections), metadata specialist (cataloguing), senior library assistant (institutional repository), library assistant (serials), and library assistant (cataloguing). Of the total population, seven metadata

specialists from the NUST library participated in the study. This included the director: library and information services, HoD: technical services, senior metadata specialist: bibliographic services, bibliographic services metadata specialist, metadata specialist: digital collections, senior library assistant: online and serials, and library assistant: bibliographic services. The remaining seven participants were from the IUM library. The participants from the IUM library were made up of the university metadata specialist who managed and oversaw library functions, three metadata specialists: cataloguing, metadata specialist: digital collections, senior library assistant: digital collections, and library assistant: cataloguing.

Data collection methods used included questionnaires, interviews, and observation. The quantitative data were analysed by descriptive methods, through tables and figures and the qualitative data are presented through thematic analysis.

1.9 ORGANISATION OF THE THESIS

This study is divided into six chapters. The introduction and background chapters are followed by the conceptual framework and literature review, research methods, presentation of the study's findings, the interpretation and discussion of the findings, and the study's summary, conclusion, and recommendations. All six chapters have an introduction, a body, and a conclusion.

Chapter 1: Introduction: setting the scene

This chapter covers the study's introduction and background, the problem statement, the study's purpose and objectives, justification of the study, originality of the study, the scope of the study, keyword definitions, ethical considerations, and the outline of chapters.

Chapter 2: Literature review and conceptual framework

This chapter discusses the conceptual framework, which includes the theories that this study was built on, as well as the literature review of the study.

Chapter 3: Research methodology

The research methodology, research paradigm, research design and population of the study, sample procedures, data collection methods, data analysis, presentation and interpretation, and the study's limitations are covered in this chapter.

Chapter 4: Presents the findings of the study

The researcher presents the findings of the study here.

Chapter 5: Interpretation and discussion of the findings

This chapter interprets and discusses the findings of the study.

Chapter 6: Summary, conclusion, and recommendations

The researcher summarises, concludes, and suggests changes to the study findings in the chapter.

1.10 SUMMARY OF THE CHAPTER

This chapter introduced the concept of adopting AI for the improvement of metadata services at IHEs in Namibia. It presented the context of the study, the problem statement, purpose of the study, and objectives of the study. The chapter also gave a brief overview on the research methodology used in the study. The next chapter focuses on the literature review and conceptual framework of the study. The chapter addresses the following themes as formulated from the objectives of the study: The current state of metadata services at IHEs in Namibia, the perceptions of metadata specialists on adopting AI to improve metadata services in libraries at IHEs in Namibia, the usability of AI to improve metadata services in libraries at IHEs in Namibia and the AI infrastructure needed to improve metadata services in libraries at IHEs in Namibia.

CHAPTER TWO

LITERATURE REVIEW: ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES

2.1 INTRODUCTION

In the previous chapter, the researcher introduced readers to the research background, problem statement, and context of the study. This chapter focuses on the literature behind AI, library services and how they are connected. A literature review is defined as a scholarly analysis of previously written work in the subject discipline or focus of a research study (Rowe 2014). Creswell and Creswell (2018) emphasise the importance of a researcher's voice and thoughts in a literature review to show interpretation and meaning from analysing previous work. A literature review is a selection of available documents relevant to a topic, which contains data and evidence written from a particular standpoint to express the views on the nature of a topic and how it was investigated in relation to the research being undertaken (Creswell 2014).

Likewise, Rowe (2014) emphasises the importance of analysing literature, as it educates the reader on the research topic, outlines areas that have been explored and the gaps that need to be filled by other researchers. This literature review for this study focused on the current state of library services in libraries and how AI can improve the library services, the perceptions of metadata specialists on adopting AI to improve library services, how useful AI can be in improving library services, and the kind of AI infrastructure needed to improve library services in libraries, especially in ensuring that the libraries use AI-aided metadata services to holistically improve the library services.

2.2 THE PURPOSE OF LITERATURE REVIEW

Rowe (2014) describes a literature review as an important component of any research study, as it forms the basis for the need for a study to be conducted in the first place. Similarly, Creswell and Creswell (2018) concur that its purpose is to understand the need and cover all areas that might need justification during a research study. Fox and Bayat (2010) acknowledge the following as the true purpose of a literature review:

- To specify that the researcher is acquainted with current research literature and developments.
- To provide comprehension of previous work in the field of study.
- To position and outline the research project and its context.
- To provide a thorough theoretical overview of existing research findings.

Another purpose of a literature review is to make significant contributions to the knowledge base of theory in research while analysing or strengthening existing theories (Torraco 2016). The purpose of this specific literature review is to build a realistic framework for considering AI for improving library services and to add onto existing literature in the field of knowledge.

2.2.1 Literature review procedure and sources

Consulting multiple sources while reviewing the literature is necessary for locating and analysing pertinent information, synthesising data, and using rational thought, summarising, assessing, and referencing abilities (Pautasso 2013). Pautasso (2013) identifies ten important points to be considered when writing a literature review:

- Define a topic and audience
- Search and re-search the literature
- Take notes while reading
- Choose the type of review you wish to write
- Keep the review focused but make it of broad interest
- Be critical and consistent
- Find a logical structure
- Make use of feedback
- Include your own relevant research but be objective
- Be up to date, but do not forget older studies

2.2.2 Referencing of sources

Referencing is an act of citing other people's ideas that have been made visible in academic publications (Neville 2016). Reference sources in research studies are a significant factor in assessing the credibility of a study. The development and dissemination of academic knowledge are the primary goals of referencing sources. According to Santini (2018), the need to trace accurate information is the driving force behind referencing and can help authors distinguish their thoughts from other people's works. It also aids in building bridges between fields of knowledge by assisting other researchers in tracing the roots of concepts.

Furthermore, references may also be required for the following reasons (Neville 2016):

- To back up a theoretical concept or assertion
- To defend the appropriateness, validity, or reliability of a method, technique, or instrument
- To demonstrate the significance or strength of a research topic, research question, or study's purpose or objective

Researchers should be willing to develop their citing guidelines and practices, as it has proven to be beneficial for both the researcher and reader. Important but under-discussed issues such as the selection of sources, particularly those from the internet need to be carefully selected and referenced in order to have quality publications (Neville 2016).

2.2.3 Steps to follow when reviewing literature

After deciding on the purpose, specific research concerns, and type of methods, it is time to begin carrying out the actual review. A trial run of the review procedure and process should be carried out when conducting the review (Pautasso 2013). Furthermore, it is important to guarantee the validity and dependability of the search technique. Depending on the type and scope of the particular review, a variety of methods might be used for the actual sample selection (Neville 2016).

According to Creswell (2014), there is no standard method for doing a literature review; however, the researcher identified four steps to be taken into account when reviewing literature:

Step 1: Investigate the existing literature in the study's discipline of expertise

Investigating the body of literature in the study's field of expertise is the first stage in performing a literature review. This entails locating and evaluating prior research studies, books, papers, and other materials that are pertinent to the subject or research question under consideration (Creswell 2014). Researchers can expand on their expertise, identify gaps in the literature, and decide whether more research is necessary by looking into the body of existing literature (Creswell & Creswell 2018).

This process should start with the choice of a specific research topic or issue, followed by a thorough search of pertinent literature sources utilising a range of search techniques (Pautasso 2013). Online databases, reference materials, and professional consultations are a few examples of these tactics. Additionally, researchers should make sure they cite reliable sources that are pertinent to their area of study (Neville 2016).

Step 2: Assess the literature gathered

The evaluation of the collected material is the second step in performing a literature review. This entails assessing the sources used for quality, relevancy, and credibility (Snyder 2019). Evaluating the literature ensures that only pertinent and legitimate literature is cited in the review, raising its general quality.

Researchers must first take into account the study’s subject or issue being looked into before deciding whether the sources they found are pertinent (Creswell 2014). The relevance, authority, and objectivity of the sources should be assessed. This entails taking into account elements such as the researcher's accreditation, the standard of the research process, and the accuracy of the findings (Pautasso 2013).

Additionally, researchers should evaluate the literature critically for biases, knowledge gaps, and other issues (Creswell & Creswell 2018).

Step 3: Create a philosophical or theoretical framework

When conducting a literature review, it is necessary to develop a philosophical or theoretical framework to serve as a guide for choosing and evaluating literature. Because it offers a conceptual foundation for comprehending the research problem, locating pertinent literature, and interpreting the findings, this framework is crucial (Creswell 2014).

A thorough comprehension of the research issue, the pertinent literature, and the research methods is necessary for the construction of a philosophical or theoretical framework (Snyder 2019). It also entails a critical evaluation of the theories and viewpoints that already exist in the discipline, which can lead to the development of fresh insights and concepts (Papaioannou, Sutton & Booth 2016). Researchers can clearly explain the rationale behind their literature study and make sure that their analysis is supported by a solid theoretical foundation by developing a philosophical or theoretical framework.

Step 4: Begin drafting up the literature review

In this step, researchers must compile and evaluate the pertinent literature using the framework they have created. The process of writing the literature review begins with a thorough search for pertinent sources (Creswell & Creswell 2018). This could entail looking up papers, articles, books, and other publications that are pertinent to the research subject in scholarly databases and other sources (Creswell 2014).

Researchers must critically assess and synthesise the data found after locating the pertinent literature. This entails examining each source's methodology, conclusions, and relevance to the research subject (Papaioannou et al. 2016). Researchers should also highlight conflicts or debates in the subject and point out gaps or contradictions in the literature (Neville 2016).

2.2.4 Map of literature review

Designed for planning and organisational purposes, a literature review map acts as a tool for guiding a researcher when conducting a literature review (Creswell & Creswell 2018).

Additionally, it creates a graphic vision of the literature review by categorising these essential concepts and creating connections or linkages between them (Creswell 2014). The researcher further adds that maps are usually presented differently according to the preference of the researcher. Researchers either use hierarchical approaches, flowcharts, or a series of circles to map their literature review. This study uses a hierarchical approach to demonstrate the map of literature review of the adoption of AI to improve metadata services, as seen below.

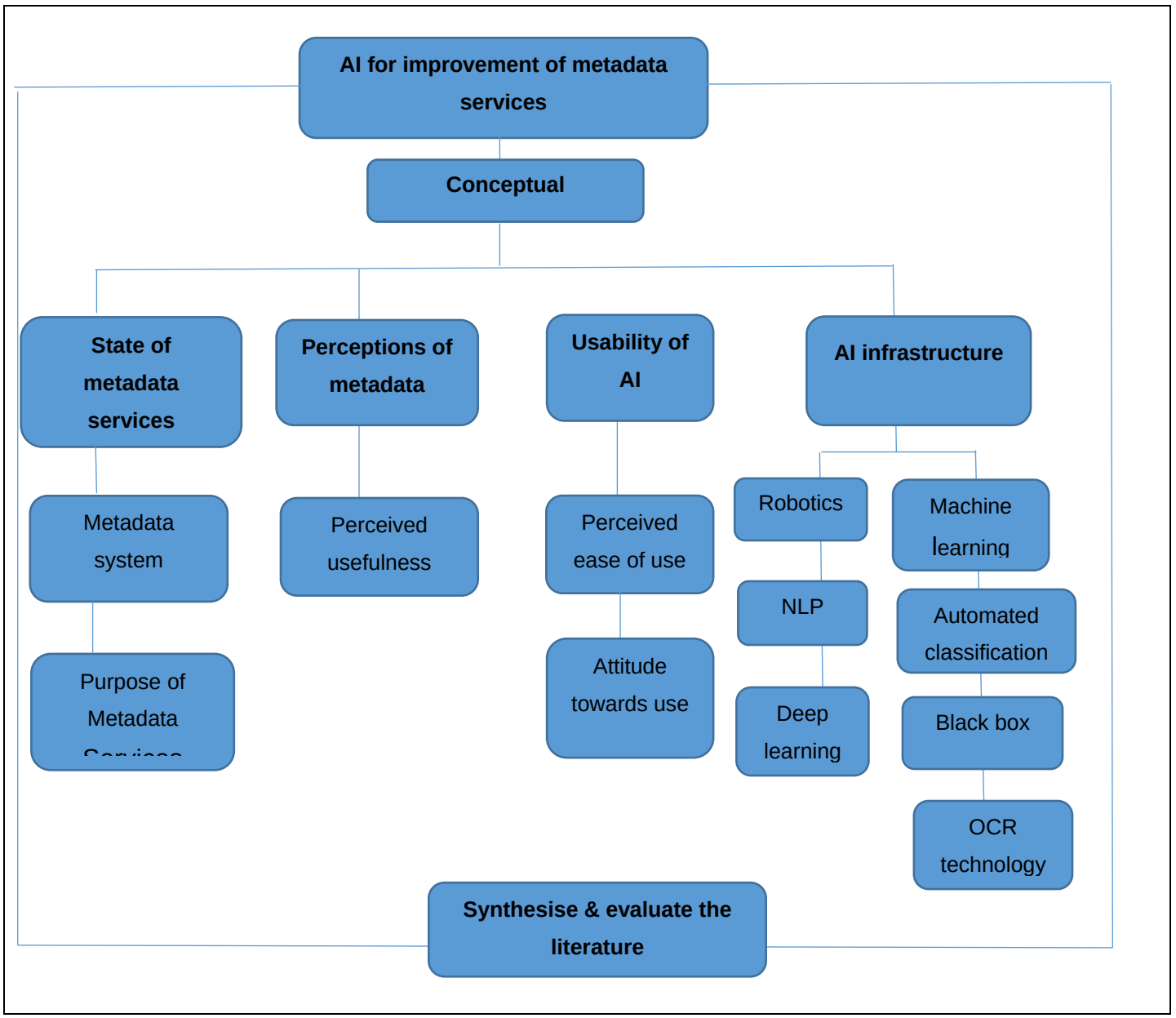

Figure 2.1: Map of the research literature (Researcher 2023)

2.3 CONCEPTUAL FRAMEWORK

Creswell and Creswell (2018) define a conceptual framework as a network of interconnected concepts and ideas that provides an understanding of a phenomenon. It is described as a framework comprising different philosophies underpinning a research study (Ngulube 2020). Conceptual framework is a combination of different theories, models, or philosophies that guide the study (Creswell 2014). By helping the researcher visualise and carry out his or her research, a conceptual framework serves as a map for a study. Conceptual framework is carefully designed to offer comprehension and understanding of a research study. A conceptual framework is made up of concepts that complement one another, articulate certain phenomena, and build a philosophy unique to that framework (Du Plooy-Cilliers, Davis & Bezuidenhout 2021).

After doing an extensive literature review, the researcher drafted a conceptual framework to ground this study. This study revolved around two key themes, namely AI and metadata services. To ground these themes, the researcher employed the TAM by Davis (1989), the Metadata Theory by Avram (1986) as well as the Digital Transformation Model in libraries (Verina & Titko 2019).

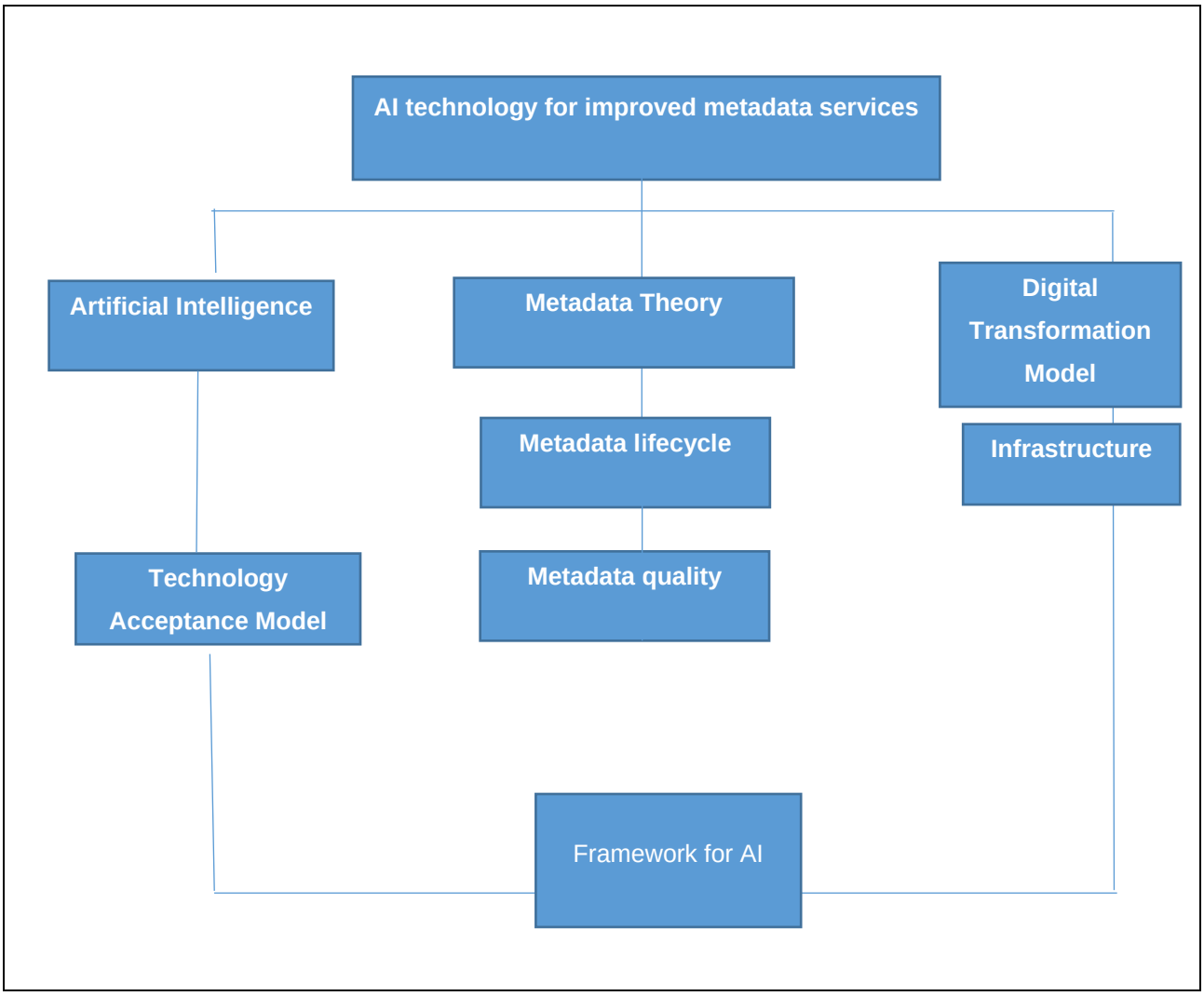

Figure 2.2: Conceptual framework (Researcher 2023)

A conceptual framework is a construct in which each notion plays a crucial part rather than merely being a collection of ideas. A conceptual framework "lays out the significant factors, conceptions, or parameters and implies linkages among them" (Miles & Huberman 2018). As seen in figure 2.2, this study adopted three concepts from the TAM theory, the perceived ease of use, perceived usefulness, and attitude towards use to determine the usefulness of AI in ensuring that the library provides quality metadata services. The TAM theory was developed in 1989 by Davis and is widely used in research matters. It is popular for evaluating or quantifying the degree of comprehension and acceptability of technology among users (Ammenwerth 2019). TAM was designed to

study and quantify the variables that affect a person's decision to adopt or reject a particular technology. The TAM model, created using psychological theory, indicates that there is a relationship between user beliefs and behaviour, views, and intentions (Lai 2017). The key driving forces behind user behaviour towards technology users are explained by this theory. Scholarly work by Davis (1989), Malatji, Van Eck and Zuva (2020) as well as Alshammari and Rosli (2020) scrutinised the TAM and revealed that it was effective at explaining people's tendency to accept technology. Furthermore, TAM efficiently explains behavioural intentions and is tailored to analyse attitudes. Therefore, the researcher adopted some of the concepts from this theory.

Libraries, which have undergone considerable changes in recent years as a result of the growth of digital technologies, might also benefit from using the notion of digital transformation (Kähkipuro 2018). Libraries must change to meet the evolving demands and standards of their users, who are in need of access to digital materials and services. The requirement to offer easy access and retrieval to resources such as books, digital archives, and online databases, is one of the main forces behind the digital transformation of libraries (Martinez 2019). As libraries undergo a digital transition, a culture shift is also necessary. Metadata specialists must be open to experimenting with new services and workflows as well as embracing new technologies. By adopting digital technology and infrastructure, libraries can offer smoother and individualised services, and better meet the changing demands of their users (Harisanty, Anna, Putri, Firdaus & Azizi 2022). Therefore, the researcher adopted the Digital Transformation Model to address the concept of AI infrastructure required to improve library services through adopting AI metadata services in libraries.

2.3.1 Artificial intelligence

A developing technology such as AI has evolved into an area of study that has been steadily replacing information communication technologies to improve human effort. It has been widely used in different industries and is recognised as an excellent innovation in the 4IR (Harisanty et al. 2022). In libraries, the goal of AI is to create computer systems or technologies that can compete with human intelligence in terms of thinking and

behaviour (Omame & Alex-Nmecha 2020). In the context of this study, AI is an embedded OCR technology that can resolve the issues of entries with errors, low quality of records and inconsistencies that make information retrieval impossible and, in turn, diminish library services in libraries. This AI can aid through automating metadata services to improve library services at IHEs in Namibia.

According to Oseji, Adekoya and Sani (2021), the technological capacity of AI is able to carry out human duties and has proven to have enhanced the operations and services of libraries. By providing better services and utilising AI, libraries may be able to better serve their users and meet their objectives. The ability of AI to function nonstop for 24 per day hours is crucial for incorporating it into library workflows (Vijayakumar & Sheshadri 2019). This can undoubtedly improve metadata services and make the library more efficient. For the purpose of this study, the researcher looked at embedding AI and AI metadata services to improve metadata services at the library. By using OCR, information in text may be extracted from documents and metadata fields like title, author, publication date, and keywords, which can be filled out automatically (Mallikarjuna 2020). Staff members at the library can enter metadata for each document automatically, saving them time and effort (Mallikarjuna & Prabhakar 2021). Hence, the metadata for the library's whole collection is kept correct and consistent. OCR makes it possible to turn scanned or visual documents into text that can be searched (Kichuk 2015). According to Kichuk (2015), the technology enables users to do keyword searches within the document's content by removing the text from the scanned material. This feature improves the accuracy and effectiveness of finding specific information within papers as well as the visibility of library resources (Paneva-Marinova et al. 2022).

2.3.1.1 Technology Acceptance Model

The TAM model plays a crucial role in technological research studies. It determines whether a certain clientele accepts a technology proposed to solve issues experienced. The theory, developed by Davis (1989), consists of four variables to assess the behaviour towards accepting a certain technology. TAM states that technology user behaviour is dependent on belief, attitude, intention, and the relationship between user behaviours

(Muchran & Ahmar 2019). For the purpose of this study, the model's goal was to clarify whether the key determinants of user behaviour towards users of technology are accepted. The researcher therefore adopted three variables from the study, including perceived usefulness, perceived ease of use, and attitude towards use to investigate the adoption of AI through adopting AI and for the improvement of metadata services. Embedding AI can improve metadata services by employing technological features, such as OCR, to capture bibliographic entries. According to Mallikarjuna and Prabhakar (2021), the OCR capability could extract the original metadata from the source and output it to the library management software, as needed.

2.3.2 Metadata Theory

Since its development by Avram in 1986, the Metadata Theory has been developed and applied significantly in the current digital era, especially with the rise of digital databases, information systems, and libraries (Bracke, McNeil & Kaplan 2023). Metadata, a term that literally translates as "data about data," offers descriptive details about resources to improve their discoverability, accessibility, and comprehensibility. The metadata theory addresses the lifecycle of metadata, including steps like creating, extracting, transforming, enhancing, validating, storing, sharing, and preserving information (Schreur & Carlson 2020). Metadata theory also addresses issues related to metadata quality, including completeness, accuracy, consistency, timeliness, and compliance with standards and best practices (Brake et al.). Quality metadata enhance resource discovery, retrieval, and usability. For the context of this study, the metadata life cycle and metadata quality components from the Metadata Theory were explored. This theory was significant to this study because they informed the objectives of the study. The researcher used components from this theory to formulate the conceptual framework of this study.

2.3.2.1 Metadata lifecycle

The metadata lifecycle refers to the stages or phases that metadata undergo from its creation to its eventual archival or disposal. Similar to the lifecycle of digital assets or information resources themselves, metadata also follows a lifecycle characterised by

various processes and activities (Schreur & Carlson 2020). According to Bracke et al. (2023), the metadata lifecycle encompasses of the following stages: The creation stage, where metadata is first generated or recorded, marking the beginning of the metadata lifecycle. Cataloguers, librarians, and metadata specialists manually enter metadata, use automated technologies, or extract metadata from already-existing sources in order to complete the creation stage. Following creation, metadata is maintained and saved in the proper systems or repositories. In order to enable effective retrieval, access, and maintenance, metadata records must be arranged, stored, and indexed. Digital asset management systems, databases, archives, and catalogue systems for libraries are examples of metadata repositories. Once stored, users can access metadata by using different interfaces, discovery tools, or application programming interfaces. Users can find and assess relevant resources by searching, browsing, and accessing metadata records. In order to increase the quality and accuracy of the information or to reflect changes to the related resources, metadata may need to be updated or modified over time. Updates could include deleting unnecessary or out-of-date information, introducing new metadata elements, or editing already-existing metadata. Lastly, to support a variety of information demands and use cases, metadata can be incorporated into various systems, applications, or workflows. Integration means connecting metadata with other systems or data sources to improve interoperability and data sharing (Johnston 2020).

2.3.2.2 Metadata quality

According to Avram's theory of 1986, the degree to which metadata appropriately, fully, consistently, and reliably depict the related resources is referred to as metadata quality (Machovec 2023). While low-quality metadata can result in mistakes, inefficiencies, and restrictions on information access and management, high-quality metadata improves resource discovery, retrieval, comprehension, and usability. Elements of high-quality metadata include accuracy, completeness, consistency, timeliness, relevance, compliance, and utility (Weitz 2020). These key concepts are significant in accessing the metadata records in libraries. In order to maximise the value and usability of digital materials in libraries, archives, repositories, and other information systems, metadata quality is crucial. For metadata to satisfy user and stakeholder expectations, quality

assurance procedures, including validation, normalisation, enrichment, and continuous maintenance, are essential (Schreur & Carlson 2020).

2.3.3 Digital Transformation Model

Digital transformation refers to the process of integrating digital technologies into many elements of a company's internal processes, techniques, and attitudes in order to radically change how they operate and provide services to their users (Verina & Titko 2019). Adoption and integration of diverse technologies are typical components of digital transformation (Vial 2019). Examples of digital transformation include connecting physical items, sensors, and devices to the internet, allowing for data collection and exchange, enabling automation and real-time monitoring or utilising intelligent algorithms and systems to automate operations, generate predictions, and enhance end user experiences (Ebert & Duarte 2018). In this study, digital transformation refers to the shift from manually cataloguing and entering metadata of library resources into the OPAC to using AI to automate the process of metadata creation and storage. The conversion process of digital transformation requires the correct infrastructure to be in place for the smooth transitioning from manual operations to automated operations (Verina & Titko 2019).

2.3.3.1 Infrastructure

The basic real world or virtual systems and facilities required for a community, company, or industry to function are referred to as infrastructure (Thacker, Adshead, Fay & Hallegatte 2019). It includes a number of fundamental elements that support and facilitate the functioning of a variety of operations and services (Verina & Tikito 2019). Organisations are increasingly turning to AI as digital transformation continues to change the corporate environment in order to obtain a competitive advantage (Roth 2019). However, a strong infrastructure is necessary to properly utilise AI for the improvement of library services. AI fundamentally needs a powerful computer environment to handle the enormous volumes of data that machine learning algorithms process (Robbins & Van Wynsberghe 2022). High-performance processors, memory, data storage, and networking capabilities are needed for a successful technology aiding AI machine.

Therefore, realising that AI requires access to high-quality computer infrastructure means that libraries must have infrastructural systems in place for gathering, storing, and managing vast amounts of data, as well as the capability to guarantee the consistency and correctness of that data (Martinez-Perez & Rodriguez-Abitia 2021).

Robust infrastructure across various systems and platforms is crucial to AI. AI cannot successfully be implemented without the presence of infrastructure. This necessitates a strong IT architecture that facilitates seamless data exchange and interoperability, as well as the capacity to manage and safeguard data across various contexts (Leiner, Bennink, Mol, Kuijf & Veldhuis 2021). According to Perc, Ozer and Hojuik (2019), AI infrastructure such as NLP enhances and increases the precision of search results and automates the handling of user requests. Therefore, a strong infrastructure is essential to supporting AI in the context of digital transformation, allowing libraries to fully explore the potential of machine learning and analytics to spur innovation and success, and ensure that the libraries provide quality services (Dhar 2020). In the context of this study, infrastructure is the virtual systems, hardware, software, and programmes that need to be installed for the AI to seamlessly automate metadata services.

2.4 STATE OF METADATA SERVICES IN LIBRARIES

The state of metadata services refers to the condition and way in which bibliographic records are being created and provided in a library. Contemporary libraries now offer both innovative and conventional library services, having transformed from centralised, paper-based computer systems into decentralised networks of digital and non-digital content (Chemulwo & Sirorei 2020). In order to recommend suitable AI, there is a need to weigh the state and benefits associated with quality metadata services.

2.4.1 Metadata system in libraries

A metadata system refers to the creation, gathering, and management of structured data components called metadata, which are used to describe, organise, and contextualise library resources like printed books, online articles, multimedia files, and digital resources (Kalita & Deka 2021). By simplifying search, retrieval, and navigation through cataloguing

approaches, the system aids users in quickly finding and gaining access to resources (Smith-Yoshimura 2020). Additionally, metadata systems facilitate interoperability between libraries by facilitating the sharing and exchange of resource data across various library networks, platforms, and systems (Kalita & Deka 2021).

Libraries around the world have been using traditional methods such as card cataloguing for several years to collect and organise bibliographic data (Eserada & Okolo 2019). Most libraries have since moved on to the electronic version of a card catalogue, known as the OPAC. Currently, libraries create and store bibliographic information of resources on OPACs through the process of original cataloguing by manually using cataloguing rules to identify and fill in metadata fields or by copy cataloguing metadata entries from resourceful databases (Iyambo 2021). Libraries use cooperative metadata production, exchange, and access to library collections by programmes like OCLC's WorldCat and national or regional library consortia (Zavalin & Miksa 2021). Furthermore, libraries are experimenting with linked data concepts and the semantic web to improve resource connections and discoverability. Libraries are linking their information with external datasets via linked data, which enhances the discoverability and contextual understanding of their resources (Raza, Mahmood & Warraich 2019). AI improves resource discovery, access, and utilisation by bringing efficiency, accuracy, and improved user experiences to metadata systems in libraries (Schreur 2020). This is done through recommendation systems, NLPs, and computer vision frameworks (Taskin & Umut 2019). Using AI to improve the current metadata services ensures that users are provided with the correct and most relevant resources at all times, workload on the metadata specialist is reduced, and the needs of the users are satisfied timeously (Chewe & Chitumbo 2018).

2.4.1.1 Metadata services reducing duplication

Duplicate records commonly occur when metadata specialists catalogue bibliographic records of materials housed in their libraries manually or during the copy cataloguing process (Zavalin, Zavalina & Miksa 2021). In an attempt to reduce duplication, libraries have been using authority control to assure uniformity in name, subject, and other regulated points of access in their cataloguing data (Wiederhold & Reeve 2021).

Duplicate or contradictory heads for the same object are avoided with the aid of authority control (Eserada & Okolo 2019). Libraries enhance resource discovery and reduce the production of duplicate data through using standardised and approved formats for titles and field phrases (Zavalin & Miksa 2021). Records are manually matched and duplicated in libraries. To find potential duplication, skilled metadata specialists compare newly received records to those already present in the catalogue (Das & Chatterjee 2015). Furthermore, to identify whether two or more entries reflect the same resource, metadata specialists use several factors, including subject headers, author, publishing information, and title (Das & Chatterjee 2015). Libraries ensure a more streamlined and organised catalogue by locating and combining duplicate records (Ullah, Shah, Asim & Muhammad 2018).

The more cataloguing requires human effort, the more duplicates of a record are likely to be found, hence the need to explore AI to reduce the duplication. AI may compare several attributes, like title, author, publication date, and ISBN/ISSN codes to evaluate metadata information and spot duplicates (Verma & Gupta 2022). To automatically find and highlight probable duplication, machine learning techniques like similarity matching or record linking can be used. Reducing duplication of records in libraries enables cataloguing to greatly enhance metadata services by speeding up the improvement of metadata creation (Roughton 2019).

2.4.1.2 Efficiency of metadata services

Every library's mandate strives to improve efficiency of services such as metadata services. Library efficiency is described as the ability of a library to achieve its mandate effortlessly, with effectiveness and little to no delays (Abdulahi, Yaya & Saidu 2020). Most libraries pride themselves on the ability to improve effectiveness and user satisfaction in performing library services (Kim, Kim & Choi 2020). With the current state of how materials are catalogued at academic libraries, the process of loading bibliographic information onto the OPAC system is slow and yields multiple errors. This significantly reduces the efficiency of the services offered by the library, as students do not receive accurate information on time. Libraries have made efforts to efficiently provide metadata

services by actively maintaining their catalogues. When fresh volumes or editions of material are released, they update catalogue records and remove erroneous or outdated metadata (Awodoyin, Osisanwo, Adetoro & Adeyemo 2016). Regular maintenance procedures, such as record cleaning and data validation, improve the metadata's overall effectiveness and usability (Abdulahi et al. 2020).

AI can identify potential problems by automatically scanning and analysing metadata, allowing metadata specialists to quickly fix and raise the quality of the data (Gul & Bano 2019). Furthermore, AI clustering algorithms can group similar records together based on their metadata attributes (Ali, Naeem & Bhatti 2020). This helps to identify potential duplicates or variations of the same resource, allowing cataloguers to review and merge similar records to eliminate duplication (Chou 2019). Users can navigate and find related information more efficiently as a result of the more accurate and context-aware searches that are made possible. However, with the aid of AI, these issues can be resolved by algorithms trained to accurately identify patterns and extract metadata from a variety of materials (Vijayakumar & Sheshadri 2019). This ensures efficiency and effective retrieval of library materials.

2.4.1.3 Turnaround times in metadata services

According to Idiegbeyan-Ose, Opeke, Aregbesola, Owolabi and Eyiolorunshe (2019), time is defined as the period of one's lifetime. In the library setting, users commonly make reference to services saving time as a reason why they value libraries. Libraries are mandated to give users access to information in the shortest period of time (Anderson, Doney, Hendrix, Martinez, Stoddart & Wright 2019). Many libraries offer information services that are user and time centred, guided by the fourth law of Ranganathan to “save the time of the reader”, which has become one of the standards for developing library collections that are timeously managed (Sathikumar 2021).

The volume of materials being processed, resources, and staffing levels available, the unique cataloguing requirements and workflows in place, as well as the size and complexity of the library's collection, can all affect the turnaround times for metadata services in libraries (Tkaczyk, Szostek, Fedoryszak, Dendek & Bolikowski 2015). When

metadata specialists fail to locate the appropriate book for a user who wanted it in a timely manner, they contribute to the rate of failure because students need access to information at all times. The introduction of AI can improve the metadata systems in libraries by saving the time of the user. This is done through automated metadata generation, which is able to examine the content of materials like books or articles and produce bibliographic metadata automatically within seconds (Schreur 2020). Furthermore, the data entry procedure can be aided by AI for metadata specialists. For instance, AI-powered autocomplete or recommendation capabilities can assist metadata specialists by anticipating and providing credible bibliographic entries based on already-existing metadata or standards (Vijayakumar & Sheshadri 2019). This quickens the cataloguing process and requires less manual labour from metadata specialists, which demonstrates its capacity to meet the requests of the library user's proficiently (Sathikumar 2021).

2.4.2 Purpose of metadata service in libraries

The goal of cataloguing in a library is to arrange and make available the physical and digital resources of the institution (Kulyk 2022). These records include fields on the title, author, subject, publishing information, and other pertinent information. The materials users require can then be found, located, and accessed either physically or digitally because of the metadata records about the physical location of objects in the library or links to online resources (Riley 2017). It assists libraries to keep track of their materials, including accessibility, circulation, and use (Choudhury, Jayanetti, Wu, Ingram & Fox 2021). For collection analysis, acquisition and deaccessioning of decision-making, and finding gaps or duplication in the collection, cataloguing data is used. Interlibrary loan services and exchange of resources among libraries are made possible through cataloguing (Chou 2019). In order to increase access to materials outside of the local collection, libraries may locate and seek materials from other institutions using metadata records.

AI, such as automatic metadata tagging, is used to create descriptions for library items like books, articles, and films (Ali et al. 2020). In order to make it easier for users to find the materials they need, AI algorithms such as NLP methods like named entity

recognition, part-of-speech tagging, and dependency parsing can analyse the text of those sources to find pertinent keywords and concepts, and create the proper metadata tags, enabling quicker retrieval of resources with greater accuracy (Schreur 2020). Furthermore, by utilising sophisticated information retrieval methods, AI can improve the search functionality of catalogues. Techniques for NLP can be used to extract information from unstructured data, enhance the relevancy of search results, and enable more complex query capabilities (Clarke & Schoonmaker 2019). Ensuring effective and efficient metadata services promotes good library services.

2.5 PERCEPTION OF METADATA SPECIALISTS ON THE USE OF AI TO IMPROVE METADATA SERVICES IN LIBRARIES

Perception refers to the ability of the brain to take in information gathered from the environment, process it, and use it to build an engaging experience (Hafri & Firestone 2021). Perception is arbitrary because each person's experiences, attitudes, and beliefs can affect how they see the world (Qiong 2017). The process through which humans comprehend and derive meaning of sensory data from the environment is referred to as perception (Hamlyn 2022). It is a basic cognitive function that enables people to comprehend, arrange, and interpret the environment around them. In this study, perception is defined as the degree to how beneficial users believe a piece of technology is in carrying out a task and how simple they believe it to be to use. it also determines whether a technology will be accepted (Ratten 2020).

The concept of perception is derived from the TAM theory, which was adopted by Davis (1989) and has been one of the most important models of technology acceptance, with perceived usefulness and ease of use as the two main elements influencing a person's intention to utilise new technology (Balaman & Bas 2021). In the technological worldview, perception refers to how/what potential operators and users of a technology might feel, think, and understand about the technology (Naicker & Van Der Merwe 2018). Although AI is proving to be a brilliant aid in libraries, the perception of metadata specialists of AI remains an important factor to consider (Cox, Pinfield & Rutter 2019). The main aspect influencing the degree of effectiveness of AI use, particularly in service provision, is how

well the innovation is viewed and incorporated into organisational operations (Gardner 2017). The three features of AI that have an impact on library services are machine learning capability, deep computing capacity, and NLP capability (Eserada & Okolo 2019). These components are fairly foreign to metadata specialists and can cause a delay in acceptance of new technology. A study done by Wood and Evans (2018) showed that 56.3% of the metadata specialists who participated in their study thought AI would fundamentally change library services for the better. Furthermore, 43.69% of the metadata specialists, who work in libraries that require improvement, believe AI would have little to no impact on metadata services.

Different metadata specialists may have different opinions on using AI to enhance library services. Some metadata specialists see AI as a useful tool that might improve user experience, streamline processes, and improve search functionality (Tinuoye, Omeluzor & Akpojotor 2016). Other metadata specialists might be more wary about implementing AI because they are worried about the possibility of biases or errors in automated processes, or because they are concerned about how automation would change the function of the metadata specialist (Paganelli & Paganelli 2017). The adoption of AI in libraries is ultimately influenced by a number of variables, such as the library's particular needs and objectives, the resources that are available, and the viewpoints and attitudes of the decision-making stakeholders, including the metadata specialists. Therefore, in this study, the researcher intended to understand the perception of the metadata specialists in using AI through adopting AI for the improvement of metadata services. OCR and other AI-assisted technologies can capture bibliographic entries, making metadata services seamless (Mallikarjuna & Prabhakar 2021).

2.5.1 Perceived usefulness

Users' perceptions of a technological innovation's usage are referred to as perceived usefulness (Ratten 2020). This idea, which comes from TAM, describes the extent to which a person thinks that using a certain system will enhance their ability to execute tasks (Davis 1989). The term "perceived usefulness" refers to the degree to which one believes that employing technology will help them (Davis 1989). Utilising technology is

thought to provide benefits for the user, and perceived usefulness is the subjective capacity of potential users to believe that utilising a particular technology will boost performance in the organisational environment (Muchran & Ahmar 2019). In the context of this study, it was seen as the perceived usefulness of AI for the improvement of library services at the academic library. Tasks such as cataloguing are frequently done for retrieval and the efficient running of library services. Library services require human effort, time, and critical attention to avoid duplications or slow delivery (Timoshenko 2020).

Manual operations of these tasks require sufficient resources in terms of the staff complement, time, and money. All these factors increase the possibility that a human error can occur, which will destroy the efficacy and output of library services (Wang, Huang, Li & Chen 2020). Many libraries implement task automation in an effort to boost effectiveness and efficiency. With the introduction of AI in libraries, administration, dissemination, and tracking of library materials remains the same; but it takes place much faster, more accurate, and more effective due to the speed and accuracy of AI in creating metadata tags.

A study by Moes and Vliet (2017) revealed that prospective users will see an AI technological innovation as enhancing their ability to accomplish their jobs by cutting down on the effort needed to complete specific tasks or delivering information on time. However, in the event that the users had a negative perception towards the usefulness of AI, they would still be eager to utilise it if it proved to be useful in accomplishing their tasks (Xia, Zhang & Zhang 2018). This makes AI highly useful in libraries, especially when improving metadata services.

2.6 USABILITY OF AI TO IMPROVE METADATA SERVICES IN LIBRARIES

The concept usability refers to how simple and effective it is for people to learn, understand, and use a product, system, or interface. It evaluates the user experience and the degree to which users can effectively and satisfactorily accomplish their goals (Wu, Rohatgi, Keesara & Chhay 2021). According to Machidon, Stoica and Tavčar (2020), usability is the measure of how user-friendly, effective, and efficient a system, product, or interface is at satisfying user needs. It includes features like user satisfaction,

accessibility, error prevention and recovery, memorability, and simplicity of learning. The goal of usability is to make sure users can quickly comprehend and navigate a product or system, complete activities effectively, learn from mistakes, and have a positive experience (Miraz, Ali & Excell 2021). Usability is a design and development priority that helps users be more productive, satisfied, and overall have a better user experience (Liu, Fu & Liu 2023). When users are comfortable with the system or product, usability indicates how quickly and accurately users can complete tasks. It is the capacity of users to recall, without having to learn again, how to operate a system or product over time (Miraz et al. 2021). Users are more likely to retain information and skills when it is memorable and consistent.

In the context of this study, usability refers to how well AI improves cataloguing and metadata operations' correctness, efficiency, and user experience. It recommends AI that is simple to use, integrated into cataloguers' existing workflows, and intuitive. This involves making user interfaces simple to understand and operate, reducing the learning curve for using AI. In order to speed up the cataloguing process, the AI algorithms, such as image recognition algorithms powered by computer vision techniques, text mining algorithms such as rule-based or machine learning-based approaches and deep learning models, should effectively assess and process the metadata, making precise suggestions and automating tedious operations (Woodward 2018).

2.6.1 Perceived ease of use

AI is a key factor in the modern information world that influences the effectiveness and quality of library operations (Omame & Alex-Nmecha 2020). With its implementation, the notion of the library and information science profession is significantly transformed from an outdated one to a more contemporary one (Asemi & Asemi 2018). While many of the most recent technology developments in libraries are still in the development stages, there are cases where these developing technologies have already been used and their effects have been seen (Cook & Gregory 2018). Perceived ease of use, according to the TAM, is the degree to which people think utilising a specific technology would be effortless (Scherer, Siddiq & Tondeur 2019). It includes how the user feels about the cognitive work

needed to utilise and comprehend the technology, as well as how confident they are in their ability to do so (Omotayo & Haliru 2020). These developments allow metadata specialists to perceive the ease of use. Sugandini (2018) states that perceived ease of use plays a role in the attitude towards the use of use technology. Therefore, it is necessary to analyse the perceived ease of use by the end user. Metadata specialists who think that AI is easy to use are more likely to take advantage of the opportunity to improve the library services because it is assumed that a technology is accepted if it is easy to use, which results in high usage and usefulness (Khan & Qutab 2016).

According to Dee and Allen (2006), the easiness of using technology is essential to the actual use of the technology by metadata specialists. It is the level at which technology is believed to relief human effort. Metadata specialists must ensure they are ready to accept, implement, and assess improvements that have the potential to offer expanded services to users as new technologies emerge (Mustafa, Ahmad, Shaari & Jannat 2021). AI devices aimed at improving library services can robotically correct many errors, including duplications and incorrect bibliographic data, allowing libraries to meaningfully advance the quality of their data (West 2015). This reduces human effort and makes the process of cataloguing smooth and efficient. In the context of this study, AI can be deemed easy to use when the metadata services in the library are streamlined and simplified. This entails those repetitive processes during cataloguing are automated and redundant complexity is reduced. To reduce the human work required by metadata specialists, AI algorithms like deep learning, key extraction and text classification can be used, for instance, to automatically extract metadata from resources and recommend appropriate metadata tags (Egloff & Picca 2020).

2.6.2 Attitude towards use

Attitude towards use refers to a person's logical and objective assessment of the technology or system under consideration for adoption (Weng, Yang, Ho & Su 2018). It represents the impression of the technology's utility and efficacy based on objective standards and data (Teo 2009). It is a key element of the TAM that affects people's intentions to embrace or reject a technology depending on their attitude towards using it.

The attitude towards use includes both subjective and objective elements, reflecting people's opinions on the technology and its prospective advantages (Weng et al. 2018).

Individuals' intents to utilise a technology are directly related to their attitude about use in TAM (Hossain, Bao, Hasan & Islam 2020). While negative views hinder adoption goals, positive attitudes toward use improve the likelihood of acceptance and adoption (Kemp, Palmer & Strelan 2019). To encourage a favourable attitude towards use, organisations and designers must address users' concerns, offer support and training, and highlight the advantages of the technology (Weng et al. 2018).

In the context of this study, attitude towards use refers to the perceptions, beliefs, and evaluations of individuals such as metadata specialists regarding the adoption and utilisation of AI technologies for enhancing metadata services in the respective libraries.

2.7 AI INFRASTRUCTURE TO IMPROVE METADATA SERVICES IN LIBRARIES

AI infrastructure refers to the fundamental technological structures and elements that support the creation, implementation, and use of AI and systems (Dhar 2020). For effective AI processing, data management, model training, and inference, AI technology requires a combination of hardware, software, and networking resources (Karaaslan, Bagci & Catbas 2019). The scale of operations and the needs of the AI applications determine the architecture and implementation of the AI infrastructure (Wozniak 2019). In libraries, AI infrastructure plays a crucial role in providing library metadata services to transform technical services (Schreur 2020).

AI infrastructure supports AI in the ability to perform automated processes such as identification and extraction of bibliographic information from a resource (Harisanty et al. 2022). The automatic extraction of descriptive metadata, such as titles, authors, subjects, and keywords, can be done through AI algorithms by analysing library materials, photos, and other data elements (Cox et al. 2019). By automating the process, metadata specialists can create metadata more quickly and consistently while also exerting less physical labour (Schreur 2020).

AI algorithms are able to examine and improve existing metadata information through the use of machine learning and NLP techniques (Vijayakumar & Sheshadri 2019). Identifying connections between entities, putting out extra subject phrases or proposing relevant resources are some examples of this. AI can assist in enhancing the metadata's accuracy, completeness and contextual significance (Schreur 2020). Metadata records can be examined by AI algorithms for mistakes, inconsistencies or missing information (Uzwyshyn 2022). They can offer automatic validation checks, such as determining whether metadata standards are being followed or identifying potential problems with the quality of the data (Schreur 2020). This ensures that the library systems' metadata is of a high calibre.

Applications in the fraternity include robotics, speech recognition, artificial neural networks, image processing, natural language processing, expert systems, and fuzzy logic (Vijayakumar & Sheshadri 2019). It has become evident that AI infrastructure plays a crucial role in the adoption of AI. Machine learning is made possible by AI infrastructure and has been observed from Apple's Siri feature and self-driving cars (Modiba, Ngoepe & Ngulube 2019). Even though these fields are not distinct, two or more applications sometimes help to improve library services. AI infrastructure enables robots to efficiently and effectively extract records, guaranteeing that organisations have quick accessibility to information (Jackson 2011). AI provides a very helpful shortcut for using this knowledge and obtaining better results. With the aid of AI, libraries concentrate on improving access to content (Whitehair 2016). However, to improve metadata services, a library needs to be equipped. This means that it should meet certain requirements to implement the technology needed. Therefore, the researcher explored the AI applications below to assess the AI infrastructure needed to improve metadata services in libraries.

2.7.1 Robotics

Robotics is generally referred to as a branch of AI that focuses on motor and perceptual skills. Robots are mechanical devices that automate tasks under direct human control or via the use of prepared algorithms and AI approaches (Omeiza & Lanre 2020). Therefore, robotics is a cognitive relationship between behaviour and its perception. It is the study

of robots, including their construction, fabrication, and applications or uses. Furthermore, it is any machine created to carry out actions when it is encoded via an automated procedure (Mason 2012). Researchers and specialists in the field of AI are developing intelligent systems that can understand and act like metadata specialists called “library robots” (Tella & Ajani 2022). For instance, in South Africa, a robot named “Sifiso” was designed to enhance library services at the National Library of South Africa (National Library of South Africa 2022). “Sifiso” is capable of performing library services through offering information services, responding to inquiries, and providing reference services such as attending to frequently asked questions and referencing (National library of South Africa 2022). In China, ‘’Xiaotu” was developed to improve information services to users (Yao et al. 2015). “Xiaotu” is a digital, intelligent chatbot that assists researchers with their search inquiries and offer on-demand virtual reference services (Yao et al. 2015). AI’s ability to manage library functions allows metadata specialists to use their time to perform other technical department duties such as repairing books and compiling statistics (Omeiza & Lanre 2020). The ultimate goal is to increase speed, efficiency, and effectiveness in processing library materials and improve library service delivery at all levels, because computers can work effectively at a level and speed beyond human capacities.

According to Vijayakumar and Sheshadri (2019), the spread of information technologies in library management has given rise to various viewpoints because of the widespread perception that the employment security of metadata specialists and other information professionals would be threatened by the usage of AI and robotic machines. However, robotic machines could enhance metadata services by automating the metadata creation process through digitising and scanning physical items, extracting metadata and filling metadata records (Monyela 2024). This boosts productivity and reduces the amount of physical effort metadata specialists have to do. Furthermore, robotics can improve the retrieval of metadata records through the use of AI storage solutions and automated retrieval systems (Tella et al. 2023). This improves library access to materials while advancing resource retrieval.

2.7.2 Machine learning algorithm

Machine learning algorithm is the scientific study of statistical models and algorithms when a computer system is employed to carry out a particular activity (Gundakanal & Kaddipujar 2019). It is considered to be a part of AI that gives systems the capacity to autonomously learn from history and improve without being expressly directed. In order to generate predictions or choices without being explicitly taught to do so, machine learning algorithms develop a mathematical model based on sample data, often known as training data (Khanzode & Sarode 2020). Thousands of resources are acquired and processed by academic libraries annually. In order to make it simple for students to search and retrieve acquired resources using the library database, metadata specialists create metadata through the process of cataloguing. In most libraries, this is done manually. With the introduction of machine learning in libraries, a wide range of potential processes can help libraries create metadata for its printed and digital collection (Gundakanal & Kaddipujar 2019). There are two main methods of machine learning algorithms: supervised or unsupervised. These two main categories of machine learning algorithms depend on the kind of data researchers are trying to understand. For instance, a supervised machine learning algorithm might be considered if attempting to examine structured data (Asemi, Ko & Nowkarizi 2020).

Unsupervised machine learning algorithm's task is examining completely unstructured data or metadata. These two techniques use different machine learning algorithms and technological tools (Gundakanal & Kaddipujar 2019). In addition to speeding up the creation of information, machine learning algorithms enable cataloguing to increase the range and depth of subject keywords. The use of machine learning algorithms in libraries has been explored in studies by Griffey, Yelton, Kim and Boman (2019) and Cordell (2020), who found that library services can benefit from machine learning algorithms combined with intelligent object-centred approaches. Furthermore, the use of machine learning techniques and machine learning methods can benefit all tasks related to information capturing and semantic indexing with a standard query language for information retrieval. The machine learning algorithm has been exercised in Konkol (2014) through the concept of "Brainy", which is a machine learning library. The

importance of this algorithm lies in the fact that machine learning algorithms can be set to automatically extract metadata from a variety of resources, including books, articles, and digital files (Gundakanal & Kaddipujar 2019). This automation increases the effectiveness of creating metadata and considerably reduces the amount of manual labour needed for cataloguing. Machine learning algorithms can compare metadata attributes such as titles, authors, or ISBNs to identify duplicate records in the catalogue (Cordell 2020). Machine learning algorithms ensure accuracy through quality control and reduce redundancy in metadata services.

2.7.3 NLP algorithm

The NLP algorithm is a branch of AI infrastructure that focuses on how robotic machines and actual human language interact (Woodward 2018). Training computers to comprehend the language that human beings use is one of computer science's long-standing objectives. It includes techniques for assisting machines in comprehending, interpreting, and producing human language (Tella et al. 2023). With a restricted vocabulary and syntax, AI experts have largely succeeded in creating natural language interfaces (Woodward 2018). By using NLP algorithm, a machine can understand the key linguistic ideas contained in a query or answer. Its objective is to create computers that can analyse, comprehend, and produce language the way people do intuitively (Perc et al. 2019). The use of the NLP algorithm to retrieve relevant information in libraries has become crucial due to the recent growth in information available. This application's major goal is to make it possible for users to access any paragraph, book, or large-scale text through enhancing information retrieval in libraries (Taskin & Umut 2019). NLP algorithm is able to aid in subject indexing and information retrieval systems (Cox et al. 2019).

The use of NLP in libraries has been explored in studies by Asemi and Asemi (2018) and Kamath, Liu and Whitaker (2019) and was found to be an excellent AI infrastructure, as it assists in managing and improving libraries and library management systems on functionalities of metadata capturing for the enhancement of library services. Written material can be generated automatically from library resources and analysed using NLP algorithms (Woodward 2018). The generation of precise and effective metadata is made

possible by extracting metadata elements from text documents (Kocaman & Talby 2021). Advanced algorithms are used by NLP-powered translation technologies to reliably translate catalogue entries into a variety of languages (Khan, Gupta, Sinhababu & Chakravarty 2023). This feature greatly enhances metadata services by making the catalogued contents understandable and accessible to users of a wide range of language backgrounds (Haffenden, Fano, Malmsten & Börjeson 2023). NLP applications break down language barriers and enhance metadata records, which in turn increases efficiency in metadata services by reaching a larger audience of library users.

2.7.4 Automated classification algorithm

Automated classification algorithm refers to a computer approach or procedure that allocates predetermined groups or tags to data based on its properties or qualities; this is referred to as an automated categorisation algorithm (Hartmann, Huppertz, Schamp & Heitmann 2019). According to Vijayakumar and Sheshadri (2019), it is a machine learning technology that classifies or categorises data points into separate categories without the need for overt human intervention. It does this by using statistical analysis and pattern recognition to enable effective categorisation and retrieval by automatically assigning precise and defined titles, key phrases or identifiers to library items depending on their subject matter (Schreur 2020). This guarantees that metadata records are created consistently despite differences in the knowledge or interpretation of individual metadata specialists.

By applying types, fields, identifiers, or other types of metadata to information, automated classification algorithm guarantees that records are always kept in an orderly fashion for rapid and easy retrieval. This type of classification is carried through via analysis of language or biometrics (Woodward 2018). The computerisation of the subordinate classification is increasingly required to boost catalogue production efficiency and relieve classifiers of their intense workload (Ali et al. 2020). Automated classification algorithm thus makes the retrieval of information easy, fast, and efficient. By using AI, automated classification algorithms examine the text or other aspects of the resources and then choose appropriate subject headers from predefined taxonomies or controlled

vocabularies (Martoglia et al. 2021). Through automation, manual subject analysis is no longer necessary, and the metadata creation procedure is sped up (Mallikarjuna & Prabhakar 2021). Automated classification algorithms guarantee consistent and uniform metadata records by accurately assigning pertinent categories or subjects to resources (Ali et al. 2020). These algorithms were important for this study because of the automatic classification of materials into predetermined classes or categories. The algorithms identify patterns from training data and make precise classification decisions by utilising machine learning techniques such as neural networks, decision trees, and clustering (Woodward 2018). Automatic classification enables automated metadata creation and retrieval, optimises the browsing experience for library users, and enhances the discoverability of materials (Lepak 2019). This enhances metadata services in libraries and enables easy retrieval of metadata records.

2.7.5 Deep learning algorithm

According to Tshimanga, Atzori, Del Pup and Corbetta (2022), deep learning algorithm is defined as a type of neural network that allows for the computational viability of multi-layer neural networks. A variety of neural network topologies with different purposes make up the crucial new field of deep learning in machine learning algorithms (Wang et al. 2020). One of the crucial roles for computers has always been the processing and analysis of data. When dealing with modest amounts of data in the beginning, building a characteristic set can almost precisely extract useful information; but, when dealing with large amounts of data, the conventional method is less dependable (Bai et al. 2020). A deeper series of algorithms for machine learning, called deep learning, is experienced through autonomous metadata generation. Deep learning algorithms can be taught to create metadata for manuscripts, periodicals, books and other library materials (Vijayakumar & Sheshadri 2019). By doing so, the precision and uniformity of the metadata may be ensured while also saving metadata specialists time and effort (Abayomi, Adenekan, Abayomi, Ajayi & Aderonke 2021). Furthermore, this AI infrastructure can be used to mine relevant information from the text of publications and literature (Timoshenko 2020). In order to increase the accessibility of resources, it can be used, for instance, to identify significant topics, subjects, and concepts as well as to

produce subject headings and other information (Vijayakumar & Sheshadri 2019). Convolutional neural networks (CNNs), in particular, are excellent at image identification tasks when using deep learning models (Nagisetty & Gupta 2019). Libraries can automatically recognise and extract graphical metadata, such as book covers, artwork, or visual content within documents, by training CNNs on massive sets of photos (Hung et al. 2020). This visual metadata improves resource discovery and adds more context to the materials being catalogued (Nagisetty & Gupta 2019). Textual content can be processed and analysed using deep learning models, such as recurrent neural networks (RNNs) and transformer models like BERT or GPT (Bai et al. 2020). According to Bai et al. (2020) deep learning aids in the production and enrichment of metadata by automatically extracting significant ideas, entities, and relationships from text. The identification of subject phrases, keywords, or topic categories linked to resources can be aided by deep learning-powered techniques, enhancing the metadata creation and discoverability (Vijayakumar & Sheshadri 2019). The deep learning algorithm was crucial in this study because it is able to automate metadata creation and comprehend the semantics of catalogue entries. This aids in the creation of more precise and complete metadata tags.

2.7.6 Black box algorithm

A black box algorithm is a sphere of AI infrastructure that controls the input and output of a machine or system without revealing how it actually works (Castelvecchi 2016). Deep networks of artificial nerves spread input and choices across tens of thousands of synapses in black box models, creating an intricate system that may be just as challenging to comprehend as that of the human brain (Lange et al. 2023). Black box algorithm development is generally used for deep learning modelling. Streams of points of data are used as inputs by the learning algorithm, which correlates particular data aspects to produce outputs (Woodward 2018). Black box algorithm assists libraries in producing metadata for digital resources, enabling catalogues to greatly enhance the breadth and depth of search phrases while also speeding up metadata development (Vijayakumar & Sheshadri 2019). Black box algorithms typically attain great levels of accuracy and performance, particularly those built on machine learning and deep learning

approaches (Komarova & Kuznetsov 2019). Furthermore, the black box algorithm feature is able to take in vast volumes of data, identify complex patterns, and make predictions or conclusions based on the knowledge gained (Schreur 2020). This could improve the precision and dependability of metadata services, hence raising the standard of resource finding and cataloguing. The black box algorithm was important for this study because it can automatically analyse and extract pertinent information from unstructured textual data, which helps libraries create metadata records. These algorithms can speed up metadata creation by automatically determining the similarities and differences between bibliographic information for cataloguing (Schreur 2020).

2.7.7 Optical character recognition

OCR technology can be used to transform text found in scanned documents or photographs into machine-readable text (Setty 2024). The technology is able to recognise characters, phrases, and sentences through the examination of patterns and shapes, making printed materials digitally readable. OCR technology has the ability to digitise numerous amounts of printed material, making available a multitude of previously inaccessible or unreadable information (Bangdiwala, Mahadik, Mehta, Salunke & Das 2023). According to Tella et al. (2023), this AI infrastructure not only saves time and effort in creating metadata records, but also has improved information retrieval and metadata services in various libraries. Additionally, OCR technology facilitates the cataloguing of unique or difficult-to-read content. OCR technology adds invaluable resources to library collections by enabling the text of old papers with faded ink or outdated typefaces to be recognised (Syu, Chang & Chang 2023). Similarly, OCR technology can handle handwritten notes or marginalia, providing a comprehensive and precise metadata record of the resource (Schoen & Saretto 2022). OCR technology saves time and eliminates the possibility of erroneous metadata records by identifying key bibliographic information to be added to the library catalogue within seconds (Tella et al. 2023). The OCR technology is further able to capture metadata records and perform quality control on the records to ensure consistency, precision, and uniformity (Martoglia et al. 2021). OCR technology was important for this study as it has the ability to greatly enhance metadata services in libraries.

2.8 SUMMARY OF THE CHAPTER

This chapter focused on key aspects of the study such as the purpose of literature review, the literature review procedures, the referencing of sources, the map of literature review, and conceptual framework of AI for the improvement of metadata services in libraries. Furthermore, chapter two discussed the themes of the study, including the state of metadata services, the perception of the metadata specialists on AI, and usability of the AI and AI infrastructure. The following chapter focuses on the research methodology section of this study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

In the previous chapter, this study discussed various themes of the literature review and conceptual framework for the improvement of metadata services. The researcher explored theories such as the TAM model, Metadata Theory, and the Digital Transformation Model. This chapter of the study constitutes of various sections, which make up the research methodology of the study. The research methodology in this study refers to the research paradigm, research approach, research design, population of the study, sampling method, data collection methods, data analysis and interpretation, reliability and validity of the study and the ethical considerations. This chapter covers descriptions, explanations, and phenomena that researchers follow in doing their study (Creswell & Creswell 2018). The researcher applied the mixed methods research (MMR) approach as informed by pluralistic ontological perspective and a pragmatist epistemological perspective of the study. According to Kaushik and Walsh (2019) and Creswell and Creswell (2018), a pragmatic paradigm is a worldview for MMR. Hence, the researcher employed a pragmatic perspective for this study. Figure 3.1 presents the map of the research methodology for the study.

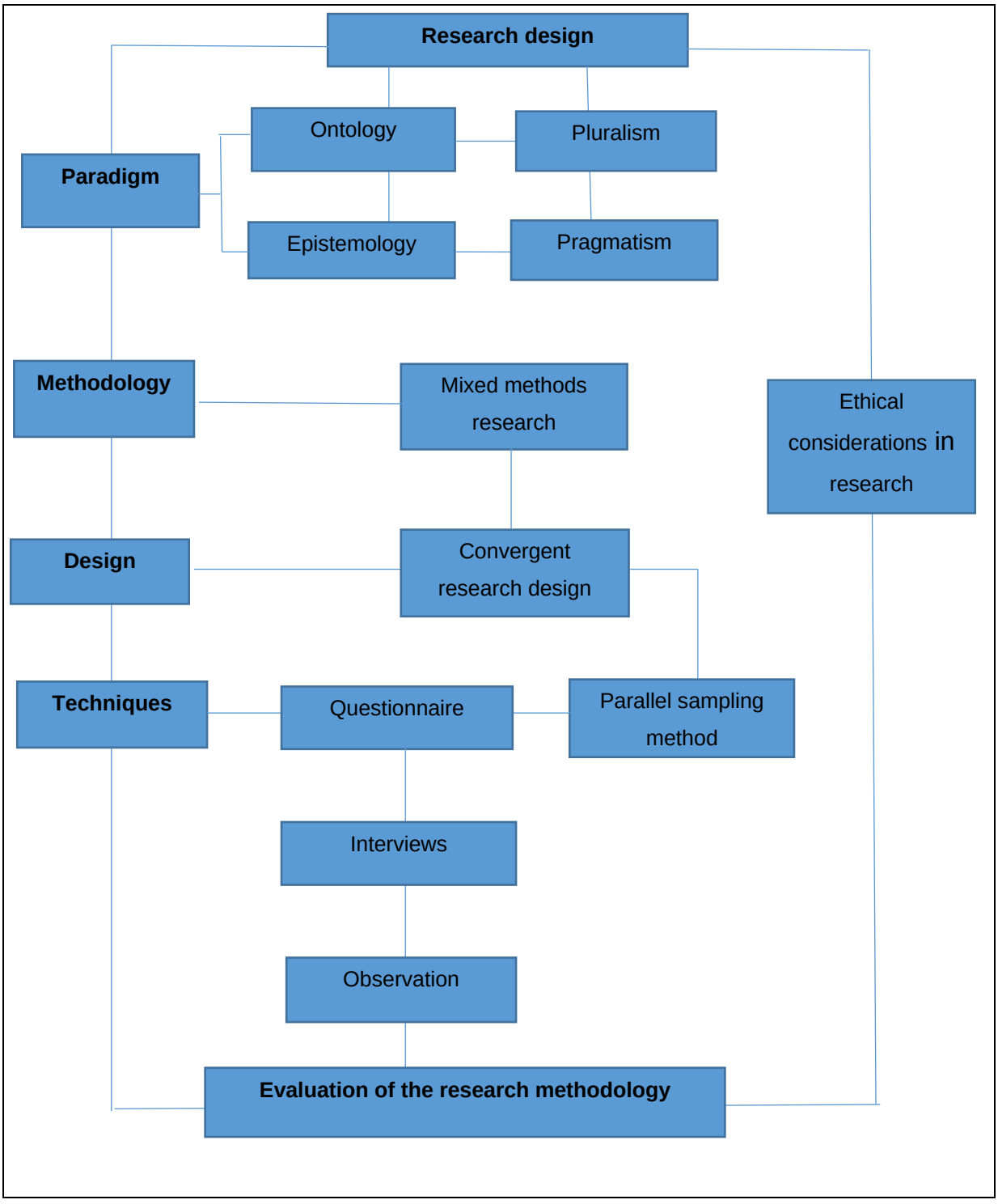

Figure 3.1: Research methodology map (Ngulube 2019)

3.2 RESEARCH PARADIGM

Understanding and expressing thoughts about the nature of reality, what can be known about it, and how to go about acquiring this information are essential skills for researchers. These constitute research paradigm components. Creswell and Creswell (2018) refer to research paradigms as philosophical worldviews and explanatory frameworks that underpin studies inclusive of positivism, constructivism, transformative, and pragmatism. A paradigm is crucial to the ideologies and processes of a specific topic, directing to an exact method of observing a particular concept (Corbett & Kember 2018). On the other hand, Du Plooy-Cilliers et al. (2021) defines research paradigms as a cluster of beliefs that govern how research should be done and how results should be interpreted. Saunders, Lewis and Thornhill (2019) mention five major philosophies: positivism, critical realism, interpretivism, postmodernism, and pragmatism. Bryman (2012) and Creswell and Plano Clark (2018) further explain that a paradigm implies a design, a structure, and an outline or system of systematic and academic thoughts, ethics, and expectations. Terre Blanche, Durrheim and Painter (2006) and Corbett and Kember (2018) opine that the research paradigm has three main dimensions, which are ontology, epistemology, and methodology. Teddlie and Tashakkori (2009) argue that there are critical paradigm issues, especially in mixed methods literature consisting of ontology, epistemology, axiology, and methodology. However, just like Ngulube (2020), this study acknowledged only two philosophical perspectives: ontology and epistemology. Therefore, this study adopted a pluralistic ontological paradigm and a pragmatistic epistemological paradigm as the research paradigms of this study.

3.2.1 Ontology

Ontology originates from the Greek word “ontos”, which means being, and “logos”, which means theory: hence, researchers define it as the “theory of being and existence” (Scotland 2012). The essence of what we think about reality is referred to as ontology. Reality is believed to be constant and governed by rules of nature (Blaxter, Hughes & Tight 2010). Antwi and Hamza (2015) justify ontology as "the way the researcher defines the truth and reality." Ontology is also described as the study of the questions, "What is

there that can be known?" and "What is the nature of reality?" (Lincoln & Guba 2013). To establish how the library perceives the use of AI for improving the metadata services, it is imperative for this philosophy to be explored. Ontology refers to our views as researchers about the nature and standing of the social world and the truth. According to Ngulube (2020), ontology is defined as the study of being; it is concerned with what actually exists in the world. It constitutes the beliefs in the existence and nature of social reality. Ngulube (2020) recognises realism, pluralism, and constructivism as the types of ontologies that exist. Therefore, this study opted for pluralism as ontological perspective.

In its simplest term, pluralism denotes a diversity of beliefs and practices (Shaw & Frost, 2015). Ngulube (2020) describes pluralism as the mixing of different pragmatic worldviews to limit the likelihood of the data or its denotations being reduced, so bringing a range of perspectives to the study. It recognises the range of pragmatic perspectives within and between methodologies. The idea of pluralism is the conviction that there are various ways to exist. Pluralism refers to the blending of paradigms, data, and/or analysis methodologies in order to encourage diversity, actively seek understanding across lines of difference, and engage in personal and methodological discourse in order to promote and foster understanding of research inquiry and findings (Frost & Nolas 2011). There may be a wide range of values, traditions, and perspectives associated with this topic (Frost & Nolas 2011).

According to Bryman (2012), pluralism in its most fundamental form suggests the combination of research methodologies to promote and nurture understanding of the research problem and results. Pluralism is a term that simply means mixture. Furthermore, Ngulube (2020) associates' pluralism with pragmatism, as the assumptions for the mixed methods approach. Researchers can use a variety of methodologies to cross-validate results by employing pluralism. The process of triangulating, which involves correlating findings from many methodologies, strengthens the validity and dependability of study findings (Creswell & Creswell 2018).

Pluralism was used as an ontological perspective in this study because pluralism works best in MMR like this study. The researcher adopted the pluralist ontological approach to

combine data collection, analysis, and research methodologies to investigate the adoption of AI to improve metadata services at IHEs in Namibia.

3.2.2 Epistemology

Creswell (2014) refers to epistemology as the foundation and logic of knowledge. Epistemology emanates from “episteme”, which is a Greek concept referring to knowledge and truth, and the suffix “ology” comes from the Greek word “logos”. This directly translates to epistemology as “theory of knowledge” (Ngulube 2020). Epistemology provides a rational footing for shaping what types of knowledge are feasible. Creswell and Plano Clark (2018) outline epistemology as the structure of information. Epistemology is the charter of knowing. In general, epistemology refers to predictions made by academics about the nature or current state of knowledge or how that knowledge is likely to develop. According to Creswell and Plano Clark (2018) and Flick (2015), positivism, interpretivism, and pragmatism exist as perspectives in epistemology. This study deployed pragmatism as the type of epistemological worldview to be used for this mixed methods study.

Pragmatism is defined as the practical way of handling the problem to be scrutinised and the outcomes of the examination (Creswell & Plano Clark 2018). It is a perspective that assesses notions or opinions of those being examined in a study (Creswell 2014). This empowers researchers to understand the world by being involved in it and not just by perceiving it. The researcher chose pragmatism as the epistemological worldview to be used because it combines the qualitative and quantitative research approaches to solve the research problem, covering all approaches to obtain in-depth results (Creswell & Creswell 2018). According to the pragmatic paradigm, combining approaches, even within the same study, allows us to use those research methods that complement the research matter (Guthrie 2010). Additionally, proponents of this philosophy assert that the most crucial research topic is a deciding factor in the epistemology and ontology adopts. (Saunders et al. 2019).

Pragmatism places a strong emphasis on the application of knowledge and its usefulness (Ormerod 2021). A pragmatic approach to AI in libraries would concentrate on the

advantages of installing AI and how they might enhance metadata services and satisfy user needs. This would entail assessing how well AI work to solve practical issues and enhance library metadata services. Pragmatism is defined by Ngulube (2020) as the ideal perspective for MMR research, as it analyses both numerical codes and narrative data. Pragmatism supports a mixed methods methodology because it is a combination of quantitative and qualitative research methods (Kivunja & Kuyina 2017). Furthermore, Marutha and Modiba (2022) suggest that the use of AI for record management is intricate and covers a wide range of subjects that may be thoroughly investigated using MMR. Since pragmatism employs abductive reasoning, this paradigm is largely suitable for MMR investigations, as it allows the researcher to switch between inductive and deductive thinking as needed during the investigation (Ngulube 2020). Hence, to investigate the adoption of AI to improve metadata services at IHEs in Namibia, pragmatism was the best research paradigm that enabled the researcher to answer research questions and address the study's objectives.

3.3 METHODOLOGY

Research approaches are defined by Creswell and Creswell (2018) as the procedures and strategies for the research. It is understood as the discipline of understanding how research is conducted. There are three techniques that are often employed in social research, which are known as qualitative, quantitative, and MMR (Ngulube 2020). The difference between the approaches is that the quantitative approach involves numerical data, the qualitative approach involves non-numerical or explanatory and descriptive data, and the mixed methods approach is a combination of both (Creswell 2014). Quantitative and qualitative research methodologies are based on fundamentally different assumptions about how research should be carried out and the researcher's function (Creswell & Plano Clark 2018). Very different presumptions about how research should be done, and the function of the researcher are involved in quantitative and qualitative research methods. This study deployed the MMR approach because it relies on both qualitative and quantitative approaches for data collection and data analysis. Interviews conducted with the library staff were recorded using a voice recorder and questionnaires were distributed for distribution.

3.3.1 Mixed methods research

Creswell and Creswell (2018) define MMR as an approach through which the researcher collects and analyses data, merges the findings and draws conclusions using both qualitative and quantitative approaches in a single study. Du Plooy-Cilliers (2014) agrees with a MMR approach, arguing that social experience and lived realities are multi-dimensional and that a single-dimensional view may be inadequate. This is done to determine the degree of understanding and justification. A mixed methods study is appropriate for complex research issues with numerous individual and circumstantial components that cannot be fully addressed by a single technique (Creswell & Creswell 2018). The MMR approach to conducting research entails gathering and combining quantitative (descriptive, reviews, statistics) and qualitative (focus groups, interviews) data. A mono-method (qualitative or quantitative) strategy may miss insights and understanding that can be gained by combining or integrating methods; however, a combination of both can handle challenges from a variety of viewpoints and, as a result, the research findings may be enriched and improved (Ngulube, Mokwatlo & Ndwandwe 2009). This combination gives academics a new chance to investigate complicated phenomena. Hence, the researcher used both the quantitative and qualitative methods to ensure that enough information is captured on the adoption of AI to improve metadata services at IHEs in Namibia. Marutha and Modiba (2022) states that the MMR is the most appropriate in studying the adoption of AI in complex and multidisciplinary topics in the LIS. This kind of approach allows the researcher to broaden and deepen understanding and validation while addressing the flaws inherent in using each methodology alone (Leedy & Ormrod 2015). MMR has various benefits, including that the designs complement each another, improved philosophical ideas, incremental development or consistency in increased validity, and provision for rectification in the event of disparities or contradictions in results, even though they are not always preferable (Creswell & Creswell 2018). As a method, it includes the philosophical perspectives that guide the collection and analysis of data as well as the blending of qualitative and quantitative data in an individual investigation or grouping of research investigations (Cronje 2014). Pragmatism can handle the competing arguments between the qualitative and

quantitative perspectives in social science and produce practical solutions that are acceptable to all sides of the issue (Marutha & Modiba 2022).

Therefore, MMR procedures and methodologies provide a realistic view of how AI could improve metadata services. AI is a complex and multi-dimensional field that involves both technical aspects such as algorithms, models, and data, as well as human-related elements such as user experiences, perceptions, and ethical considerations (Bryman, Becker & Sempik 2008). MMR allows researchers to combine qualitative and quantitative data to gain a comprehensive understanding of AI's impact, usability, and implications (Meister 2018). To ensure that the intended results are obtained, doing a scientific study on issues related to AI calls for advanced research techniques, as it might not be adequately addressed by a single study approach (Marutha & Modiba 2022).

3.4 RESEARCH DESIGN

Research designs are types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research design (Creswell 2014). As stated by Punch (2014), research design is a description of the method used to collect and analyse data. Marutha and Modiba (2022) indicate the existence of sequential exploratory research design, explanatory sequential research design, convergent research design, embedded research design, and multiphase design as the research designs used in the mixed methods approach. This study employed the convergent research design method, as it was deemed appropriate for the study. According to Ngulube (2020), qualitative and quantitative data could be gathered simultaneously to validate the findings and get a deeper understanding of the phenomenon. Hence, the researcher was able to address the quantitative and qualitative objectives of the study using the convergent research design method in investigating how the adoption of AI can improve metadata services in libraries.

3.4.1 Convergent research design

This study's research design blended the quantitative and qualitative approaches. Research using mixed methods includes gathering both quantitative and qualitative data

and integrating both types of data during analysis. According to Creswell and Plano Clark (2018), the convergent research design is an MMR design in which quantitative and qualitative methodologies are gathered and processed individually before being combined for comparison to produce rich results. The design is used to collect both quantitative and qualitative data concurrently, with the aim of comparing the data equally and fairly at the same time (QUAL-QUAN), and then combining it to give a rich analysis of findings (Ngulube 2020). It is a great design to getting a diversity of outcomes to understand a matter without prejudice. It is used to obtain a more thorough grasp from two approaches, as it confirms the outcomes of various techniques.

This research design is well recommended because it covers the weaknesses in both quantitative and qualitative methods and is best used when the researcher has limited time to collect data (Creswell & Plano Clark 2018). Furthermore, it is well recognised in recent research methodology literature by Ngulube (2020) and Creswell and Plano Clark (2018). The researcher chose this research design because it is associated with MMR (Ngulube 2020). Furthermore, this type of research design has the ability to meaningfully and complementary integrate both qualitative and quantitative data (Creswell 2014). Researchers could acquire insights on several factors at the same time by combining approaches to gather data regarding AI services (Marutha & Modiba 2022). In the convergent design, complementary qualitative and quantitative data are collected concurrently to gain a greater understanding of the phenomenon and for the goal of validation (Marutha & Modiba 2022).

3.4.2 Population

This section sought to present the target population of the study, which consists of people who have the same characteristics and are from a larger group of the same organisation. Population is described as the entire set of objects or people that are the focus of the research and from which the researcher seeks to determine certain characteristics (Creswell & Creswell 2018). Population refers to every component of study from which a researcher hopes to draw conclusions (Neuman 2014). This study consisted of a population of twenty (20) metadata specialists from the UNAM, NUST, and IUM libraries

with expertise in metadata services. Of the total population, six (6) metadata specialists were from the UNAM library. This included the senior metadata specialist (responsible for overseeing technical functions within the department), metadata specialist (responsible for the curation and accessibility of digital collections), metadata specialist (cataloguing), senior library assistant (institutional repository), library assistant (serials), and library assistant (cataloguing). Of the total population, seven (7) metadata specialists from the NUST library participated in the study. This included the director (library and information services), HoD (technical services), senior metadata specialist (bibliographic services), bibliographic services metadata specialist, metadata specialist (digital collections), senior library assistant (online and serials), and library assistant (bibliographic services). The remaining seven (7) participants were from the IUM library. The participants from the IUM library consisted of the university metadata specialist who managed and oversaw library functions, three metadata specialists (cataloguing), metadata specialist (digital collections), senior library assistant (digital collections), and library assistant (cataloguing).

3.4.3 Sampling method

A sampling method is a way to choose a sample of people from a larger population. Selecting a sample cluster from the population being investigated is the practice in research methodology (Leedy & Ormrod 2015). It is the process of choosing a subset of the population to be a representation of the whole population and to give a picture of the data on behalf of the population (Babbie 2014). Sampling is the process of identifying a sample from a population of interest for the researcher to fairly generalise findings to the population from which the sample was taken after examining the sample (Berndt 2020). Marutha and Modiba (2022) state that parallel sampling, identical sampling, nested sampling, and multi-level sampling are the most appropriate sampling methods for MMR. This study employed parallel sampling as the sampling design for this research since the same sample was used during both the quantitative and qualitative phases of the study.

3.4.3.1 Parallel sampling design

Creswell and Plano Clark (2018) define parallel sampling as choosing participants from the same population for each component of the study. The qualitative and quantitative samples are taken from comparable interest populations, as evidenced by a parallel relationship. The quantitative phase, plus the qualitative phase, makes up this sampling technique (Creswell & Creswell 2018). In this sampling design, researchers have two or more parallel quantitative and qualitative components, either simultaneously or with a short time interval; the results of the strand are integrated into meta-inferences following an isolated analysis; related questions are addressed, either in terms of quantitative and qualitative components or in terms of aspects of the same mixed research question (Schoonenboom & Johnson 2017). This means that the researcher collects quantitative and qualitative data from the same population in approximately the same time period. The researcher chose this type of sampling method because the study consisted of the same participants for both qualitative and quantitative methods (Marutha & Modiba 2022). The level of continuity it produces is the most obvious benefit of using the same sample for both quantitative and qualitative methods. The decision to adopt a parallel sampling approach over a mixed methods design should be justified by emphasizing its alignment with the study's objectives. This approach is particularly suited to studies aiming to compare or contrast viewpoints across separate domains. Furthermore, parallel sampling may be more pragmatic and efficient in contexts where resources, time, or expertise for conducting fully integrated mixed methods designs are limited. Hence, from the UNAM library, one (1) university metadata specialist, one (1) head of department, one (1) senior metadata specialist, and one (1) metadata specialist participated in the interview. From NUST library one (1) Director of LIS, one (1) metadata specialist and two (2) acting metadata specialists participated in the interview. From the IUM library one (1) campus metadata specialist participated in the interview. Questionnaires were administered during the data collection period of the study to UNAM library staff members of the following positions: two (2) assistant metadata specialists, two (2) senior library assistants, and one (1) library assistant. From the NUST library, questionnaires were distributed to two (2) assistant metadata specialists, one (1) senior library assistant and

one (1) library assistant. At the IUM library, the researcher administered questionnaires to four (4) library assistants.

3.5 DATA COLLECTION METHODS

According to Creswell and Creswell (2018), data collecting instruments are used to acquire data from respondents, and many instruments might be used to obtain study data. Data collection methods are seen as ways for evaluating impacts that range along a continuum. These approaches are quantitative and/or qualitative research methods. Questionnaires, interviews, observation, and checklist are some of the instruments identified that are applicable in research data collection (Ngulube 2020). This study employed questionnaires, interviews, and observation as data collection instruments. These instruments are discussed in depth in the following sections.

3.5.1 Questionnaire

Questionnaires are defined by Creswell and Creswell (2018) as a method of gathering data in the absence of a researcher in which a respondent is asked to answer a series of questions. A questionnaire allows respondents to respond to questions at their leisure. A questionnaire is a research tool that consists of a series of questions with the goal of gathering data from the responses (Silverman 2017). A questionnaire can be made up of either closed-ended or open-ended questions. Closed-ended questions are those that can be replied to with a single word or a brief phrase, whereas open-ended questions allow respondents to give a more comprehensive response to a particular subject (Flick 2018). Using questionnaires has the advantage of being inexpensive and enabling rapid and effective surveying of many respondents, even if they are not all in the same location.

Questionnaires are mostly used to obtain essential information from a population study. The researcher distributed questionnaires during the data collection period of the study to UNAM library staff members of the following positions: one (1) metadata specialist, one (1) senior library assistant, and two (2) library assistants. From the NUST library, questionnaires were distributed to one (1) senior library assistant and one (1) library assistant. At the IUM library, the researcher administered questionnaires to three (3)

metadata specialists, one (1) senior library assistant, and one (1) library assistant to gather an informed understanding of how AI may contribute to the improvement of metadata services at IHEs in Namibia.

3.5.2 Interviews

A conversation between two or more people is what is meant by the term interview, which refers to a process for acquiring data. In an interview, the subject responds to inquiries about the research problem while being in close proximity to the interviewer (Creswell & Creswell 2018). Interviews give the researcher the opportunity to choose the manner and topic of the questions to be asked, as well as the wording of the interview questions. Interviews are either structured, in which closed-ended questions are preset, or semi-structured, in which open-ended questions allow participants to freely express their perceptions on the subject at hand (Kumar 2011). Interviews often require the interviewer to be present when asking questions regarding the study to provide clarification when necessary. Interviews use a combination of closed- and open-ended inquiries, often followed by questions such as “how” and “why" to probe the respondent into elaborating and giving more explanations and information to the data collector. Interviews allow respondents to express their views without limitations and often result in insights imperative to the research study.

The semi-structured interview is regarded as a research data technique used with the specific goal of collecting data orally through the use of a predetermined set of questions (Creswell & Creswell 2018). In order to gather information about adopting AI for the improvement of metadata services at IHEs in Namibia, semi-structured interviews as a method of data collection were deemed a practical alternative. The researcher conducted interviews with one (1) senior metadata specialist and one (1) metadata specialist from the UNAM library.

From NUST library, one (1) director of LIS, one (1) HoD, one (1) senior metadata specialist, and two (2) metadata specialists participated in the interview. From the IUM library, one (1) university metadata specialist and one (1) metadata specialist participated

in the interview regarding adopting AI for the improvement of metadata services at IHEs in Namibia.

3.5.3 Observation

According to Kumar (2015), Creswell and Plano Clark (2018), and Creswell and Creswell (2018), observation is a method of gathering data in which a researcher observes first-hand the behaviours of individuals who pique their interest. According to Kumar (2015), observation is the deliberate, methodical, and selective process of observing and recording a phenomenon or interaction as it happens. Similarly, Creswell and Plano Clark (2018) back up the notion that observation is a method for gathering data that necessitates the researcher to deliberately and carefully observe events as and when they happen. Creswell and Creswell (2018) suggest that observation is the best way to obtain data since it allows the researcher to view the subjects directly and does not depend on their willingness to share information. The researcher observed how HIEs in Namibia created processes and saved metadata records. The researcher also looked at the retrieval and access of metadata records. It was also noted the amount of time metadata specialists spent on metadata creation processes through both manual and electronic cataloguing records. The researcher's goal was to determine which metadata services could be automated by AI during the entire observation.

3.6 DATA ANALYSIS AND PRESENTATION

Creswell and Creswell (2018) define data analysis as the way data collected from respondents are classified and interpreted. During this phase, a researcher gathers a substantial amount of interview notes, audio proceedings, video data, replications, or information from records, all of which should be carefully analysed and interpreted (Flick 2018). Data analysis is the methodical organisation, integration, and examination of data, the linking of data to concepts, and the identification of overarching trends or themes (Neuman 2014). The quantitative data were analysed and represented by bar charts and tables as well as textual, tabular, and summary formats (Creswell & Plano Clark 2018). In order to analyse the qualitative data, the researcher used verbatim quotes from the participant, quoting the participants’ responses word for word.

Data collected were interpreted using both quantitative and qualitative analysing tools (Creswell 2014). Data interpretation is defined by Bryman (2012) as the process of using various logical methods to interpret data collected and draw meaningful conclusions. The researcher used both qualitative and quantitative data gathering methods, as well as mixed methods data analysis and interpretation tools to analyse and interpret the data.

3.7 RELIABILITY AND VALIDITY OF THE STUDY

Creswell (2014) describes reliability and validity as a process used by researchers to demonstrate the accuracy of their findings and persuade readers of their authenticity or credibility. The uniformity and dependability of the research data and metrics are referred to as reliability. If the same results can be achieved when a study is repeated under comparable circumstances, it is said to be dependable (Rose & Johnson 2020). The uniformity of the data across various items or questions within a measure is significant in research (Creswell & Plano Clark 2018). Validity relates to the precision and applicability of the research findings (Creswell & Creswell 2018). The outcomes of a study must be significant and pertinent to the research questions in order for it to be regarded as valid (Taherdoost 2016).

3.7.1 Reliability

Reliability focuses on the uniformity of the researchers across time and data collection instruments (Creswell & Plano Clark 2018). It is the extent to which a questionnaire, interview, or observation procedure produced the same results on repeated trials (Creswell & Creswell 2018). The consistency and stability of the measurements or data gathering techniques utilised in a study are referred to as reliability in research. It is the extent to which a research tool such as a test or questionnaire produces reliable results over time and in a variety of settings (Mohamad, Sulaiman, Sern & Salleh 2015). If a dependable tool is applied repeatedly to the same population or sample, it consistently yields the same results. Test-retest reliability, inter-rater reliability, and internal consistency reliability are a few of the different ways that dependability can be evaluated (Taherdoost 2016). Replicable studies with consistent outcomes help to strengthen the veracity and trustworthiness of their conclusions. To ensure reliability, the researcher

ensures the validity, credibility, transferability, and confirmability of the conclusions and interpretations when using both qualitative and quantitative approaches in the study. In this study, the researcher made sure that participant identity was kept confidential, that the instrument used to collect the data was in good condition, and that both quantitative and qualitative data were collected in an effective and efficient manner in order to establish credibility, reliability, and dependability.

3.7.2 Validity

Validity focuses on the verdict of specifics and confirmation (Du Plooy-Cilliers 2014). To ensure validity, pilot testing interviews are required to make sure it is feasible (Creswell & Plano Clark 2018). If a research study has a good validity, it is able to provide data that are realistic and viable (Creswell 2014). The degree to which a study accurately measures or tests what it is meant to measure or test is known as validity in research. It refers to how well a research tool or instrument, like a questionnaire or experiment, assesses what it is intended to test. Validity is a crucial aspect of research since it establishes the reliability and significance of a study's findings (Taherdoost 2016). The researcher ensured that all MMR designs, techniques, and instruments are properly and transparently used in this study to ensure that the study adheres to the standards, through pilot testing of the data collection instruments in order to produce valid, trustworthy, and reliable results. The researcher ensured that data collection tools such as questionnaires were provided to respondents without errors and vague statements that could compromise the validity of the study. Furthermore, the researcher adhered to the study questions throughout the interview, completed the observations as directed by the checklist, and observed the present LMS using the checklist. These aided the researcher in making sure that the instruments used to collect the data were reliable and genuine.

3.8 ETHICAL CONSIDERATIONS

Ethics in research provides standards for what is acceptable or unacceptable behaviour for researchers (Du Plooy-Cilliers 2014). A researcher must be trustworthy and adhere to ethical principles and professional norms in order to perform research responsibly. Ethics exist to safeguard persons chosen to take part in research (Flick 2018). Hence,

researchers should always consider ethical issues throughout the research process (Ngulube 2015). This study was conducted following the ethical principles outlined in Unisa's research ethics policy (2013). Personal information and records submitted by responders were kept private, as per the policy. The policy further stipulates that all data collected from respondents, as well as security protocols for protecting respondents' privacy must be kept confidential by ensuring that respondents' names are not listed on the research instruments. This is ensured by the ethical conundrum of informed consent being taken into consideration. Israel and Hay (2006) assert that in order for participants to give their active permission to research, they must first comprehend the nature of the study and their role within it. This is made feasible by having respondents sign an agreement.

A consent document must be signed by each respondent. The permission form gives participants the chance to opt out of participation without consequences. The consent form outlines the goal of the study and each participant's criteria. A promise of confidentiality is therefore given to each participant. The researcher does not have an option to allow users to make their identities known and every paper remains anonymous. Participants are given forms to give consent to the researcher to carry out the study, and the researcher is expected to explain that taking part in the study is completely voluntary and a participant has the right to not participate or withdraw during the process.

In this study, the researcher obtained special permission from the participants to record or not record the interviews. In order to maintain confidentiality, raw data from the study were secured on an external drive with password-protected files. Additionally, the researcher openly made the participants aware of the researcher's participation during the observation process.

3.9 SUMMARY OF THE CHAPTER

This chapter introduced the methodology of the study adopted to investigate the adoption of AI to improve metadata services at IHEs in Namibia. Research methodology is defined as a basis that directs the entire process of finding, collecting, and interpreting research data (Kumar 2014). Hence, the chapter unpacked the ontology and epistemology chosen

to be followed by the researcher. The research approach, research design, population, sampling method, data collection methods, data analysis, and presentation, as well as the reliability and validity of the study were also explained and justified in this chapter. The researcher detailed which research design was used and justified why interviews, questionnaires, and observation were chosen as the data collection methods to use in this MMR (Creswell & Creswell 2018). Data collection techniques used to collect data from the respondents and participants were discussed and justified to validate to the reader why the researcher used the instruments they used to collect data (Creswell & Creswell 2018). This chapter also discussed the analysis and presentation of the research findings and explained why the researcher chose charts, tables, and verbatim quotes (Creswell & Plano Clark 2018). The ethical considerations of the study, including voluntary participation, were also discussed. The next chapter covers the research study's findings.

CHAPTER 4

DATA ANALYSIS AND PRESENTATION OF THE FINDINGS

4.1 INTRODUCTION

The previous chapter detailed the research design and methodology employed in this study. The chapter addressed the research paradigm, the research technique and methodologies employed, the sample procedure followed, the sampling frame used, the sampling size chosen from the whole study population, and the data collection procedures. The current chapter focuses on the data analysis of the research data. The data analysis chapter is known to improve comprehension, broaden theory, and increase knowledge (Creswell & Creswell 2018). Plooy-Cilliers (2018) defines data analysis as the methodical inspection, interpretation, and conversion of unprocessed data into significant findings, developments, and conclusions.

The researcher used a mixed methodologies technique to collect data, and the same convergence approaches were used to study the same phenomenon in order to broaden and deepen the findings (Creswell & Plano Clark 2018). The previous chapter used graphics and tables to enhance the readability and comprehension of the content. The researcher used thematic analysis for the qualitative data and descriptive analysis for the quantitative data to present the data convergently, even if the data were only integrated during the interpretation stage (Creswell & Plano Clark 2018).

4.2 DATA PRESENTATION AND ANALYSIS STRATEGY

The study's findings are presented through written descriptions, tables, and quotes in their original form in verbatim. The findings are presented in the order of the study's objectives, which were driven by the objective of investigating the use of AI to enhance metadata services in Namibian IHEs. The research results have been analysed based on the following research objectives:

- To evaluate the current state of metadata services at IHEs in Namibia.

- To examine the perceptions of metadata specialists on adopting AI to improve metadata services in libraries at IHEs in Namibia.
- To determine the usability of AI to improve metadata services in libraries at IHEs in Namibia.
- To identify the AI infrastructure needed to improve metadata services in libraries at IHEs in Namibia.

As detailed in chapter three, the qualitative data were collected through interviews and by observation. Questionnaires were used to collect quantitative data. The quantitative data were presented using figures, charts, and tables with MS Excel spreadsheet. The qualitative data were presented in text using explanations, descriptions, and narratives in MS Word (Marutha & Ngulube 2012). The study's respondents and participants are described in detail in the following section.

4.3 DESCRIPTION OF RESPONDENTS AND PARTICIPANTS

This study's respondents and participants were metadata specialists from IHEs in Namibia who performed metadata services functions in libraries. Six (6) metadata specialists were from the UNAM library. This included the senior metadata specialist (responsible for overseeing technical functions within the department), metadata specialist (responsible for the curation and accessibility of digital collections), metadata specialist (cataloguing), senior library assistant (institutional repository), library assistant (serials), and library assistant (cataloguing). Seven (7) metadata specialists from the NUST library participated in the study. This included the director (library and information services), HoD (technical services), senior metadata specialist (bibliographic services), bibliographic services metadata specialist, metadata specialist (digital collections), senior library assistant (online and serials), and library assistant (bibliographic services). The remaining seven (7) participants were from the IUM library. The participants from the IUM library consisted of the university metadata specialist who managed and oversaw library functions, metadata specialist (cataloguing), metadata specialist (cataloguing), metadata specialist (cataloguing), metadata specialist (digital collections), senior library assistant (digital collections), and library assistant (cataloguing). Among the metadata specialists

from IHEs in Namibia, various roles and responsibilities within library settings were defined. The university directors and metadata specialists encompassed strategic planning, resource management, user support, and ensuring the smooth operation of library functions, vital for supporting teaching, learning, and research endeavours within these institutions. The head of technical services managed cataloguing and acquisitions. The senior metadata specialists oversaw technical functions and provide leadership, while some of the metadata specialists focused on digital collections' curation and accessibility. Multiple metadata specialists and library assistants handled cataloguing tasks, institutional repositories, and serials management, ensuring efficient organisation and accessibility of library resources.

4.4 PERSONAL DATA

In this section, the researcher collected information, including the age group, gender, highest qualification, job title, and number of years in current position to indicate the representation of the sample group. This assisted the researcher to determine whether respondents and participants were balanced in terms of these categories. This was to make sure the study sample was representative of the whole population based on the respondents and participants.

4.4.1 Respondents per age group

The respondents were asked to indicate their age group through the questionnaire administered, to specify the representation of the age group ranges of the respondents. As indicated in figure 4.1, four (36.3%) respondents indicated that they belonged to the 36-40 age group, three (27.3%) respondents indicated that they belonged to the 25-30 age group, two (18.2%) respondents selected the 41-45 age group, one (9.1%) respondent indicated that they belonged to the 31-35 age group, and one (9.1%) respondent indicated to be from the 18-24 age group.

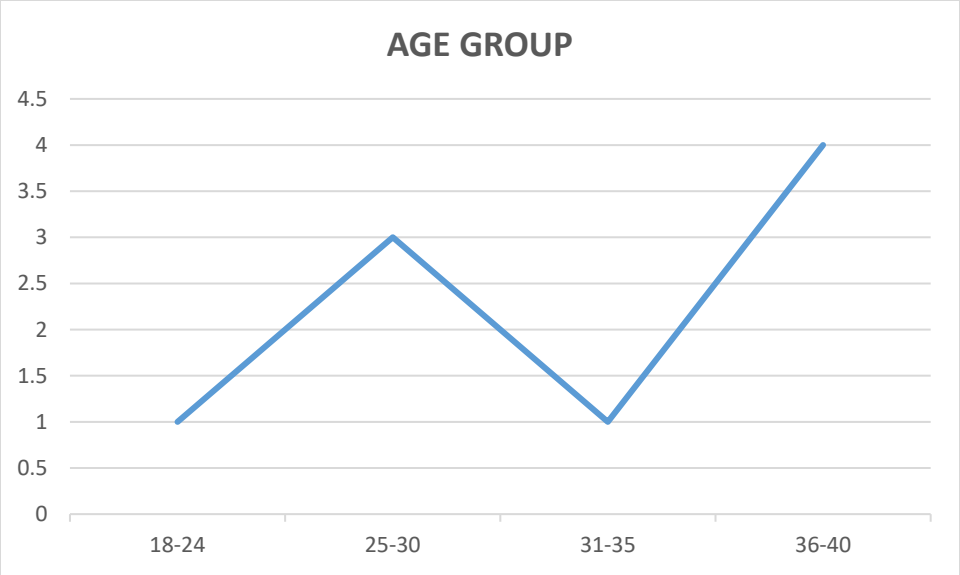

Figure 4.1 Respondents per age group (n=11)

Interviews were conducted with nine participants. The following were the responses regarding their age group:

Participant 1 stated that *"I am between the ages of 46 to 50"*.

Participant 2 stated that *"I turned 33 last month, so I am in the 31-35 age bracket"*.

Participant 3 stated that *"I belong in the 51-55 age group"*.

Participant 4 stated that *"I am between the ages of 31 to 35"*.

Participant 5 state that *"I am in the 51-55 group"*.

Participant 6 stated that *"I am between 25-30 years of age"*.

Participant 7 stated that *"I am in the 25-30 age group"*.

Participant 8 state that *"I am between 36 and 40"*.

Participant 9 stated that *"I am between 41-45 years age"*.

4.4.2 Respondents per gender

The sample consisted of three male respondents and eight female respondents who participated in the questionnaire administered.

Interviews were conducted with two males and seven females from the technical services departments of the IUM, NUST and UNAM libraries.

4.4.3 Respondents per highest qualification

The respondents were asked to specify their highest qualification. As indicated in figure 4.2, five (45.4%) respondents indicated that they possessed an honours degree, three (27.3%) indicated that they had a bachelor's degree and three (27.3%) indicated that they had a master's degree, as depicted below:

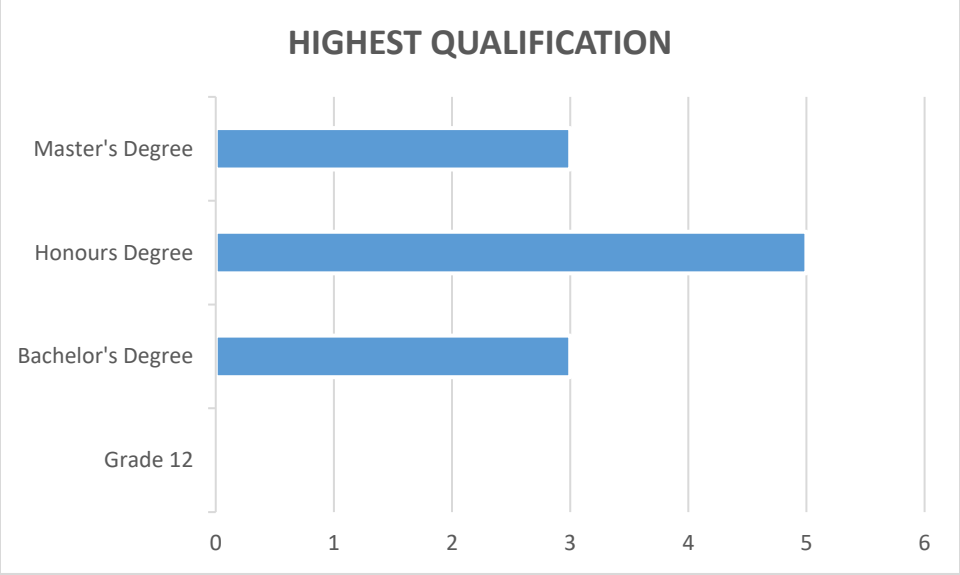

Figure 4.2 Highest qualification of respondents (n=11)

Interview participants were also asked about their qualifications, and they replied in the following manner:

Participant 1 stated that:

> *"I have a bachelor's degree in information studies".*

Participant 2 stated that:

"I have a master's in library and information science".

Participant 3 stated that:

"I have a bachelor's degree".

Participant 4 stated that:

"I have a master's degree in information science".

Participant 5 stated that:

"I have a master's degree in library and information studies".

Participant 6 stated that:

'"I have an honours degree in information science".

Participant 7 stated that:

"I have a diploma in library and information science".

Participant 8 stated that:

"I have a master's degree in digital information management".

Participant 9 stated that:

"I am a PhD holder".

4.4.4 Job title

The respondents were asked to indicate their current job titles in the questionnaire. As indicated in figure 4.3, four (36.4%) respondents indicated that they were metadata specialists, four (36.4%) respondents indicated that they were library assistants and three (27.3%) indicated that they were senior library assistants.

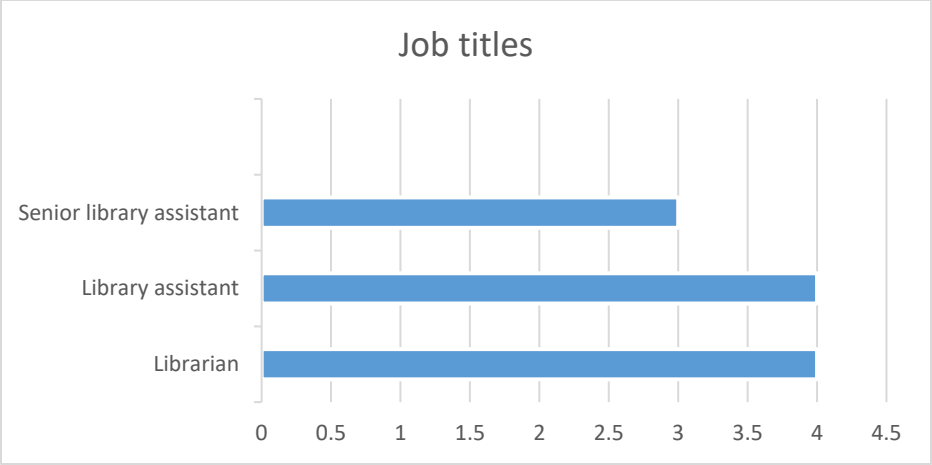

Figure 4.3 Respondents job titles (n=11)

Interview participants were also asked about their job positions and the following were their responses:

Participant 1 stated that:

"I am the director of the library".

Participant 2 stated that:

"I am the digital metadata specialist".

Participant 3 stated that:

"I am a metadata specialist".

Participant 4 stated that:

"I am the head of technical services".

Participant 5 stated that:

"I am the senior metadata specialist-technical services".

Participant 6 stated that:

“I am a metadata specialist”.

Participant 7 stated that:

“I am a metadata specialist”.

Participant 8 stated that:

“I am a senior metadata specialist”.

Participant 9 stated that:

“I am the university metadata specialist”.

Furthermore, participants were asked to indicate their roles in the library, and these were their responses:

Participant 1 stated that *“I am the leadership of the library”*.

Participant 2 stated that *“My role is to preserve the institutional repository through physical and digital collections”.*

Participant 3 stated that *“I mainly supervise cataloguers”*.

Participant 4 stated that *“I head the technical unit”*.

Participant 5 state that *“My role entails cataloguing and classification”*.

Participant 6 stated that *“I catalogue and classify library materials”*.

Participant 7 stated that *“I do cataloguing and classification”*.

Participant 8 state that *“My main responsibility is to catalogue”*.

Participant 9 stated that *“I manage the library and report to the stakeholders”*.

4.4.5 Number of years working in the library

In the questionnaire administered, the respondents were required to indicate the threshold of number of years they have been working in the library. Figure 4.4 indicates that five (45.4%) respondents have been working in the library for 5-7 years, three (27.3%) indicated that they have been in the library for 7-10 years, one (9.1%) respondent has been in the library for 10 years +, one (9.1%) for 2-5 years, and one (9.1%) for 0-2 years.

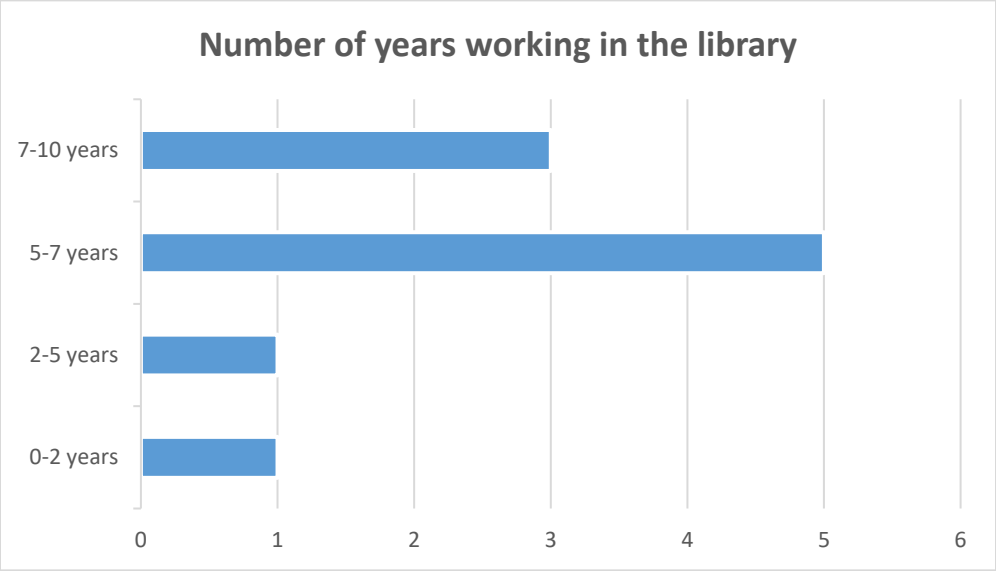

Figure 4.4 Number of years working in the library (n=11)

During the survey interviews, participants were also asked to indicate the number of years they have been working in the library and this was what the participants had to say:

Participant 1 stated that:

> *"I have been working for 27 years as a cataloguer, but for the past six years, I have been the director of the library".*

Participant 2 stated that:

> *"I have worked here for eight years as a cataloguer".*

Participant 3 stated that:

"I have been working for 20 years as a cataloguer".

Participant 4 stated that:

"I have been working here eight years as a classifier and cataloguer".

Participant 5 stated that:

"I have 23 years' experience in cataloguing and classifying".

Participant 6 stated that:

"I have been working for three years as a cataloguer".

Participant 7 stated that:

"I have three years' experience working here as a cataloguer".

Participant 8 stated that:

"I have two years' experience in my role as a senior metadata specialist, but, previously, I catalogued and classified for about eight years".

Participant 9 stated that:

"I have five years' experience as a university metadata specialist and 20 years in circulation and technical services".

4.5 DATA PRESENTATION

This section presents the findings by addressing the objectives of the study.

4.5.1 State of metadata records

The first of objective of the study was to evaluate the current state of metadata services at IHEs in Namibia. The researcher collected data through administering questionnaires and interviews. The respondents and participants had to answer various questions under this objective to establish the state of metadata records in their libraries.

4.5.1.1 Format in which metadata records are created

To establish the format in which metadata is created, the respondents were asked through closed-ended questions about the format in which the records were created in their libraries. Figure 4.5 indicates how the respondents either indicated that metadata is created electronically or both electronically and manually. Seven (63.6%) respondents indicated that metadata records are created electronically and four (36.4%) indicated that metadata records are created both electronically and manually.

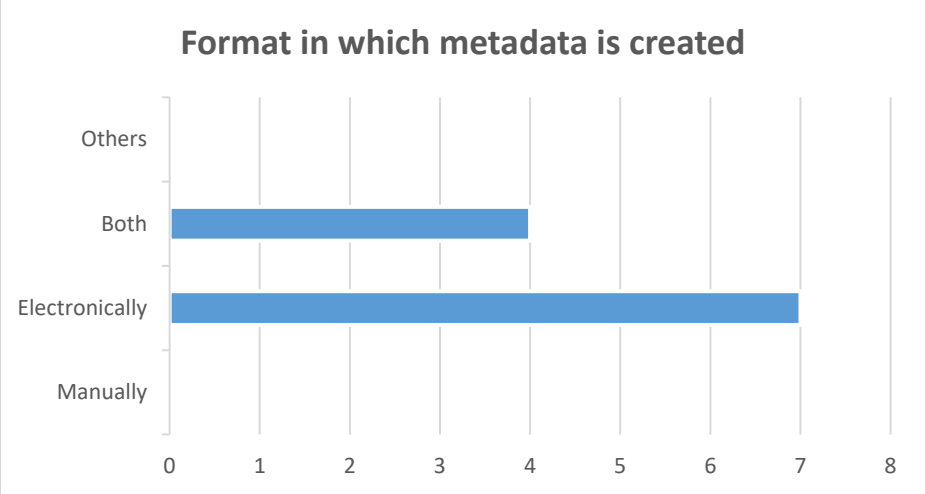

Figure 4.5: Format in which metadata records are created (n=11)

The respondents were further asked through an open-ended question to describe how effective metadata records were created at their libraries. These were their responses:

Respondent 1 stated that:

> *"It is not very effective because they are done in accordance with international standards and procedures but still have errors".*

Respondent 2 stated that:

> *"It is very effective".*

Respondent 3 stated that:

“It is good, we can retrieve our records”.

Respondent 4 stated that:

“It is effective”.

Respondent 5 stated that:

“It is good but slow”.

Respondent 6 stated that:

“It is quite well with qualified staff”.

Respondent 7 stated that:

“It is fine especially with good internet”.

Respondent 8 stated that:

“It is very effective”.

Respondent 9 stated that:

“It is not so effective”.

Respondent 10 stated that:

“It is doing fine”.

Respondent 11 stated that:

“It is really effective”.

Through interviews, participants were asked about the format in which the records in their libraries were created. The responses were as follows:

Participant 1 stated that:

"Through copy cataloguing, original manual cataloguing and Dublin Core".

Participant 2 stated that:

"Electronically, I do not do physical cataloguing".

Participant 3 stated that:

"Using cataloguing tools such as RDA, DDC, MARC 21 format and Library of Congress subject headings to manually create metadata of library resources".

Participant 4 state that:

"Through cataloguing manually and electronically".

Participant 5 stated that:

"Original cataloguing, copy cataloguing and through the OPAC system".

Participant 6 stated that:

"Electronically, through the Mandarin M3 library management system".

Participant 7 stated that:

"Records are created electronically through the library management system".

Participant 8 stated that:

"We electronically create metadata records".

Participant 9 stated that:

"Both electronically and manually".

The researcher observed that the metadata records were created both physically and electronically.

4.5.1.2 Format in which metadata records are managed

There are various formats in which metadata records can be managed. Through a closed-ended question, the respondents were asked about the manner in which metadata records were managed. All 11 respondents indicated that metadata records were managed electronically in their libraries.

Through an open-ended question in the questionnaire, the respondents were also asked about the effectiveness of the format used at their library to manage metadata records. The following were the answers received:

Respondent 1 stated that:

> *"Effective because we are able to interact with other databases such as OCLC".*

Respondent 2 stated that:

> *"It is very effective".*

Respondent 3 stated that:

> *"It is good".*

Respondent 4 stated that:

> *"Records are in order and place, no loss of migrated information. So, I would say it's being managed well".*

Respondent 5 stated that:

> *"It is effective enough".*

Respondent 6 stated that:

> *"It is very effective technological system".*

Respondent 7 stated that:

“It is effective because our records will not disappear”.

Respondent 8 stated that:

“It is very effective management of records”.

Respondent 9 stated that:

“It is better, but it is an open-source software”.

Respondent 10 stated that:

“It is very effective”.

Respondent 11 stated that:

“It is very effective”.

Through interviews, participants were asked about the process in which metadata records were handled in their libraries in order to determine the format in which metadata was managed. All nine participants indicated that metadata records were managed electronically in their libraries. These were their responses:

Participant 1 stated that:

“We manage metadata records electronically in our library”.

Participant 2 stated that:

“Through electronic platforms”.

Participant 3 stated that:

“Metadata records are managed digitally on library management systems”.

Participant 4 stated that:

“Records are managed electronically”.

Participant 5 stated that:

"Metadata records are managed in an electronic format".

Participant 6 stated that:

"We manage the records electronically".

Participant 7 stated that:

"The records are managed in an electronic format".

Participant 8 stated that:

"We electronically manage metadata records".

Participant 9 stated that:

"Metadata records are managed electronically".

The researcher observed that the metadata records were all managed electronically using library management systems.

4.5.1.3 Accuracy of metadata records in library's catalogue

It is essential to access the accuracy of metadata records in library management systems to guarantee efficient resource organisation and information retrieval. The respondents were asked through an open-ended question how they accessed the accuracy of metadata records in their library catalogue. These were their responses:

Respondent 1 stated that:

"By carrying out quality control through reports. Through creating lists to check records with missing information, duplicates and errors and feedback from users".

Respondent 2 stated that:

"We do quality control".

Respondent 3 stated that:

> *"We do quality control of our record on the information system daily as we catalogue our materials".*

Respondent 4 stated that:

> *"I am not sure".*

Respondent 5 stated that:

> *"By double checking while cataloguing".*

Respondent 6 stated that:

> *"Someone superior usually comes to moderate records created".*

Respondent 7 stated that:

> *"We create records using Marc 21 standard which is up to standard".*

Respondent 8 stated that:

> *"Through quality control using our university's rules".*

Respondent 9 did not answer the question.

Respondent 10 stated that:

> *"By verifying correct fields before submitting".*

Respondent 11 stated that:

> *"By doing an audit of the metadata records".*

The interview participants were also asked to describe how they accessed the accuracy of metadata records in their library catalogues. Their responses were as follows:

Participant 1 stated that:

"Through quality control by doing spot checks to correct errors".

Participant 2 stated that:

"Once I have added metadata records on the system I do a search, to see if I can find them. Additionally, by going through bibliographic data of a record more than twice".

Participant 3 stated that:

"By performing quality control of all records and by moderating the cataloguers' entries".

Participant 4 stated that:

"We assess the accuracy by spot checking fields in the library management system and consistency checks".

Participant 5 stated that:

"We do verifications on the standard of the metadata records".

Participant 6 stated that:

"Through data profiling, and moderation by supervisor".

Participant 7 stated that:

"By performing quality assurance, spot checks using the guidelines and standards of the university on quality assurance".

Participant 8 stated that:

"After cataloguing, the supervisor has to do a verification on the process".

Participant 9 stated that:

"We correct the records when we find inconsistencies".

The researcher observed that there was no definite process and routine performed by the metadata specialists in assessing the accuracy of a record in the libraries.

4.5.1.4 Retrieval of metadata records

The significance of retrieving metadata records stems from its essential function in enabling accurate and efficient information access and management. The respondents were asked through closed-ended questions to indicate how metadata records were retrieved in their libraries. Figure 4.6 specifies that ten (90.9%) respondents indicated that the online method was used to retrieve metadata records and one (9.1%) respondent indicated online and physical methods were used to retrieve metadata records.

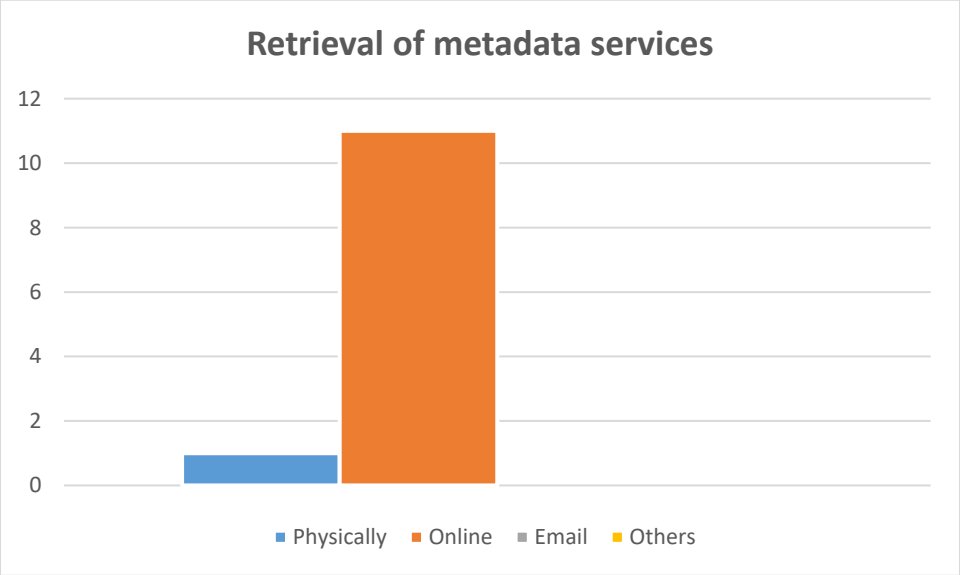

Figure 4.6 Retrieval of metadata services (n=11)

The respondents were further asked through open-ended questions to explain which method of accessing metadata records was effective at their library. All respondents stated that the online method was the most effective method of metadata retrieval.

The participants were also asked how metadata records were retrieved by users in their libraries. These were their responses:

Participant 1 stated that:

“Through our discovery platform known as EBSCO discovery services”.

Participant 2 stated that:

“Through the web access platform, e.g. digital collections to access past examination papers and by asking for metadata specialists to help search through email”.

Participant 3 stated that:

“The records are retrieved through the EBSCO discovery services, online public access catalogue and prescribed databases set up by the library”.

Participant 4 stated that:

“Users retrieve metadata records by the EBSCO discovery services and catalogue run by EBSCO Online”.

Participant 5 stated that:

“Through the discovery services as well as the library open public access catalogue”.

Participant 6 stated that:

“Via the open public access catalogue”.

Participant 7 stated that

“It is retrieved by using the open public access catalogue”.

Participant 8 stated that:

“Through the open public access catalogue system by searching for keywords”.

Participant 9 stated that:

"Our library has a system, called the open public access catalogue that houses all the metadata records of our library, and this is how records are retrieved by the users".

The researcher observed that metadata records were retrieved electronically through the libraries' online public access platforms and physically by asking staff on the shelves to help retrieve records.

4.5.1.5 Period taken to retrieve metadata records

The time it takes to retrieve a record can be affected by the type of record and how it was created. The respondents were therefore asked through closed-ended question to indicate how long it took to retrieve metadata records at their library. Six (54.5%) respondents indicated that it took 5-10 minutes to retrieve metadata records and five (45.5%) respondents indicated that it took about 10-30 minutes to retrieve metadata records, as displayed in figure 4.7.

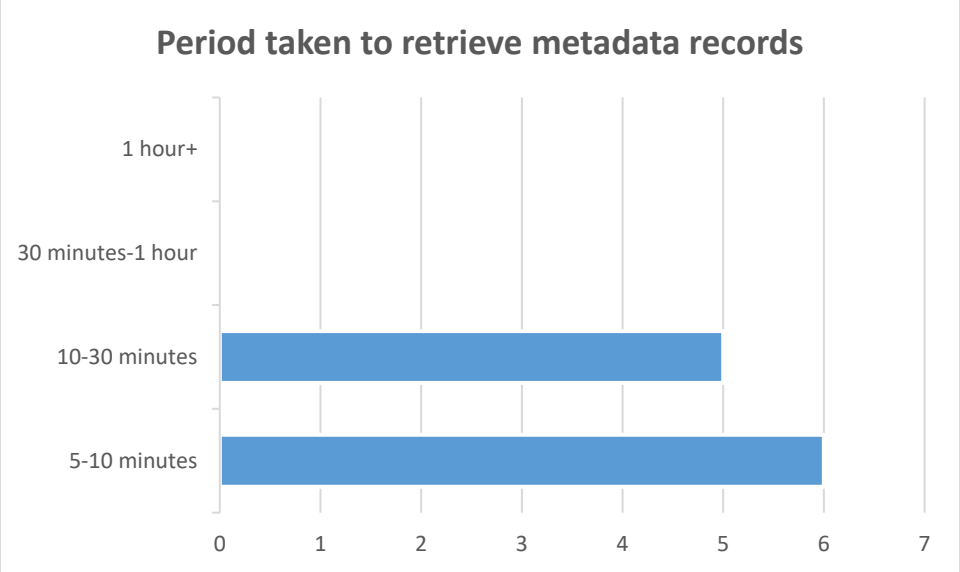

Figure 4.7: Period taken to retrieve metadata records (n=11)

The participants were also asked about the time it took to retrieve metadata records in their libraries. These were their responses:

Participant 1 stated that:

“Instantly, it takes less than a minute”.

Participant 2 stated that:

“It takes about one to five minutes; however, it can be improved to instant retrieval..

Participant stated that:

“It takes about 10-15 minutes to retrieve records if user is familiar with the open public access catalogue system”.

Participant 4 stated that:

“It should take less than a minute if the internet bandwidth is good”.

Participant 5 stated that:

“Records are retrieved instantly”.

Participant 6 stated that:

“It takes less than a minute”.

Participant 7 stated that:

“It depends on the connectivity and search skills”.

Participant 8 stated that:

“It can be retrieved within seconds”.

Participant 9 stated that:

“Approximately 2-5 minutes”.

The researcher observed that at UNAM library and NUST library, retrieval was within 2 minutes and at IUM library it took up to 4 minutes to retrieve a record.

4.5.1.6 State of metadata records in libraries

The respondents were asked about the state of the metadata records in their libraries. They were asked to select whether the state was good or bad. Ten respondents indicated that the state of metadata records at their library was good, whereas one respondent specified that it was fair.

The respondents were then asked to rate the library's current state of metadata records. They had to state whether they agreed, were unsure, or disagreed with the statements below. Ten (90.9%) respondents agreed that metadata records were in good condition, and one (9.1%) was unsure about the condition. Eight (72.7%) respondents agreed that metadata records were easily accessed and three (27.3%) indicated that they were unsure. Nine (81.8%) respondents agreed that records were easily retrieved and two (18.2%) indicated that they were unsure. Ten (90.9%) respondents agreed that metadata records were maintained, and one (9.1%) respondent was unsure. All eleven (100%) respondents agreed that metadata records were saved and protected.

Table 4.1: State of metadata records (N=11)

STATE OF METADATA RECORDS	RATINGS		
	Agree	Unsure	Disagree
Metadata records are in good condition	10	1	0
Metadata records are easily accessed	8	3	0
Metadata records are easily retrieved	9	2	0
Metadata records are maintained	10	1	0
Metadata records are saved and protected	11	0	0

Through an interview, participants were asked about the state of the metadata records in their libraries. These were their responses:

Participant 1 stated that:

> *“The records in the library catalogue are okay and the system operates well”.*

Participant 2 stated that:

> *“The metadata records are in a bad condition due to the duplications and inconsistencies found”.*

Participant 3 stated that:

> *“We could conclude that the state of metadata records is fair because we are still able to retrieve records even though the library management system has issues”.*

Participant 4 stated that:

> *“The state of the records is in a fair state due to the challenges with the cataloguing skills”.*

Participant 5 stated that:

> *“The state of metadata records is in a fair condition”.*

Participant 6 stated that:

> *“Metadata records are well loaded on the library management system but some fields are missing so it is fair”.*

Participant 7 stated that:

> *“I think it is bad and needs urgent attention”.*

Participant 8 stated that:

> *“I’m not quite sure”.*

Participant 9 stated that:

> *"The state of metadata records is doing okay, especially on our new system".*

The researcher observed that the state of the metadata records in the libraries was in a fair condition.

4.5.1.7 Challenges faced in managing metadata records in libraries

In managing metadata records, various challenges affecting the management of metadata records in libraries may occur. The respondents were asked through open-ended questions if they faced any challenges faced in managing metadata records for library resources. Nine (81.8%) respondents indicated that they did face challenges and two (18.2%) indicated that they were not aware of any challenges faced.

Respondents were further asked through open-ended questions to explain what kind of challenges they faced in managing metadata records for library resources. These were their responses:

Respondent 1 stated that:

> *"Not much, but sometimes we have five entries of the same record instead of one".*

Respondent 2 stated that:

> *"It is mostly system problems".*

Respondent 3 stated that:

> *"If a cataloguer is tired, they just enter some fields, and some fields are incomplete so you might not find the record".*

Respondent 4 did not answer.

Respondent 5 stated that:

> *"Wrong spellings of bibliographic information".*

Respondent 6 stated that:

> *"Sometimes we do not pick up duplication and then students say we have more books".*

Respondent 7 stated that:

> *"The system can be slow especially with bad internet".*

Respondent 8 stated that:

> *"Many challenges especially mistakes by staff when cataloguing wrongly".*

Respondent 9 did not answer.

Respondent 10 stated that:

> *"Only my boss can overwrite my error and sometimes she is not around".*

Respondent 11 stated that:

> *"Too many entries of one book, internet connectivity and not knowing how to fully operate the system because there was no training given to staff members".*

The participants were also asked to point out any challenges faced in managing metadata records for library resources. These were the participants' responses:

Participant 1 stated that:

> *"Apart from correcting mistakes, none that I am aware of".*

Participant 2 stated that:

> *"The main challenge is that it is slow, the method used to create metadata is quite slow".*

Participant 3 stated that:

"Some functions on the management system do not function well, cataloguers still struggle to catalogue and there are a number of duplication of records".

Participant 4 stated that:

"Lack of accuracy and lack of interlinkage between manually cataloguing and electronically managing the metadata records".

Participant 5 stated that:

"Spelling differences as well as inconsistencies in the creation of the record".

Participant 6 stated that:

"Low connectivity, making it slow".

Participant 7 stated that:

"The process can be straining and time-consuming, there are internet challenges, infrastructural challenges, duplicates and errors from old cataloguing process".

Participant 8 stated that:

"Not sure".

Participant 9 stated that:

"Just incorrect spellings and duplication of records".

The researcher observed inconsistencies of the metadata records with duplications and spelling errors.

4.5.1.8 Improvements to enhance metadata services in libraries

Improvements can be made on metadata systems to enhance services in libraries. The respondents were asked through open-ended questions to mention any improvements

that could be made to enhance metadata services in their libraries. These were their responses:

Respondent 1 stated that:

> *"Offering training of metadata specialists, conducting metadata audit, collaborating with institutions such as the online computer library centre".*

Respondent 2 stated that:

> *"Get systems that work or are good with individual library needs".*

Respondent 3 stated that:

> *"The need to ensure that data transferred from one information system to another is comprehensive and accurate".*

Respondent 4 stated that:

> *"The library needs to introduce new systems and offer training to staff".*

Respondent 5 stated that:

> *"Perhaps we need to introduce technologies being used by developed countries for cataloguing".*

Respondent 6 stated that:

> *"Get a system that flags duplication or automatically cleans records".*

Respondent 7 stated that:

> *"Update the system and get better internet packages".*

Respondent 8 stated that:

> *"We need to refresh the cataloguers on how to catalogue especially correctly".*

Respondent 9 did not answer the question.

Respondent 10 stated that:

> *"By improving the library management system to a commercial system instead of open system".*

Respondent 11 stated that:

> *"Training of library employees on the tricks of cataloguing".*

The participants were asked to state any improvements that can be made to enhance metadata services in their libraries. These were their responses:

Participant 1 stated that:

> *"None at this point, the library catalogue is frequently updated".*

Participant 2 stated that:

> *"Improve speed through AI software which is compatible and can be linked to the current library management system in use".*

Participant 3 stated that:

> *"Training on the library management system".*

Participant 4 stated that:

> *"Speeding up metadata creation and management processes and training cataloguers on how to better catalogue bibliographic material".*

Participant 5 stated that:

> *"Newly updated thesaurus, change of cataloguers as well as change of attitude towards cataloguing".*

Participant 6 stated that:

“Getting a commercial software”.

Participant 7 stated that:

“Follow current library trends in the market, improve maintenance”.

Participant 8 stated that:

“Introduce interoperability, systems that speak to each other”.

Participant 9 stated that:

“Introducing AI to verify the work”.

4.5.2 Perceptions of metadata specialists on adopting AI to improve metadata services

The second objective of the study was to understand the perceptions of metadata specialists on adopting AI to improve metadata services at IHEs in Namibia. The researcher collected data through administering questionnaires and interviews where the respondents and participants had to answer various questions under this objective to understand their perceptions.

4.5.2.1 Familiarity of AI

To deduce whether the respondents had any knowledge on AI, they were asked through a closed-ended question, whether they were familiar with AI and its applications in library metadata services. Eight (72.7%) respondents indicated that they were familiar with AI and its applications in library metadata services, and three (27.3%) respondents indicated they were not familiar with AI and its applications in library metadata services.

The respondents were also asked through closed-ended questions to indicate their understanding about the adoption of AI for the improvement of metadata services in their libraries. Figure 4.8 presents that five (45.4%) respondents indicated that AI managed metadata records effectively, seven (63.6%) respondents indicated that AI made metadata creation faster, seven (63.6%) respondents indicated that AI ensured accuracy

and consistency in metadata records, and three (27.3%) indicated that AI provided security for the metadata records.

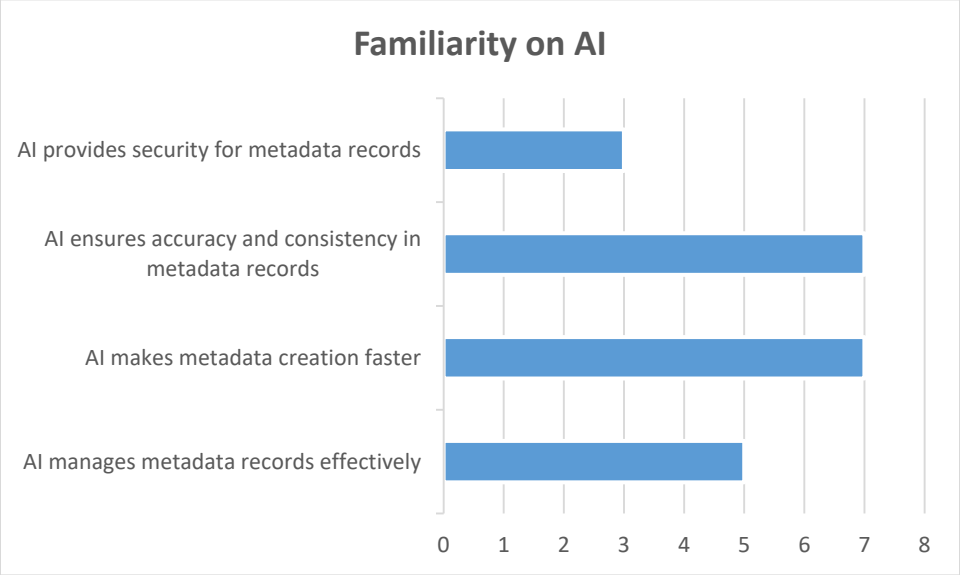

Figure 4.8: Familiarity on AI (n=11)

Respondents were also asked through closed-ended questions what they thought should be done for them to familiarise themselves with the adoption of AI for the improvement of metadata services in libraries. According to figure 4.9, two (18.2%) respondents indicated attending workshops and conferences on AI and metadata services and two (18.2%) indicated that training on AI and metadata services would familiarise them with AI for the improvement of metadata services.

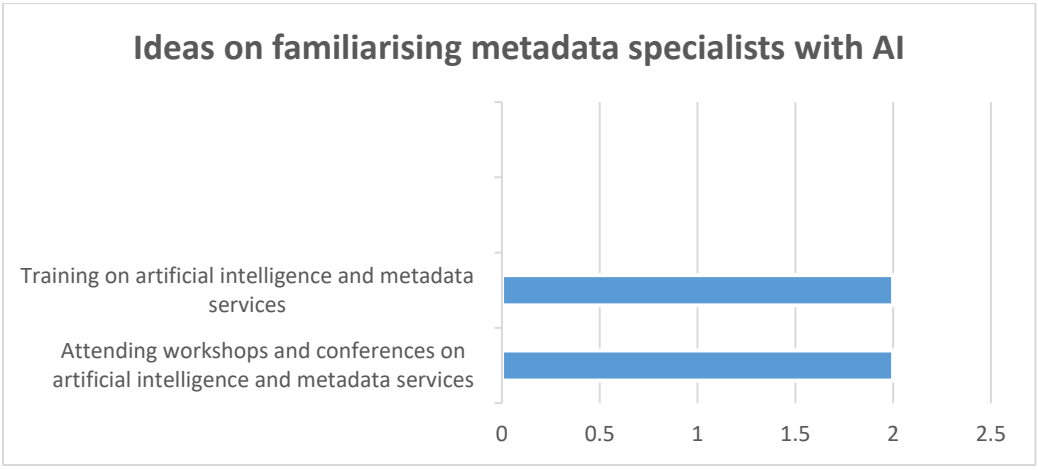

Figure 4.9: Ideas on familiarising metadata specialists with AI

Participants were asked to give their understanding of the adoption of AI for the improvement of metadata services in their libraries. These were their responses:

Participant 1 stated that:

> *"It is using software/servers to enhance speed or accuracy of metadata creation, making it available faster".*

Participant 2 stated that:

> *"This is technology to save time when creating metadata, accurate and efficient. Technology to improve speed of metadata services in retrieving records, to enhance operations in accessing information".*

Participant 3 stated that:

> *"It is a new way of working, involving new technologies and computers doing human work".*

Participant 4 stated that:

> *"Using technology to manage our time and fasten the metadata creation process".*

Participant 5 stated that:

> *"Not sure".*

Participant 6 stated that:

> *"The use of machines to automate metadata services".*

Participant 7 stated that:

> *"I really do not know".*

Participant 8 stated that:

"AI and metadata services combination is quite new to me, so I really don't have an understanding".

Participant 9 stated that:

"There is no understanding at this point".

4.5.2.2 Effectiveness of AI if properly implemented to improve metadata services in libraries

Through an open-ended question, the respondents were asked to give their opinion of AI being effective if properly implemented to improve metadata services in libraries. The following were their responses:

Respondent 1 did not answer.

Respondent 2 stated that:

"Yes, because it will make the work of the metadata specialists easier, efficient and free from errors".

Respondents 3 and 4 did not answer.

Respondent 5 stated that:

"Yes, I think AI would be effective if properly implemented".

Respondent 6 stated that:

"Indeed it will be effective to improve metadata services".

Respondents 7 to 11 did not answer.

The participants were also asked to give their opinion on AI being effective if properly implemented to improve metadata services in libraries. The following were their responses:

Participant 1 stated that:

> *"AI can improve metadata quality and advance processes, but effective implementation and continuous monitoring are essential".*

Participant 2 stated that:

> *"AI can improve information quality and automate laborious processes. The capabilities of AI can be used by libraries to give more precise and thorough metadata".*

Participant 3 stated that:

> *"AI can enhance metadata quality and discoverability making it quite effective".*

Participant 4 stated that:

> *"It will be effective because metadata retrieval will be quite easy".*

Participant 5 stated that:

> *"It will make metadata records consistent and uniform".*

Participant 6 stated that:

> *"Yes, the automation of metadata services will be effective in improving library services".*

Participant 7 stated that:

> *"As long as it's properly adopted, I think it will be effective".*

Participant 8 stated that:

"I think it will be effective in managing the records because of the accuracy it will bring".

Participant 9 stated that:

"I believe it would be effective in enhancing our library services as it is a technological advancement".

4.5.2.3 General opinions about AI to enhance metadata services in the library

The respondents were asked to select opinions they agreed with from a list of general opinions of AI to enhance metadata services in the library. Figure 4.10 illustrates how six (54.5%) respondents indicated that AI could provide effective metadata services in the library and five (45.5%) respondents indicated that metadata specialists could lose their jobs if AI is applied to improve metadata services at the library.

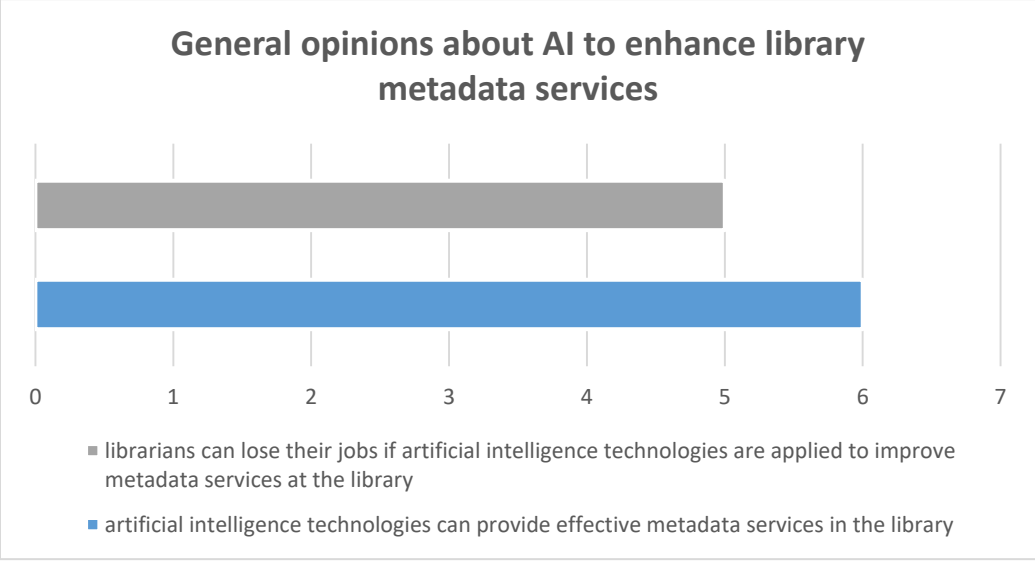

Figure 4.10 General opinions about AI to enhance library metadata services

Participants were also asked about their general opinions of AI to enhance library metadata services. These were their responses:

Participant 1 stated that:

“AI, in my opinion, have enormous potential to improve library metadata services”.

Participant 2 stated that:

“AI have the potential to completely transform metadata management in libraries by delivering precise and thorough information that meets user needs”.

Participant 3 stated that:

“AI’s automation powers can improve libraries' metadata efficiency and quality, enabling users to find resources with ease”.

Participant 4 stated that:

“AI can improve library metadata services but I’m not sure human metadata specialists will be needed at work anymore”.

Participant 5 stated that:

“Although I don’t know too much about the topic, I think AI makes work easier and faster”.

Participant 6 stated that:

“AI will simplify cataloguing and the whole metadata retrieval process”.

Participant 7 stated that:

“I think it is a good innovation and it is here to transform the information world”.

Participant 8 stated that:

“AI will get rid of duplication in the system”.

Participant 9 stated that:

“It will improve efficiency and access to resources for our library”.

4.3.2.4 Benefits of using AI to improve library metadata services

With the introduction of AI in libraries comes great benefits such as automating metadata creation and reducing manual effort thereof. The researcher sought to understand the view of the respondents when it came to the benefits of using AI to improve library metadata services. In figure 4.11, seven (63.6%) respondents indicated easy creation of metadata records, four (36.4%) indicated easy retrieval of metadata records, four (36.4%) indicated faster retrieval of metadata records, and three (27.3%) indicated accurate and consistent metadata records.

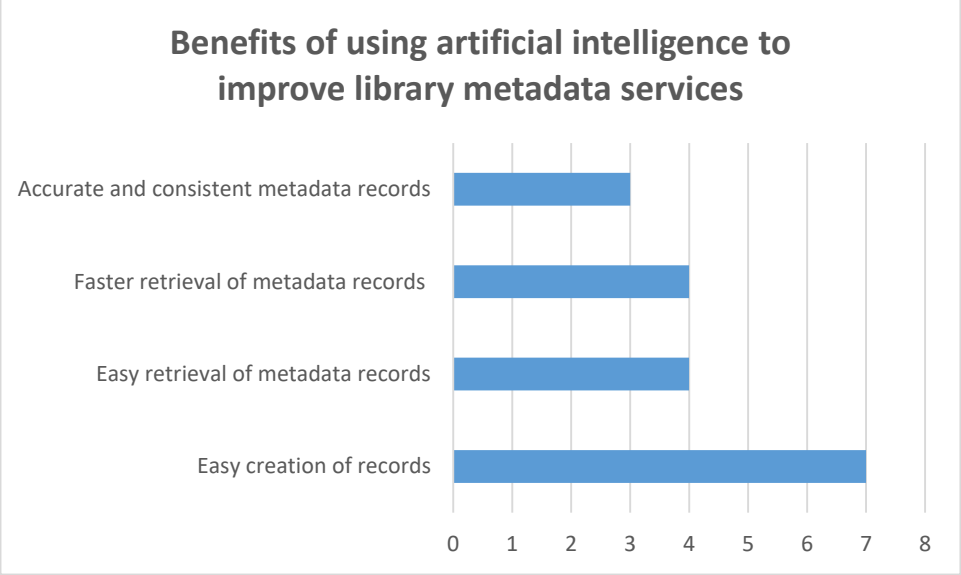

Figure 4.11 Benefits of using AI to improve library metadata services

The participants were also asked to give their general views on the benefits of using AI to improve metadata services. These were their responses:

Participant 1 stated that:

> *"Library metadata services will be more accurate, machines will be interacting with other machines with no human contact which usually slows it down".*

Participant 2 stated that:

"AI that can pick up bibliographic information or embedded metadata such as name, type and location within the resource could benefit library metadata resources".

Participant 3 stated that:

"Work is done faster, more accessible and great accuracy".

Participant 4 stated that:

"Speeding up metadata services, 24 hours services to cater for when human metadata specialists are not available".

Participant 5 stated that:

"Wider range of subject headings, great exposure for the library and it would improve efficiency in the library".

Participant 6 stated that:

"Accuracy will be improved, minimising of incorrect spelling, it makes work easier".

Participant 7 stated that:

"Less time spent doing work, increases efficiency and high standard of work".

Participant 8 stated that:

"The standard of work will be high".

Participant 9 stated that:

"Enhance access and discoverability and it will perform faster".

4.5.2.5 Factors with negative influences on AI for library metadata services

To establish opinions of the respondents on the challenges of adopting AI, respondents were asked through closed-ended questions of factors, in their opinion, which might have a negative influence on the adoption of AI for metadata services. According to figure 4.12,

11 (100%) respondents indicated that a limited budget and lack of training and unfamiliarity could have a negative influence, three (27.3%) indicated that it could be the complexity of AI systems, and six (54.5%) indicated that it could be the unwillingness and resistance to change of metadata specialists.

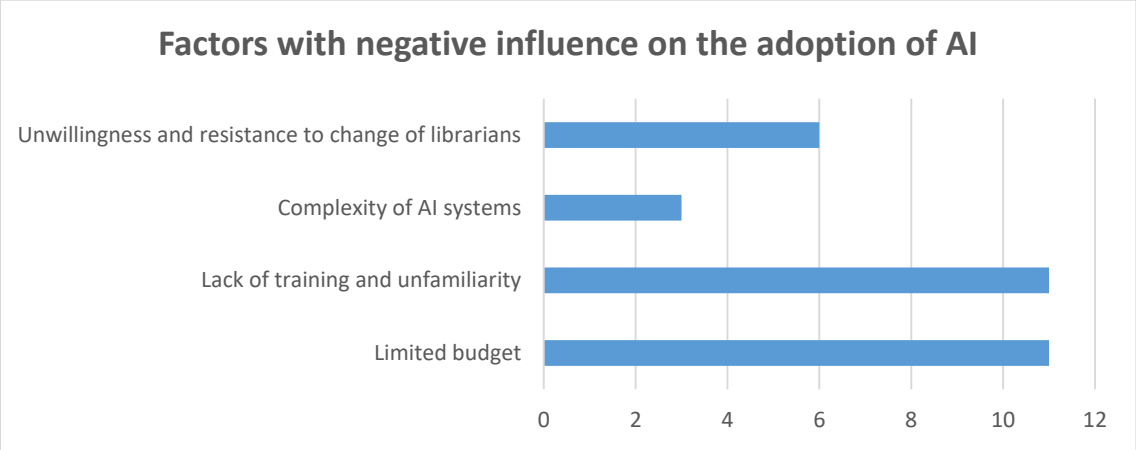

Figure 4.12 Factors with negative influence on the adoption of AI

The participants during the interviews were asked to list factors which might negatively influence the adoption of AI for metadata services. These were their responses:

Participant 1 stated that:

> *"Humans do not understand the concept of AI or how to utilise it and the fear of losing jobs to machines".*

Participant 2 stated that:

> *"Finances (lack of funds), expensive equipment, cutting of budgets and stakeholders not seeing the importance of adopting AI for the library to improve. Employees' resistance to change because of technophobia".*

Participant 3 stated that:

> *"Money problems (budget cuts) and lack of training on AI."*

Participant 4 stated that:

"Attitude of metadata specialists, anxiety because there might be a loss of human jobs. Budget cuts and the environment might not be conducive for adopting the AI".

Participant 5 stated that:

"Financial restrictions and reluctance, as well as fear of loss of jobs".

Participant 6 stated that:

"Financial implications, lack of expertise and infrastructure".

Participant 7 stated that:

"Connectivity, bad infrastructure and lack of knowledge on AI".

Participant 8 stated that:

"Software viruses, poor infrastructure".

Participant 9 stated that:

"Poor to no skills on AI".

4.5.2.6 Participation in the adoption of artificial technologies for the improvement of library metadata services

Through a closed-ended question, respondents were asked about willingly participating in the implementation of AI for the improvement of library metadata services. Seven (63.6%) respondents indicated that they would be willing to participate, two (18.2%) indicated that they were not willing to participate, and two (18.2%) respondents did not answer the question.

Respondents were further asked through open-ended questions to elaborate on their willingness to participate in the implementation of AI for metadata services improvement. These were their responses:

Respondent 1 stated that:

"Yes, embracing change is always good for library services".

Respondent 2 stated that:

"Yes, to change with the times as everything is now going digital".

Respondents 3 to 11 did not answer the question.

When the respondents were asked to elaborate why they were not willing to participate in the implementation of AI for the improvement of library metadata services, none of the respondents who selected that they were not willing to participate answered the question.

The participants were asked if they were willing to actively participate in the implementation of AI for the improvement of library metadata services and these were their responses:

Participant 1 stated that:

"Yes. The university is technology driven if it's to their advantage. The university is keen to adopt new developments".

Participant 2 stated that:

"Definitely, it is an opportunity to use it to improve services in my current job".

Participant 3 stated that:

"Yes, to embrace new technologies and accept change".

Participant 4 stated that:

"Yes, to learn and be part of new services to be implemented in the technological sphere."

Participant 5 stated that:

"Yes, change is great."

Participant 6 stated that:

"Yes, open to anything that can improve me as a metadata specialist".

Participant 7 stated that:

"Yes, learning opportunity through training".

Participant 8 stated that:

"Yes, it is an opportunity to become a better metadata specialist".

Participant 9 stated that:

"Definitely, I am always open to change".

4.5.3 Usability of AI technologies to improve metadata services in libraries

The third objective of the study was to understand the usability of AI to improve metadata services at IHEs in Namibia. The researcher collected data through administering questionnaires and interviews during which the respondents and participants had to answer various questions under this objective to understand their perceptions.

4.5.3.1 Activities performed through AI to improve metadata services in libraries

In order to successfully implement and usability AI, it is imperative to assess its usability and assess the activities that can be performed through AI. The respondents were asked through closed-ended questions to identify activities that could be performed through AI to improve metadata services in libraries. Six (54.5%) respondents selected automated metadata creation, four (36.4%) respondents selected duplicate detection as an activity, two (18.2%) respondents selected enhanced keyword extraction, and one (9.1%) respondent selected semantic tagging.

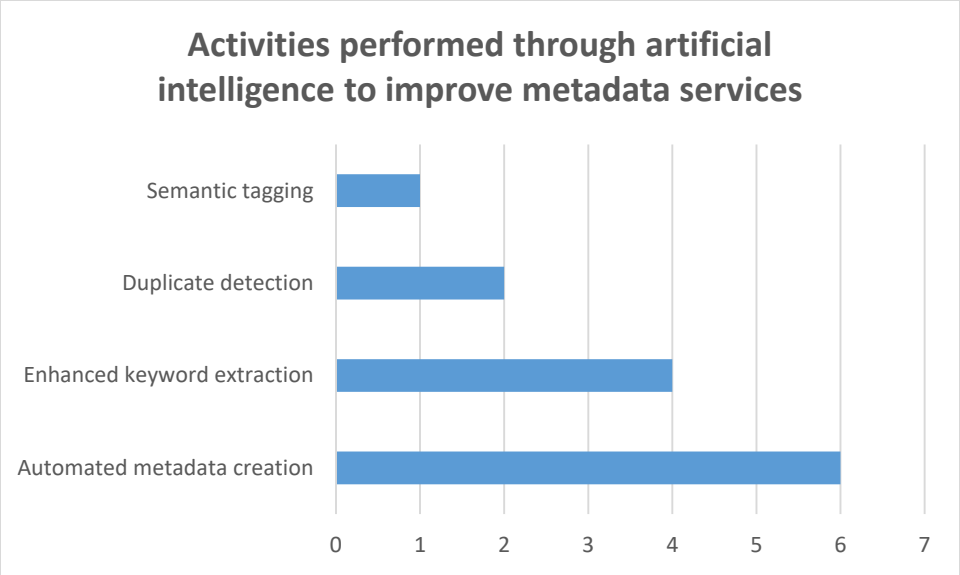

Figure 4.13 Activities to be performed through AI to improve metadata services

The respondents were further asked through open-ended questions how the metadata services they selected in the previous question could be performed through AI. These were their responses:

Respondent 1 stated that:

> *"Not sure, but once the system is installed, I am convinced that everything will be possible".*

Respondent 2 stated that:

> *"I am not sure".*

Respondent 3 stated that:

> *"After detecting the duplicates the system can automatically erase duplication after thorough verification".*

Respondent 4 did not answer the question.

Respondent 5 stated that:

“I have no background on this”.

Respondent 6 did not answer the question.

Respondent 7 stated that:

“It will automatically create metadata for the records”.

Respondent 8 did not answer the question.

Respondent 9 did not answer the question.

The respondents were further asked through open-ended questions why metadata services should be performed through AI. These were their responses:

Respondent 1 stated that:

“To make indexing of records easy, free from duplication and to save time of cataloguers especially when they have to do everything manually which can be time-consuming”.

Respondent 2 stated that:

“I am not sure”.

Respondent 3 stated that:

“Because I believe it’s faster done by the advanced technology”.

Respondent 4 did not answer the question.

Respondent 5 did not answer the question.

Respondent 6 did not answer the question.

Respondent 7 stated that:

“For easy retrieval of metadata”.

Respondent 8 did not answer the question.

Respondent 9 did not answer the question.

The participants were also asked to identify activities which could be implemented through AI for metadata improvement. These were their responses:

Participant 1 stated that:

> *"It can start with automated cataloguing, and machines processing books instead of humans sitting to do the work and self-issue and return".*

Participant 2 stated that:

> *"Workshops, by creating metadata with AI and using AI to detect duplication in metadata records".*

Participant 3 stated that:

> *"I'm not sure".*

Participant 4 stated that:

> *"Automated chat bots".*

Participant 5 stated that:

> *"No knowledge on it as it is still in a new topic in metadata services".*

Participant 6 stated that:

> *"Natural language processing"*

Participant 7 stated that:

> *"Tools to check spelling, duplicates and rectify them".*

Participant 8 stated that:

“Robot to do and maintain shelve reading”.

Participant 9 stated that:

“Not sure”.

The participants were further asked to explain how the mentioned metadata services can be performed through AI. These were their responses:

Participant 1 stated that:

“Through software”.

Participant 2 stated that:

“Through AI-specialised software to detect duplicate metadata creation”.

Participant 3 stated that:

“Do not know much on the topic”.

Participant 4 stated that:

“Answering queries and directing catalogue”.

Participant 5 stated that:

“No knowledge on it as it is still in a new topic in metadata services”.

Participant 6 stated that:

“No knowledge on it.”.

Participant 7 stated that:

“I have no idea, but I am sure there are tools on the market”.

Participant 8 stated that:

“I really do not have information on that”.

Participant 9 stated that:

“Not sure”.

The participants were then asked to explain why they think metadata services should be performed through AI. These were their responses:

Participant 1 stated that:

“I wouldn’t say it should, although as a gradual process, migrating to AI is a slow process and we cannot get rid of physical employees”.

Participant 2 stated that:

“Metadata services would be faster. Databases whose metadata is created manually is much slower with human effort. AI is more efficient and accurate”.

Participant 3 stated that:

“It will make the job easier”.

Participant 4 stated that:

“AI should run the library while humans are off”.

Participant 5 stated that:

“No knowledge on it, as it is still in a new topic in metadata services”.

Participant 6 stated that:

“Maybe it will bring change, metadata will be more effective, and work will be easier and not time-consuming”.

Participant 7 stated that:

"To rectify our current issues".

Participant 8 stated that:

"Combination of humans and AI could be a big thing, although humans need to make sure they cover the aspect of ethics on AI handling data".

Participant 9 stated that:

"It will improve libraries".

4.5.4 AI infrastructure for the improvement of metadata services

The last objective of the study was to understand what kind AI infrastructure can be used to improve metadata services at IHEs in Namibia. The researcher, through administering questionnaires and interviews, incited the respondents and participants to answer various questions under this objective to get some insight.

4.5.4.1 AI infrastructure for metadata services

AI infrastructure refers to the tools that can be used to improve metadata services. The respondents were asked through closed-ended questions whether they knew of any AI infrastructure that could be used for metadata services. Seven (63.6%) of the respondents indicated that they did know of AI infrastructure and four (36.4%) respondents indicated that they did not know of any AI infrastructure that could be used to improve metadata services.

The respondents were further asked through closed-ended questions to indicate which AI infrastructure they were familiar with that could be used to improve metadata services. According to figure 4.14 the results were as follows: five (45.5%) respondents specified robotic machines, three (27.3%) respondents specified NLP, and one (9.1%) specified machine learning.

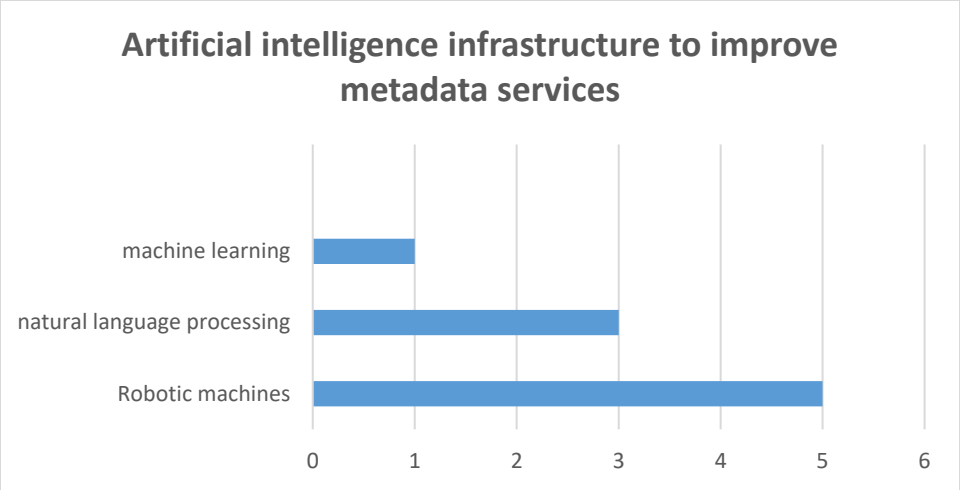

Figure 4.14 AI infrastructure to improve metadata services

The respondents were asked through open-ended questions what they thought could be done to familiarise themselves with the AI infrastructure that could be used to improve metadata services. The following were their responses:

Respondent 3 stated that:

> *"Get training to familiarise with it".*

Respondent 7 stated that:

> *"Training will help".*

Respondents 1, 2, 4-6, 8, 9-11 did not answer the question.

The participants were asked to mention any AI infrastructure used for metadata services. These were their responses:

Participant 1 stated that:

> *"Robotic machines, probably machine learning, programmed classification, and natural language processing. The library already does optical character recognition although it has not been integrated to the library management system".*

Participant 2 stated that:

“Network, data and the cloud for the storage”.

Participant 3 stated that:

“Robotic machine, optical character recognition and machine learning”.

Participant 4 stated that:

“Computers, software, storage equipment, servers”.

Participant 5 stated that:

“No idea”.

Participant 6 did not have an answer to the question.

Participant 7 stated that:

“Software, networking system and hardware with specifications”.

Participant 8 stated that:

“I do not have knowledge on infrastructure for AI”.

Participant 9 stated that:

“Computers”.

4.5.4.2 Application of AI infrastructure for metadata services

The respondents were asked about how AI infrastructure could be used in metadata services. According to figure 4.15, the results were as follows: nine (81.8%) respondents selected that the infrastructure could automate metadata creation, five (45.5%) selected that it could perform quality control and validation, three (27.3%) selected that it could automate metadata enrichment, and two (18.2%) selected that it could be used to automate language translation.

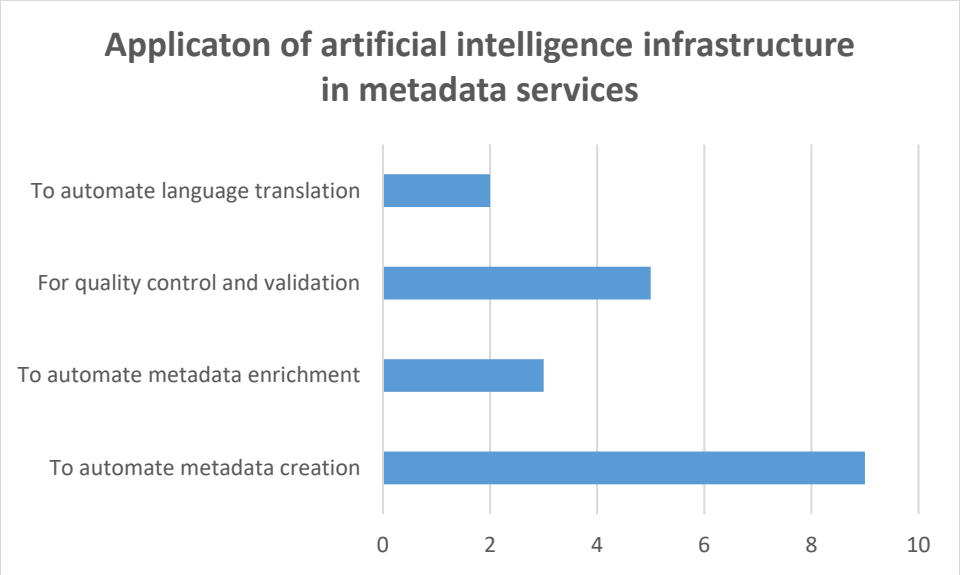

Figure 4.15 Application of AI infrastructure in metadata services

The participants were asked on how AI infrastructure could be used in metadata services. These were their responses:

Participant 1 stated that:

> *"Z39.50 Protocol is used".*

Participant 2 stated that:

> *"To build algorithms. Network is needed for connection to go through and cloud is a service provider for storage".*

Participant 3 stated that:

> *"To automate metadata creation and for quality control".*

Participant 4 stated that:

> *"Used to capture and save data".*

Participant 5 stated that:

“No knowledge on it”.

Participant 6 stated that:

“We have not implemented AI, so I wouldn’t really know”.

Participant 7 stated that:

“By programming the machines”.

Participant 8 stated that:

“I am not sure”.

Participant 9 did not answer the question.

4.5.4.3 Importance of AI infrastructure for implementation of metadata services

The respondents were asked through open-ended question to give reasons as to why they thought AI infrastructure could be important for the improvement of metadata services. These were their responses:

Respondent 1 stated that:

“It will improve speed and support the technology”.

Respondent 2 stated that:

“It can improve accuracy and relevance of data”.

Respondent 3 stated that:

“It can minimise and reduce errors that are repetitive.

Respondent 4 did not answer the question.

Respondent 5 stated that:

“Easy retrieval of metadata”.

Respondent 6 did not answer the question.

Respondent 7 stated that:

> *"It can manage hardware computing resources".*

Respondent 8 stated that:

> *"It can help data developers access data".*

Respondent 9 stated that:

> *"Improvement of cataloguing".*

The participants were also asked to explain why they thought AI infrastructure could be important for the implementation of metadata services. These were their responses:

Participant 1 stated that:

> *"AI cannot exist without infrastructure/software. These are needed to connect networks and internet connections as well as for humans to communicate with the AI".*

Participant 2 stated that:

> *"Infrastructure should be in place for the technology to work".*

Participant 3 stated that:

> *"Yes, it is of importance, it is not possible to have AI without infrastructure".*

Participant 4 stated that:

> *"Without infrastructures there is no AI. They are enablers".*

Participant 5 stated that:

> *"Yes, drives AI in the right direction".*

Participant 6 stated that:

“Improves efficiency and accuracy in metadata, makes it faster”.

Participant 7 stated that:

“Easier and faster, also every technology requires infrastructure”.

Participant 8 stated that:

“Errors in spelling and duplication will be corrected”.

Participant 9 stated that:

“Yes, I believe infrastructure should be put in place for stability and for it to work”.

4.6 SUMMARY OF THE CHAPTER

The study's conclusions from the data gathered through four distinct methods, including interviews, questionnaires, interviews, and observation, were provided in this chapter. While qualitative data were analysed via verbatim quotes from the participants, quantitative data were analysed independently and separately using tables, charts, and graphs. Convergent presentation of the results was necessary to provide high-quality research outcomes. The information gathered and displayed was predicated on the goals of the research. The state of metadata services in libraries, metadata specialists' perceptions about using AI to improve library metadata services, the usability of AI for improving library metadata services, and the infrastructure needed to implement AI were the main topics of this study's findings. Therefore, the next chapter provides the interpretation and discussion of the findings of the study, as reported in this chapter with support from the literature review.

CHAPTER 5

INTERPRETATION AND DISCUSSION OF THE RESEARCH FINDINGS

5.1 INTRODUCTION

The previous chapter analysed and presented the outcomes of the study based on the objectives. This chapter deliberates the interpretation and discussion of the study's findings based on the information gathered from the sampled respondents and participants (Creswell & Creswell 2018). The findings from the previous chapter were explained in the previous chapter so that the reader could fully understand them. The following themes that emerged from the objectives are used in this chapter to interpret and discuss the findings.

- Current state of metadata services at IHEs in Namibia.
- Perceptions of metadata specialists on adopting AI to improve metadata services in libraries at IHEs in Namibia.
- Usability of AI to improve metadata services in libraries at IHEs in Namibia.
- AI infrastructure needed to improve metadata services in libraries at IHEs in Namibia.
- Framework for adoption of AI to improve metadata services in libraries at IHEs in Namibia.

5.2 STATE OF METADATA SERVICES AT INSTITUTIONS OF HIGHER EDUCATION

The researcher had to evaluate the state of metadata services in libraries to establish whether they were in a good or bad condition. The state of metadata services within a library captures the current status and methodology employed in the creation and provision of bibliographic records (Chemulwo & Sirorei 2020). When recommending appropriate AI to improve metadata services in a library, it is important to consider the current status of a library in terms of metadata services, whether good or bad (Corrado

2021). If metadata services are in a bad state, it would decrease the discoverability of metadata records on the OPAC when users are unable to locate the resources required due to inaccurate or incomplete metadata, hence users would not be able to retrieve the records (Satija, Bagchi & Martínez-Ávila 2020). These challenges make metadata services inefficient and lead to them being in a bad state. However, a good state of metadata services would enhance information retrieval and improve metadata efficiency and accessibility because metadata records are properly and consistently catalogued with no errors and duplications (Corrado 2021).

It is, therefore, the responsibility of academic libraries in Namibia to ensure that the metadata services are in good condition. A good state of metadata services contributes to a more effective and user-friendly library environment, supporting the library's mission to provide access to information and resources for its users (Satija et al. 2020).

5.2.1 Format in which metadata records are created

In the last five decades, libraries used to create and manage bibliographic metadata using conventional techniques such card cataloguing until the adoption of technology, which saw most, if not all, libraries switching to electronic means to catalogue library resources (Eserada & Okolo 2019). According to Iyambo (2021), libraries currently either use original cataloguing, which involves manually identifying and filling in metadata fields using cataloguing rules or copying metadata entries from external databases to create and maintain bibliographic information of resources on electronic library OPACs. Hence, the majority of the respondents indicated that metadata records are created electronically, and the minority of the respondents indicated that metadata records are created both electronically and manually. Most of the participants also mentioned that they only relied on electronic methods to create metadata, such as LMSs, while the minority of participants specified the use of manual creation of metadata, using tools like RDA, DDC, MARC 21, and Library of Congress subject headings. The researcher observed that the metadata records were created both manually and electronically.

Based on the majority of respondents and participants indicating the use of the electronic format for the creation of metadata records in libraries, the results might be representing

a shift towards technological efficiency and the simplification of metadata creation processes in the libraries. This might also be because the manual metadata creation process is known to be long and slow, compared to the electronic metadata creation process. However, it is important for libraries to make use of electronic metadata creation methods because it yields less errors and duplication in the records, compared to the manual process of metadata creation (Schreur 2020).

5.2.2 Format in which metadata records are managed

According to Hamutumwa (2014), libraries have been managing metadata records in an electronic format as a response to the ever-changing technological needs of libraries. Iyambo (2021) suggests that the electronic management of library records is preferred, since it enables remote access to users through the OPAC. According to Clarke and Schoonmaker (2019), the preference for electronic management of records likely stems from its efficiency, accessibility, and the ability to integrate with external databases, underlining the importance of technology in modern metadata records management practices. Hence, the majority of the respondents solidly reported managing metadata records electronically. The majority of the participants also indicated that metadata records in their libraries were managed electronically. The researcher observed that the metadata records were all managed electronically using library management systems. The high prevalence in responses of the use of the electronic format managing metadata records might be because libraries might prefer electronic formats in managing metadata records to ensure records do not get lost or misplaced as is the case with manually managing metadata records. Libraries might also be utilising electronic formats to manage metadata records because of the effectiveness of electronic formats, including the speedy process of metadata records retrieval and management. According to Kalita and Deka (2021), electronically managing metadata records ensures that libraries manage records orderly with no loss of migrated information and the assurance that records would not disappear.

5.2.3 Accuracy of metadata records in library's catalogue

The ultimate goal of quality control and ensuring accuracy is to eliminate errors and ensure the library's resources are accessible (Nero & He 2018). Wiederhold and Reeve (2021) mention asking users for feedback, making checklists, and using reports to ensure quality control and accuracy in libraries. Ensuring accuracy gives metadata specialists the ability to find and fix errors, duplicates, and missing data in library catalogues (Eserada & Okolo 2019). Hence, the majority of the respondents indicated that the libraries ensured accuracy by doing quality control of metadata records in their library catalogues. The respondents highlighted quality control processes such as verification, metadata audits, and adherence to standards in assuring quality. A minority of the respondents expressed uncertainty about the accuracy assurance measures. The majority of the participants mentioned various ways to evaluate the accuracy of metadata records in their library catalogues using a range of methods. The emphasis on quality control by doing consistency checks, spot checks, and verification procedures is a recurring theme in the participants' responses.

This might be an indication that there were inaccuracies in metadata records, hence the participants adopted quality control methods in an attempt to find mistakes in their library catalogues. It might also be that records previously catalogued were not complete or retrievable on the library catalogue and standards had to be set for a metadata record to be deemed accurate or standard before being loaded onto the library catalogue. The uncertainty of a few respondents of how metadata specialists maintain accuracy in libraries might indicate a lack of knowledge or participation in quality control procedures (Kim et al. 2020).

It is important to have accurate metadata services in libraries because it serves as the backbone of information organisation and retrieval systems (Nero & He 2018). Metadata provides essential details about library resources, such as titles, authors, subjects, and formats, enabling users to efficiently locate and access materials (Schreur 2020). Without accurate metadata records, users may struggle to find relevant resources, denying them access to information. Additionally, accurate metadata ensures the integrity and reliability

of library collections, supporting the library's mission to facilitate knowledge discovery and dissemination.

5.2.4 Retrieval of metadata records

The ability to catalogue is a crucial component of information dissemination because it is an access and retrieval tool that enables users to find information needed to satisfy their information needs (David-West & Angrey 2018). In the recent years, the use of computers in cataloguing has replaced conventional cataloguing, marking a paradigm change in the field of metadata retrieval (Corrado 2021). According to Monyela (2020), information retrieval has significantly improved since the introduction of the online cataloguing of metadata records. Retrieving information online ensures speedy information accessibility and efficiency, making it the preferred method for retrieving information (Vijayakumar & Sheshadri 2019). Hence, the majority of the respondents indicated that the online method was used to retrieve metadata records and the minority of respondents indicated that online and physical methods were used to retrieve metadata records. All the respondents also indicated that the online retrieval method was the most effective in their libraries. The majority of the participants consistently highlighted the reliance on electronic platforms for metadata retrieval in their libraries. Commonly mentioned platforms included the EBSCO discovery services, OPAC, and library-specific systems like EBSCO Online. The researcher observed that metadata records were retrieved electronically through the libraries' online public access platforms and physically by asking staff on the shelves to help retrieve records.

Libraries might prefer using online methods to retrieve metadata because it offers rapid access to metadata records, enable speedy searches with the help of strong algorithms, and allow users to access information from anywhere. However, the indication that some libraries are using both online and physical methods might be because the library collection is not fully digitised and some resources can only be retrieved physically.

However, the manual or physical retrieval of metadata entries from a library presents notable challenges. Users of this traditional method physically locate and browse library collections, which can be difficult and time-consuming, particularly for big repositories

(Corrado 2021). Furthermore, human error is more likely to occur during manual retrieval, which could result in errors or missing data. Furthermore, depending solely on physical access could delay users accessing relevant information from the comfort of their homes (Abdulahi et al. 2020).

It is important for libraries to retrieve metadata electronically because online or electronic metadata record retrieval is essential for effective metadata records' accessibility. Electronically accessed metadata makes it easier to quickly retrieve, analyse, and share metadata among many users and platforms from remote areas. This improves the general use of metadata resources by guaranteeing that it is accurate, timely, and useful at all times (Sathikumar 2021).

5.2.5 Period taken to retrieve metadata records

According to Iyambo (2021), the manual process of retrieving library records is time-consuming. Manual searching of physical records necessitates browsing in shelves to retrieve a record, which takes up more time. Hence, most libraries prefer retrieving records using online platforms to enable quick and efficient automatic retrieval and prompt keyword searches (Salaba & Chan 2023). However, even with the use of online platforms for retrieving records, the time it takes to retrieve a metadata record can be affected by the hardware, software, or applications in use (Corrado 2021).

Hence, the majority of the respondents mentioned that it took about 5 to 10 minutes to retrieve a metadata record in their libraries and the minority of respondents mentioned that it took between 10 to 30 minutes. The majority of the participants indicated that they had a quick turnaround time for information retrieval, describing it as "instant" or "takes less than a minute." However, the minority of the participants indicated that factors such as internet bandwidth, connectivity, and search skills affected retrieval and made it a lengthy process. The researcher also observed that at the UNAM and NUST libraries, faster retrieval times were experienced than at the IUM library.

The period it takes for a record to be retrieved might be greatly affected by factors such as the type of library management system, hardware and software being used to run the

system, and perhaps that could be why respondents reported lengthier times to retrieve a record. Search skills of metadata specialists might also affect the retrieval of records, with some retrieving records instantly and others struggling to navigate. It is important to retrieve metadata easily in the library because quick access to information resources depends on the library's metadata records being retrieved efficiently. Users may quickly find relevant materials with ease of access, which boosts the metadata services efficiency and makes the library more effective (Okeji & Mayowa-Adebara 2020).

5.2.6 State of metadata records in libraries

According to Maseh (2016), an organisation cannot efficiently manage its records if it relies on unreliable systems for record keeping. The state of records, whether good or bad, directly affects the metadata services of a library. Metadata records that are in a poor state would result in the library offering poor metadata services. However, well-maintained records would improve the metadata services of a library (Schreur 2020). This could be attributed by the fact that the state of libraries metadata services in libraries has evolved from centralised, paper-based computer systems to decentralised networks of digital and non-digital content, providing both traditional and new library services (Chemulwo & Sirorei 2020). The majority of respondents indicated that the state of metadata records at their library was good, whereas one respondent specified that it was fair. Furthermore, it was noted that the respondents indicated that metadata records were in good condition, with a minority of respondents being unsure about the condition of metadata services in their libraries. The majority of participants indicated that the state of metadata records in libraries fair in fair condition, with a minority of participants indicating that it was in a bad condition. The researcher observed that the state of the metadata records was in a fair condition.

Some of the libraries might have good metadata systems used in the libraries, keeping the records in good condition. This might be because of the various security measures in accessing, editing, and retrieving metadata records by using passwords and authentication processes. However, for those who indicated a fair or bad condition, it might be because it took time to retrieve records and because some errors and

duplications existed in the library catalogue. The respondents who were unsure might have attributed this to not dealing with the system or users on a daily basis. It is important to have a good state of metadata services in libraries because it provides the basis for efficient information retrieval and cataloguing (Sathikumar 2021). By making it easier to catalogue and maintain metadata records, metadata in good condition helps users find pertinent information easily and quickly.

5.2.7 Challenges faced in managing metadata records in libraries

Libraries may face a number of challenges when it comes to managing metadata records because the field of information retrieval is dynamic and always changing (Adejo & Misau 2021). These difficulties, which range from technical difficulties to problems involving users, might affect the efficacy and efficiency of library systems (Huang 2021). Examining these challenges can assist libraries in finding solutions or enhancements in order to improve the management of metadata records. Nine respondents indicated that they did face challenges and two indicated that they were not aware of any challenges faced.

The responses from the respondents revealed a variety of difficulties encountered when maintaining metadata records in libraries. According to the majority of respondents, challenges ranged from technical glitches, such as system problems and slow internet, to human factors like fatigue affecting metadata creation accuracy. The respondents also highlighted the challenge of incorrect spelling and duplication impacting metadata records. The minority of respondents mentioned that they relied on work supervisors for overwriting errors and that there was a lack of training on metadata systems.

Furthermore, the majority of the participants outlined challenges such as the slow process of creating metadata, duplicate records, and errors and system faults. Participants indicated the inaccuracy and lack of interlinkage between manual and electronic cataloguing. The participants also stated that there were spelling errors and inconsistencies, as well as internet and infrastructure difficulties. The researcher's observation found spelling errors, duplications, and discrepancies in metadata information, highlighting the complex issues surrounding metadata records management in libraries.

Challenges in metadata records systems might be caused by the lack of proper cataloguing skills, the low number of employees who have the ability to make changes on the system, and perhaps the network and internet issues facing libraries in offering access to information and fast retrieval. The metadata specialists might not share screens during the cataloguing process and hence are unable to detect duplication and errors as they catalogue.

However, it is important to seek for solutions to solve challenges affecting metadata services in libraries because these challenges affect metadata records retrieval and management. Users may find it more difficult to retrieve metadata records if resources are not properly catalogued as a result of missing or erroneous metadata (Schreur 2020). Furthermore, inconsistent metadata formats and standards make it more difficult for library systems to communicate with one another and prevent data exchange with other repositories (Vijayakumar & Sheshadri 2019). These difficulties reduce user satisfaction, the effectiveness of library operations, and ultimately, the library's objective of providing effective metadata services.

5.2.8 Improvements to enhance metadata services in libraries

Improving metadata services in libraries is a necessity in the digital age, since managing and retrieving information requires accuracy and efficiency (Mallikarjuna 2020). These improvements, which range from technology advancements to research into metadata systems, aim to improve the usability, accuracy, and accessibility of library systems (Huang 2021). Examining the manner in which libraries develop and adjust their metadata services is a positive approach to the challenges in libraries, guaranteeing that libraries continue to be dynamic and efficient in offering good metadata services (Cox et al. 2018). According to Riley (2017), the use of technology, training, and user feedback to improve services in libraries has proven to enhance libraries.

The majority of respondents indicated the significance of the implementation of new systems, duplicate identifiers, automated data cleaning, and communication amongst metadata specialists as improvements to enhance metadata services. Implementing AI for verification was also mentioned by the respondents. A minority of the respondents

indicated the need for training on new cataloguing trends and technologies through training initiatives. The majority of the participants suggested updating the metadata systems, improving speed and accuracy through AI software, and making improvements for system interoperability. The suggestions from the respondents are an indication that there are challenges affecting metadata services in libraries. Most of the suggestions involved the use of technology to improve the metadata services. This might be attributed by the fact that libraries are following technological trends and are utilising AI, robotics, big data analytics, data mining, IoT and AI-aided applications and software to provide quality and reliable services (Chigwada & Nwaohiri 2021).

5.3 PERCEPTIONS OF METADATA SPECIALISTS ON ADOPTING AI TO IMPROVE METADATA SERVICES

This section deals with the interpretation of the findings based on the perception of metadata specialists on the adoption of AI to improve metadata services at IHEs in Namibia. According to Knox et al. (2021), perception is a TAM concept that describes how users of a given system perceive its use. User perception, according to the literature, is defined as the attitude and actions of users with relation to the use of AI for the improvement of metadata services in libraries (Prigg 2017).

5.3.1 Familiarity of AI

According to Paganelli and Paganelli (2017), most metadata specialists are not familiar with AI and their use in libraries because they are not exposed to current trends, they are not willing to learn, and they are not interested in the topic (Kalita & Deka 2021). According to Hervieux and Wheatley (2021), although a few metadata specialists are starting to show interest in AI as a result of recent research studies on AI and its capabilities, conferences and workshops, there is still a huge gap in really having an in-depth understanding of what it can do in their libraries. The participants' technological proficiency, training experiences, or exposure to AI applications in their library environments may have had an impact on their differing answers (Tella et al. 2023). The majority of the respondents stated they were familiar with AI and its applications in library metadata services, and the minority of respondents stated they were unfamiliar with AI

and its applications in library metadata services. The majority of the respondents also mentioned that AI efficiently manages metadata records, expedites the creation of metadata, ensures consistency and accuracy in metadata records, and offers security for the metadata records.

To familiarise themselves with AI for the improvement of metadata services, the majority of the respondents indicated that attending workshops, training, and discussions on AI and metadata services would enable them to better understand AI.

The majority of participants also indicated that their understanding of the adoption of AI for the improvement of metadata services in their libraries was using technology and software to automate metadata services. Participants associated AI with increased productivity, accuracy, and speed in the development and retrieval of metadata records. Metadata specialists might become more interested in AI because it has the potential to improve user services and information management. Furthermore, metadata specialists might have grasped the concept of AI emerging into library services because they understand how it can improve information retrieval, and mold user experiences.

It is important for libraries to use AI for cataloguing since it has the capability to enhance metadata creation and effectively manage metadata records by automating these processes (Asemi & Asemi 2018). AI enables metadata systems to keep standardised records, minimising human errors and inconsistencies (Huang 2021).

5.3.2 Effectiveness of AI to improve metadata services in libraries

In the digital era, there is increasing interest in the efficiency of AI in enhancing library services within libraries. According to Omeiza and Lanre (2020), AI has proven to be effective in managing and improving the metadata services in libraries. In ensuring effectiveness, AI can, if properly implemented, enhance speed, accuracy, and efficiency, making it effective in improving metadata services in libraries (Chigwada & Nwaohiri 2021). It is critical to investigate the effectiveness of AI, as libraries struggle with the changing needs of information services (Huang 2021). Hence, respondents suggested that AI can be effective in improving metadata services in libraries, particularly when

applied correctly. The respondents expressed confidence in the effectiveness of AI by highlighting how it can improve productivity, reduce errors, and make metadata specialists' jobs easier.

The participants also indicated that AI could be effective in improving metadata services in libraries. Participants indicated that functions in metadata services could be automated and corrected and services would be much more efficient. This might be due to the fact that AI ensures that cataloguing processes are sped up. The respondents and participants might have been aware that AI is less susceptible to human errors, and that it ensures consistency in records. Furthermore, AI can enhance user experience and satisfaction, which is the main objective of academic libraries. AI can be effective in improving the metadata services in libraries because it speeds up information retrieval by ensuring that records are properly created, saved, and stored for optimal retrieval purposes. Furthermore, metadata specialists spend less time creating bibliographic entries because AI automates cataloguing processes, working at a faster pace than humans (Schreur 2020).

5.3.3 General opinions about AI to enhance metadata services in the library

Adejo and Misau (2021) suggest that AI can generally enhance the quality of metadata services in libraries by ensuring that quality and effective services are provided to the users. In order to speed up the cataloguing process, AI algorithms such as image recognition algorithms powered by computer vision techniques, text mining algorithms such as rule-based or machine learning-based approaches, and deep learning models, effectively assess and process the metadata, making precise suggestions and automating tedious operations (Woodward 2018). AI improves metadata records creation and retrieval processes, enhance efficiency, speed, and accuracy in metadata services (Huang 2021). Hence, the respondents stated that AI could enhance the quality of metadata services in libraries. A minority of respondents, however, voiced concerns about the loss of jobs, which reflected fears about the potential of AI and what it could mean for human metadata specialists. The participants also indicated that the adoption of AI could enhance metadata services in libraries.

This might be because AI can enhance metadata services by using algorithms trained to accurately identify patterns and extract metadata from a variety of materials, speeding up the metadata processes, while also maintaining accuracy and consistency. The fear of loss of jobs expressed by respondents could be a result of various degrees of knowledge, experience, and perspectives among metadata specialists.

AI would ensure that the metadata services are enhanced because algorithms for natural language processing can extract important information from textual resources, enhancing the accuracy and completeness of metadata records (Tella et al. 2023). More accurate resource discovery can be made possible by machine learning algorithms that examine usage trends to recommend pertinent metadata tags. Libraries can increase resource discoverability, expedite metadata procedures, and enhance user experience by utilising AI.

5.3.4 Benefits of using AI to improve library metadata services

According to Huang (2021), AI can be beneficial in improving the library metadata services by improving records retrieval processes, efficiency, speed, and accuracy in metadata services. Benefits of using AI for enhancing metadata services for libraries provides understanding of how these technologies can guarantee metadata records accuracy, speed up processes, and improve metadata services, putting libraries at the forefront of effective information services (Chigwada & Chisita 2021). Hence, the respondents indicated that AI could benefit and improve the metadata services. The participants also indicated that AI would benefit and improve metadata services by improving accuracy and increased precision in metadata records.

This might be because AI can recognise bibliographic information or embedded metadata such as name, type, and location within the resource. It also makes work easier by improving accuracy and minimising incorrect spelling and errors. Cox et al. (2018) agree that the benefits of AI improve search and discoverability of materials through auditing of the metadata record and can catalogue automatically to ensure accuracy in indexing of materials (Cox et al. 2018).

5.3.5 Factors with negative influences on AI for library metadata services

According to Huang (2021), there are factors that can negatively affect the use of AI in managing the metadata services, which include the fact that metadata specialists might be more wary about implementing AI because they are worried about the possibility of biases or errors in automated processes, or because they are concerned about how automation would change the function of the metadata specialist (Paganelli & Paganelli 2017). The adoption of AI in libraries is ultimately influenced by a number of variables, such as the library's particular needs and objectives, the financial implications, resources that are available, and the viewpoints and attitudes of the decision-making stakeholders, including the metadata specialists (Adejo & Misau 2021). Hence, the respondents indicated that limited library budgets, a lack of training and unfamiliarity, unwillingness, and resistance to change of metadata specialists, and the complexity of AI systems are the factors that can negatively influence the use of AI for library metadata services.

The participants also outlined human resistance, fear, ignorance, technophobia, and fear of losing their jobs as the major negative influences in adopting AI for the improvement of metadata services. Participants also mentioned financial limitations, budget cuts, and costly equipment as possible negative influences in the adoption of AI. Other hindrances included inadequate infrastructure and connectivity problems. This might be because these factors can become potential challenges and risks associated with the implementation of the adoption of AI for the improvement of metadata services. These factors could include concerns about job dismissals, metadata privacy issues, errors in AI algorithms, and the need for substantial investment in training and infrastructure. However, it is important for libraries to mitigate these factors by putting proactive steps into action. Firstly, libraries should make sure that their current employees have the skills needed to properly integrate AI by providing them with extensive training and upskilling programmes. To resolve concerns regarding metadata privacy, strong privacy rules and ethical norms should be implemented. In order to guarantee the precision and trustworthiness of metadata services, ongoing oversight and auditing of AI algorithms can assist in locating and fixing problems as soon as possible. Lastly, to guarantee long-term

success in improving metadata services within libraries and to establish a solid platform for AI deployment, significant investments in infrastructure and training are crucial.

5.3.6 Participation in the adoption of AI for the improvement of library metadata services

Yoon, Andrews and Ward (2022) state that when trained, metadata specialists can easily participate in activities to help adopt and implement AI to improve and provide quality metadata services. Monyela (2024) states that metadata specialists feel like highly valued members of an organisation's team who help embrace and apply AI to improve library services, which raises the standard and efficiency of information management. Hence, respondents indicated that they would participate in adopting AI to provide quality metadata services. The participants all indicated willingness to participate in the adoption of AI for metadata services in libraries. Furthermore, they elaborated on the importance of keeping up with the technological advancements around the globe, wanting to improve as information professionals and being keen to learn and thrive in the digital era.

This might be because of the need to keep up with technological changes and adjusting to the digital environment in libraries. Metadata specialists might be keen on learning new trends such as the adoption of AI in their industry and might want to be part of new services to be implemented in the technological sphere. It is important for metadata specialists to participate in the adoption and implementation of AI because of their expertise in ensuring responsible integration, addressing ethical concerns, mitigating errors, and customising AI solutions to meet the specific needs of libraries. Metadata specialists should play a significant role in the adoption and implementation of AI, as it might improve metadata services and information management within libraries (Schreur 2020).

5.4 USABILITY OF AI TO IMPROVE METADATA SERVICES

This section is about the interpretation of the findings based on the examination of the usability of AI to improve the metadata services in libraries. Machidon et al. (2020) define usability as the degree to which a system, product, or interface is easy to use, effective,

and efficient in meeting user needs. User satisfaction, accessibility, error prevention, recovery, memorability, and ease of learning are some of its features. According to Ali et al. (2020), usability highlights the ability of users to quickly understand and navigate a product or system, complete tasks effectively, learn from mistakes, and have a positive experience. In this study, usability was based on the fact that AI can perform activities to improve metadata services in libraries.

5.4.1 Activities performed through AI to improve metadata services in libraries

AI can be used to perform various activities that can improve the metadata services in libraries. According to Ali et al. (2020), activities that can be performed through AI include automated metadata creation, enhanced keyword extraction as well as duplicate detection. Schreur (2020) also identifies scanning, semantic tagging, NLP and image recognition. Hence, the respondents indicated automated metadata creation, duplicate detection, enhanced keyword extraction, and semantic tagging as some of the activities that can be utilised through AI for the improvement of metadata services. The participants also expressed a recognition of AI's ability to do repetitive activities more effectively by proposing the automation of metadata processes. Respondents also highlighted that AI would make record indexing a simpler process, free of duplication, and it would save cataloguers time, speeding up the retrieval of metadata records, particularly when they have to complete everything manually, which takes a lot of time.

Participants further highlighted a variety of uses for AI in enhancing quality, including the creation of metadata and identifying duplicates. Suggestions for AI for spelling errors and duplicate checking were also made by the participants. However, few participants highlighted that metadata services can be done through the use of AI-specialised software, but the rest could not answer the question, possibly due to the unfamiliarity and newness of the topic in the LIS industry. Participants explained the need to maintain a balance between the use of AI and human employees in performing metadata services. The participants outlined the possibility for speedier metadata services by highlighting the efficiency and accuracy benefits that can be achieved with AI. Participants also mentioned the simplicity, efficiency, and enhancement that AI could bring to metadata services.

This might be because of the understanding the respondents and participants had of AI and their imagination of how it could work in libraries. This gives a clear indication of how the respondents understood the abilities needed to utilise and comprehend AI. By imagining AI use in libraries, respondents and participants exhibited a deep understanding of the abilities and perspectives needed to properly utilise this technology. This acknowledgement showed a deliberate approach to integrating AI and a willingness to change with the environment of information management and discovery in library settings.

It is important that AI is used to perform these activities because AI may increase efficiency, accuracy, and reduce laborious chores, and they are essential for carrying out metadata-related operations in libraries (Huang 2021). Libraries can manage massive amounts of metadata more efficiently and guarantee consistency and completeness by utilising AI. AI also makes it possible to analyse text and visual content more deeply, which improves metadata identification and retrieval. Eventually, AI for metadata services improves user satisfaction, information management, and retrieval, allowing libraries to adapt to changing user needs in the digital era (Omotayo & Haliru 2020).

5.5 AI INFRASTRUCTURE FOR THE IMPROVEMENT OF METADATA SERVICES

This section addresses the interpretation of the findings based on the identification and the use of AI infrastructure that were implemented to improve the metadata services in the libraries. AI infrastructure is defined as the basic technological framework and components that enable the development, application, and use of AI systems and technologies (Dhar 2020). It entails using software and hardware that can be used to support AI in automating processes like finding duplications and boosting efficiency (Wozniak 2019). AI infrastructure plays a crucial part in providing library metadata services to transform technical services (Schreur 2020).

5.5.1 AI infrastructure for metadata services

According to Tella et al. (2023), AI infrastructure plays a significant role in ensuring that quality metadata services are managed. AI infrastructure that is suitable for metadata

services refers to NLP, machine learning, image recognition, robotics, deep learning algorithms, and recommendation systems (Ajani & Sulyman 2023). However, according to Harisanty et al. (2022), it is possible for metadata specialists to not know of any AI infrastructure. This may have been impacted by the lack of exposure to AI in a library setting or their professional backgrounds (Schreur 2020). Hence, the majority of the respondents mentioned that they were not aware of AI infrastructure for metadata services. However, the minority of respondents identified robotic machines, NLP, and machine learning as the type of AI infrastructure they were familiar with. The respondents who indicated not being familiar with AI infrastructure for metadata services were asked what could be done to improve familiarity and proposed going on training in AI to have a better understanding. The participants also revealed good knowledge and comprehension of AI infrastructure, mentioning robotic machines, machine learning, OCR, networking systems, hardware, network, data, and cloud, which indicated an understanding of storage infrastructure in AI. Participants also mentioned general computing and storage equipment, reflecting a broad perspective on the technical components involved in metadata services. The participants might have mentioned AI infrastructure because of the awareness of advanced technologies, contributing to metadata improvement in the LIS sector. The participants' depth of knowledge about AI infrastructure likely stemmed from a combination of ongoing learning efforts, and a recognition of the strategic importance of AI in their respective fields.

It is important for libraries to have AI infrastructure to manage and provide quality metadata services. Libraries need AI infrastructure in order to manage metadata effectively and deliver high-quality services. With proper AI infrastructure, libraries are able to automate operations like metadata creation, enrichment, and validation with the help of scalable computer resources, machine learning models, and metadata management tools (Vijayakumar & Sheshadri 2019). By increasing metadata relevance, correctness, and consistency, this infrastructure raises user satisfaction and facilitates resource discovery.

5.5.2 Application of AI infrastructure for metadata services

When properly deployed, AI infrastructure can execute automated procedures for extracting metadata from resources (Harisanty et al. 2022). AI systems can automatically extract descriptive metadata, including titles, authors, subjects, and keywords, by analysing images, library materials, and other data elements (Cox et al. 2019). Metadata specialists can produce metadata more rapidly and consistently with less physical labour by automating the process (Schreur 2020). Hence, the respondents indicated that AI can be used to facilitate the automation of metadata creation, and quality control and validation. Respondents also indicated that language translation automation can be achieved through the application of AI infrastructure. The participants also indicated that AI infrastructure can aid in building algorithms and programming machines as well as through metadata creation. Some respondents and participants did not have an answer, indicating the lack of knowledge of AI in Namibian libraries.

This might be because of the interest of metadata specialists in enhancing metadata services in their libraries. AI infrastructure might ensure accuracy and consistency in metadata records (Schreur 2020). The respondents' choice of automating metadata enrichment points to a comprehension of AI's function in supplementing metadata with more functions to effectively operate, indicated their awareness of AI's capacity to overcome linguistic boundaries.

AI infrastructure can assist in resource discovery and cataloguing by increasing the accuracy and dependability of metadata services (Woodward 2018). Because it can automatically analyse and extract relevant information from unstructured textual data, AI infrastructure is crucial to adopting AI to improve metadata services in libraries. AI infrastructure can assist libraries in creating metadata, as these algorithms are able to identify important concepts, objects, and themes, which lead to more accurate and comprehensive metadata records for efficient metadata organisation and improved metadata discovery (Komarova & Kuznetsov 2019).

5.5.3 Importance of AI infrastructure for improvement of metadata services

Schreur (2020) discusses the importance of infrastructure when it comes to AI and implementing it into our daily lives. The importance of AI infrastructure for the implementation of AI is crucial to the technology functioning optimally in improving efficiency, accuracy, and adaptability of a system (Huang 2021). Hence, respondents indicated that technology supports and speeds up enhancement, which can only be achieved through proper AI infrastructure in place. Respondents also emphasised the efficiency advantages that can be achieved through automation with proper software. The effectiveness of AI infrastructure was also explained, with focus on the management of hardware computing resources in successfully operating AI. Participants also indicated how important AI infrastructure is for the deployment of metadata services through AI. The participants mentioned that AI and infrastructure are interdependent and emphasised how crucial technical support is to AI's efficient operation. According to the participants, infrastructure is necessary for AI to function and acts as an enabler for its functions. The participants also highlighted that infrastructure was present in all areas of technology and could not see how AI could function without it. This might be because of metadata specialists understanding that any technology, in order to function, requires support. AI requires a combination of hardware, software, and networking resources, known as AI infrastructure, for efficient AI processing, metadata management, model training, and inference (Karaaslan et al. 2019).

5.6 SUMMARY OF THE CHAPTER

This chapter interpreted and discussed the findings of the study as outlined in chapter four, to give the readers an accurate meaning of the data collected and presented. The chapter discussed and interpreted the findings of the state of metadata services, the perceptions of metadata specialists in adopting metadata services, the usability of metadata services, and the infrastructure required to support AI. The next chapter focuses on proposing a framework for the adoption of AI to improve metadata services in libraries at IHEs in Namibia. The proposed framework could aid libraries in improving their metadata services through AI.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS OF THE STUDY

6.1 INTRODUCTION

The previous chapter presented the interpretation of the research findings. This chapter summarises the findings, and makes conclusions and recommendations based on the study's research objectives. This chapter identifies areas for further research based on the results and findings of this study. Furthermore, this chapter proposes a framework for the adoption of AI to improve metadata services in libraries at IHEs in Namibia.

6.2 SUMMARY FROM THE FINDINGS OF THE STUDY

The research findings are summarised in this section, with an emphasis on the most important findings rather than all of the specifics of the findings (Babbie 2013). This section provides an overview of the research findings based on the research's study objectives.

6.2.1 State of metadata services at IHEs in Namibia

The first objective of the study was to establish the current state of metadata services at IHEs in Namibia. For libraries to effectively manage metadata services, the state of metadata services should be in good condition. A summary of the findings is presented below:

- Metadata records are created both electronically and manually in libraries.
- Metadata records are stored electronically in libraries using library management systems.
- Metadata records are managed electronically in libraries using library management systems.
- Libraries ensure accuracy by doing quality control of metadata services in their library catalogues.

- Metadata records are retrieved electronically through the libraries' Online Public Access platforms and physically by asking staff in the library to help retrieve records.
- It takes about five to ten minutes to retrieve a metadata record in libraries, depending on the connectivity and hardware being used to support the system.
- Metadata records are manually saved by the metadata practitioners.
- The state of the metadata records was in a fair condition.
- There are inconsistencies such as duplications and spelling errors found in the metadata records.

6.2.2 Perception of metadata specialists on the use of AI to improve metadata services in libraries

The second objective of the study was to establish the perceptions of metadata specialists on the use of AI at IHEs in Namibia. For libraries to effectively adopt AI for the improvement of metadata services, the perception of metadata specialists on the use of AI should be considered. A summary of the findings is presented below:

- Metadata specialists were familiar with AI and its applications in library metadata services.
- Metadata specialists stated that AI can be effective in improving metadata services in libraries, particularly when applied correctly.
- Metadata specialists stated AI can enhance the quality of metadata services in libraries.
- Metadata specialists expressed concern about the loss of jobs, which installed fears about the potential use of AI for metadata services.
- Metadata specialists believed AI can benefit and improve metadata services by improving accuracy and increasing precision in metadata records.
- Limited library funding/budgets, a lack of training and unfamiliarity, unwillingness, resistance to change of metadata specialists, and the complexity of AI systems are the factors that can negatively influence the use of AI for library metadata services.

- Metadata specialists indicated that they would participate and contribute positively to adopting AI to provide quality metadata services.

6.2.3 Usability of AI to improve metadata services

The third objective of the study was to determine the usability of AI to improve metadata services in libraries at IHEs in Namibia. For libraries to effectively adopt AI for the improvement of metadata services, the usability of AI should be considered. A summary of the findings is presented below:

- Metadata specialists identified automated metadata creation, duplicate detection, enhanced keyword extraction, and semantic tagging as some of the activities that can be performed through AI for the improvement of metadata services.
- AI would make record indexing a simpler process, free of duplication. It would save cataloguers time by speeding up the retrieval of metadata records, particularly when they have to complete everything manually, which takes a lot of time.
- Metadata specialists highlighted those improvements can be done through the use AI software, but the rest could not indicate how activities can be performed through AI, possibly due to the unfamiliarity and newness of the topic in the LIS industry.
- Metadata specialists explained the need to maintain a balance between the use of AI and human employees.

6.2.4 AI infrastructure for the improvement of metadata services

It was also important to identify the AI infrastructure needed to improve metadata services in libraries at IHEs in Namibia. The summary of the findings is as follows:

- Metadata specialists mentioned that they were not aware of AI infrastructure for metadata services.
- Metadata specialists who were aware of AI infrastructure for metadata services identified robotic machines, NLP, and machine learning as the types of AI infrastructure they were familiar with.

- Those who were aware of AI for metadata services indicated that it can be used to facilitate the automation of metadata creation, quality control, and validation.
- They also indicated that language translation automation can be achieved through the application of AI infrastructure.
- Metadata specialists did not have an answer, indicating the gap in knowledge of AI at IHEs in Namibia.
- Metadata specialists indicated that the improvement of metadata services in IHEs can only be achieved through proper AI infrastructure in place.

6.3 CONCLUSION OF THE STUDY FROM THE FINDINGS

This section provides conclusions based on the objectives of this study. According to Babbie (2013), a study should end with a statement about what the researcher discovered about the subject matter and where future research can be directed. The IHEs in Namibia currently catalogue library materials through the concept of original cataloguing and copy cataloguing from remote databases. Through this practice, metadata record entries of low quality, containing spelling errors, duplication of entries, and inconsistencies in cataloguing are created. When a user or metadata specialist searches for a material on the OPAC, ineffectively catalogued materials are not displayed, making information retrieval impossible. Users are ultimately impacted by this since they are unable to locate all of the items kept in the library, rendering it incompetent and unable to meet the needs of students for research and education. This indicates that users' demands are not met by the library and that their time is being wasted. Students' academic development is hampered since this results in lower-quality information retrieval and more work for metadata specialists, who are needed to fix mistakes and make records freely accessible. Hence, the main objective of this study was to investigate and recommend an AI framework that can be adopted to improve metadata services in libraries at IHEs in Namibia. The framework is presented and discussed as the last part in the next section, which deals with the study's recommendations.

6.3.1 State of metadata services at IHEs in Namibia

This section provides the conclusion about the state of metadata services at IHEs in Namibia. Metadata records in the libraries are generated through both electronic and manual processes, resulting in a hybrid system for their creation. These records are then electronically stored and managed within library management systems such as Mandarin, Sierra, and Folio. To ensure accuracy, libraries employ quality control measures on metadata records within their catalogues. Retrieval of metadata records occurs through both electronic means, via the libraries' online public access platforms and physically, with staff assistance in locating resources on the shelves. The time required for retrieval typically ranges from 5 to 10 minutes, contingent upon the connectivity and hardware supporting the system.

The safeguarding of metadata records is paramount, with libraries implementing measures to save and protect them. Currently, the state of these records is generally fair, although inconsistencies such as duplications and spelling errors have been identified within them. Despite these challenges, libraries remain committed to maintaining the integrity and accessibility of their metadata records. Through ongoing evaluation and adaptation, libraries strive to ensure that their metadata records remain a valuable resource for information discovery and access in the digital age.

6.3.2 Perception of metadata specialists on adopting artificial intelligence to improve metadata services at IHEs in Namibia

This section provides the conclusion about the perception of metadata specialists on adopting AI to improve metadata services at IHEs in Namibia. Most metadata specialists exhibited a solid understanding of AI and their potential applications within library metadata services, highlighting their familiarity with the subject matter. They acknowledged that AI has the capability to significantly enhance metadata services in libraries, particularly when implemented correctly, highlighting their confidence in its efficiency. Metadata specialists emphasised the potential of AI to improve the quality of metadata services, emphasising its capacity to enhance accuracy and precision in metadata records, thus improving the overall user experience.

However, alongside their interest, metadata specialists expressed concerns about the potential consequences of AI, particularly regarding job losses and the role of human metadata specialists after the integration of AI into metadata services. Despite recognising the benefits AI can bring, there was anxiety about its impact on employment within the field. Despite these reservations, metadata specialists mentioned potential benefits AI can bring to metadata services, emphasising the need for proper training and support to make it work effectively and efficiently.

Several factors were identified as potential barriers to the adoption of AI in library metadata services. These included limited funding, a lack of training, familiarity among staff, resistance to change, and the perceived complexity of AI systems. Nevertheless, the metadata specialists expressed a willingness to participate in the adoption of AI to enhance metadata services, reflecting their commitment to providing quality services and adapting to emerging technological trends.

6.3.3 Usability of AI to improve metadata services in libraries at IHEs in Namibia

This section provides the conclusion about the usability of AI to improve metadata services in libraries at IHEs in Namibia. There include a range of activities that could be enhanced through AI to improve metadata services, including automated metadata creation, duplicate detection, enhanced keyword extraction, and semantic tagging. AI could facilitate the metadata process, eliminate duplication, and save metadata specialist significant time, particularly in the manual completion of tasks. While some metadata specialists identified potential improvements achievable through AI-specialised software such as Clarifai and OpenText Magellan, other metadata specialists struggled to articulate specific methods, possibly due to the newness of the topic within the LIS industry. Moreover, metadata specialists stressed the importance of striking a balance between AI and human involvement, highlighting the complementary nature of both in ensuring effective metadata management.

6.3.4 AI infrastructure for the improvement of metadata services at IHEs in Namibia

This section provides the conclusion about the AI infrastructure required for the improvement of metadata services at IHEs in Namibia. Metadata specialists expressed a lack of awareness regarding AI infrastructure for metadata services. However, some metadata specialists, who were familiar with such infrastructure, identified several key components, including robotic machines, natural language processing (NLP) algorithm, and machine learning algorithm. These metadata specialists highlighted the potential of AI infrastructure to automate metadata creation, improve quality control, and facilitate validation processes of metadata records. Additionally, they noted the role of AI infrastructure in language translation automation. However, despite a minority of metadata specialists having knowledge about AI, the overall level of knowledge regarding AI in Namibian libraries appeared limited. Many metadata specialists were unable to provide specific insights, indicating a significant gap in understanding AI within the profession. However, there was consensus among metadata specialists regarding the importance of technology support and speed enhancement, with many acknowledging that proper AI infrastructure was essential to achieving these objectives. Metadata specialists recognised that establishing robust AI infrastructure was necessary in ensuring efficiency, accuracy, and effectiveness in metadata management.

6.4 RECOMMENDATIONS

A framework for the adoption of AI for the improvement of metadata services in libraries will ensure efficiency and mitigate multiple challenges being faced at IHEs in Namibia. Automation capabilities of AI can significantly improve metadata creation processes, mitigating challenges associated with manual data entry and reducing the likelihood of errors such as duplications and spelling inconsistencies. By automating repetitive tasks, metadata specialists can allocate their time more efficiently to higher-value activities, thereby enhancing overall productivity and resource allocation. Furthermore, AI-driven duplicate detection mechanisms can help libraries maintain data integrity and consistency within their metadata records. Through sophisticated algorithms, AI can identify and flag

duplicate entries, enabling metadata specialists to rectify inconsistencies promptly and ensure the accuracy and reliability of their metadata repositories. Additionally, AI-powered NLP algorithm can enhance keyword extraction and semantic tagging, enriching metadata records and improving resource discoverability for users. This framework will enhance metadata services in libraries, making academic libraries efficient and providing accurate information to users at all times.

6.4.1 Recommendation about the state of metadata services at IHEs in Namibia

This section gives recommendations on the state of metadata services at IHEs in Namibia. It is proposed that metadata records are created and maintained in electronic format, as opposed to being hybrid. This will enable libraries to automate the creation of metadata records, reducing reliance on manual processes and ensuring consistency and accuracy across all records. It is further recommended that libraries adopt AI for quality control measures, such as duplicate detection and spelling error identification, to maintain the integrity of metadata records within library catalogues. Libraries should implement AI-enhanced library management systems, which include functionalities such as semantic tagging and natural language processing to enhance resource discoverability and metadata records. This will ensure smooth metadata retrieval of consistent and accurate metadata records in libraries.

6.4.2 Recommendation about the perception of metadata specialists on adopting AI to improve metadata services at IHEs in Namibia

This section gives recommendations on the perceptions of metadata specialists on adopting AI to improve metadata services at IHEs in Namibia. Libraries should offer extensive training programmes to metadata specialists on AI, ensuring that they acquire the necessary skills to effectively incorporate it into metadata services. This will reduce concerns about employment losses by educating metadata specialists on AI's function as a tool to complement and not replace the skills of human metadata specialists. Libraries should also consider providing enough funds to enable the application of AI for metadata services for effectiveness and user satisfaction in libraries.

6.4.3 Recommendation about the usability of AI to improve metadata services in libraries at IHEs in Namibia

This section provides recommendations on the usability of AI for the improvement of metadata services in libraries at IHEs in Namibia. Libraries should adopt AI-embedded OCR technology software, such as OpenText Magellan and Clarifai, that was designed especially for metadata services. For metadata specialists, these platforms can save time and resources by automating tasks like keyword extraction, duplicate identification, automated metadata creation, and semantic tagging. Libraries should implement initiatives for metadata specialists' education and training in order to enable them to efficiently use AI in metadata services. This could be helpful to familiarise metadata specialists with concepts and technologies related to their profession through workshops, seminars, or online courses.

6.4.4 Recommendation about the AI infrastructure for the improvement of metadata services in libraries at IHEs in Namibia

This section provides recommendations on the AI infrastructure for the improvement of metadata services in libraries at IHEs in Namibia. Libraries should organise and execute thorough AI training courses for metadata specialists to raise knowledge and comprehension of AI infrastructure and its possible uses in metadata services. AI infrastructure identified to support metadata services include robotic machines, NLP, and machine learning. The libraries should invest in AI infrastructure designed specifically for metadata management to facilitate automated tasks like keyword extraction, duplicate detection, semantic tagging, and metadata creation. The AI infrastructure will also enable smooth interaction with current workflows and systems.

6.4.5 Recommendation about the proposed framework to adopt AI for the improvement of metadata services at IHEs in Namibia

This section gives recommendations on the nature of AI framework that was applied and used to create and manage metadata records at IHEs in Namibia. This AI framework should address the metadata services challenges experienced at the library such as

metadata records duplications, errors, and spelling inconsistencies. This framework should also address the challenges faced by users when retrieving the metadata records. The AI framework would ensure that metadata records are identified, created, quality checked, and saved by the AI-embedded OCR technology integrated into the LMS. Metadata records that have errors would be flagged by the AI-embedded OCR technology, and such records would be either deleted or edited to accurately fix the error.

The AI chatbot would be programmed to ensure the smooth, quick, and effective retrieval of metadata records from the OPAC system once metadata records are saved. The AI chatbot can help retrieve metadata entries from an OPAC system by offering a user-friendly, conversational search and resource access interface. Voice and text interface options are a means for users to communicate with the AI chatbot; in return, it may interpret user intent and extract pertinent metadata records from the OPAC by utilising AI infrastructure such as NLP algorithm. Furthermore, the AI chatbot may help users refine their search queries, make recommendations based on their individual preferences, and identify relevant resources. All of these features improve the user experience when searching and increase the effectiveness of metadata retrieval.

6.4.5.1 Recommended framework

The central objective of this study was to recommend a framework that could implement AI for the improvement of metadata services at IHEs so that metadata records would be effectively created and managed. The framework illustrated in figure 6.1 was introduced with the intention to apply AI for the improvement of metadata services. This framework was created to help the libraries overcome the difficulties with their existing metadata services. Upon effective adoption and implementation of this framework, the libraries will have a reliable system for efficient metadata services. The use of AI for effective metadata services would address all of the challenges experienced, such as duplicated metadata records, spelling errors, and inconsistencies within the record. The efficiency of metadata services can be enhanced by the combination of an AI-embedded OCR technology with a scanner and strong server storage. The AI would be crucial in identifying and fixing any flaws or inconsistencies, which preserves the accuracy of the metadata records.

Furthermore, it is expected that the AI-embedded OCR technology's quality-checking functions will reduce metadata duplication. Additionally, an AI chatbot that is equipped with refined deep learning and machine learning algorithms ensures rapid and easy information retrieval while also providing accurate and trustworthy metadata descriptions.

The study proposes a framework for the adoption and implementation of AI for the improvement of metadata services at IHEs in Namibia. Figure 6.1, which represents the framework of the study, shows how AI can be used to improve metadata services through the use of AI-embedded OCR technology and an AI chatbot.

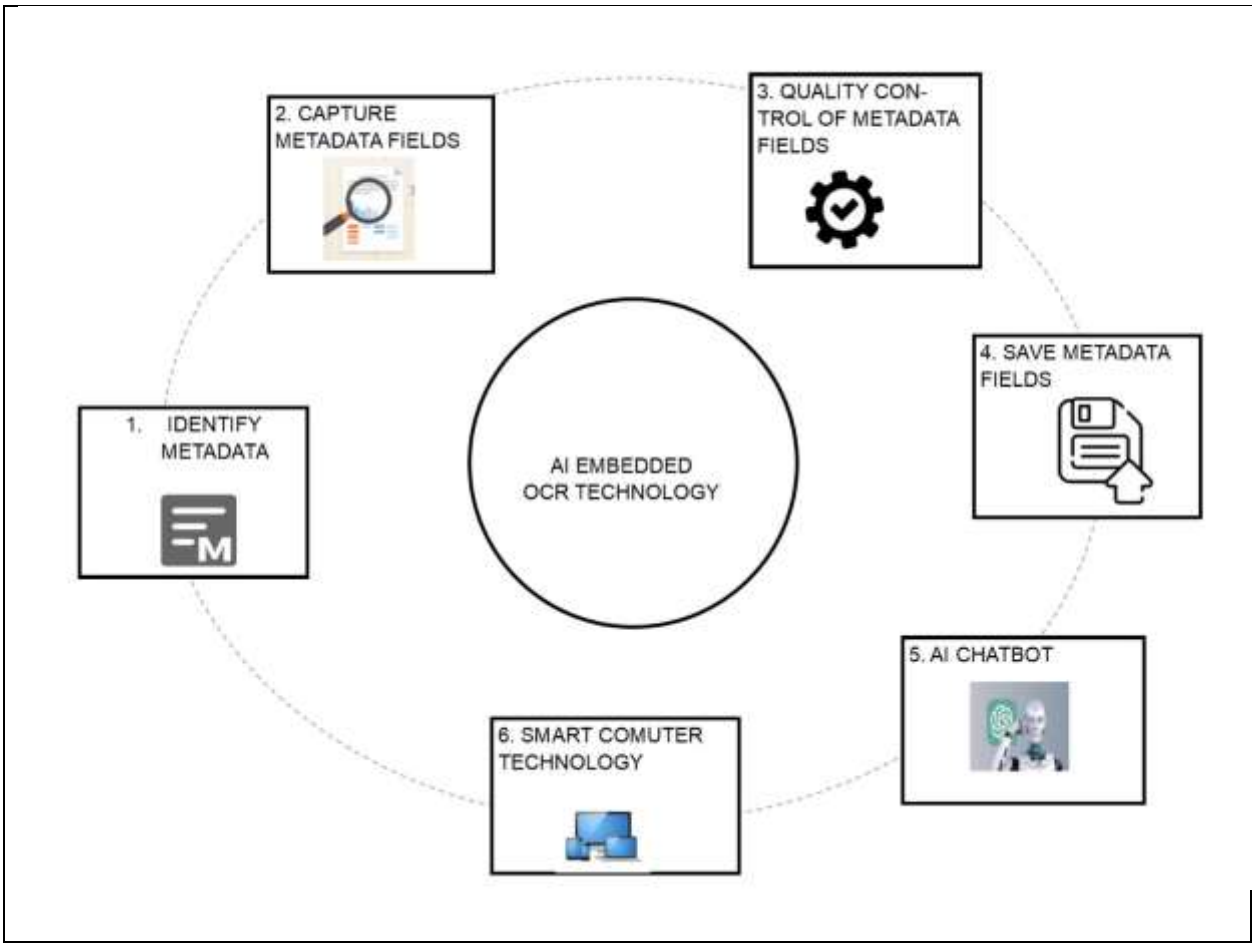

Figure 6.1: Framework to adopt AI to improve metadata services at IHEs in Namibia (researcher 2024)

This proposed model begins with the first step in the process, which is to identify metadata items by scanning any text-containing materials, such as books or documents, into digital

images. These pictures could be acquired via taking digital pictures, or by scanning tangible documents with AI-embedded OCR technology. The acquired images are subjected to pre-processing techniques to enhance their quality and OCR precision. Text portions inside the processed photos are detected and located using sophisticated algorithms. Text can be precisely separated from the background and other graphical elements by using methods like edge detection, contour analysis, and connected component labelling. After text regions are found, the AI-embedded OCR technology recognises and extracts text using deep learning models such as RNNs and CNNs. These models analyse patterns, shapes, and contextual information to decipher characters and words with remarkable precision. After text recognition, the AI-embedded OCR technology concentrates on finding particular metadata entries that are incorporated into the recovered text. Metadata items like document names, authors, publication dates, keywords, and classification tags are then identified for metadata entries.

After identifying metadata fields within a resource using AI-embedded OCR technology, the system proceeds to capture and extract these fields through advanced data processing techniques. The system uses the bounding box localisation to properly delineate and isolate each detected metadata field in the text. In order to do this, rectangular zones are defined around the metadata fields according to their size and geographical positions inside the document. The AI-embedded OCR technology executes text segmentation within each bounding box in order to precisely extract the textual material that corresponds to the metadata field. Text segmentation algorithms distinguish particular metadata entries from surrounding text and graphical elements by examining the text's organisation and structure. Following segmentation, the AI-embedded OCR technology makes use of algorithms and deep learning models to extract the text to be included in each metadata field. To extract useful metadata items, the technology examines the text's characters, words, and patterns. After the text material has been extracted, it is processed and organised to find particular metadata elements such titles, authors, dates of publication, keywords, and ISBNs. To precisely classify and name each metadata field, the parsing procedure combines linguistic analysis, pattern matching, and regular expression matching. To enhance the extracted metadata field, the AI-embedded OCR technology supplements it with more contextual data. This can entail

adding illustrative metadata tags, improving metadata attributes with additional data sources, or connecting metadata fields to relevant sites. Finally, the captured and extracted metadata fields are structured and formatted for integration into the library catalogue. This integration facilitates seamless organisation and retrieval of resources based on metadata attributes, enabling efficient access and utilisation of information.

The next step involves AI-embedded OCR technology performing quality control measures by verifying that metadata fields follow preset structures and formats. It uses spell-checking and grammar-checking algorithms to identify and fix mistakes, spelling errors, and grammatical errors. It then suggests corrections or highlights possible errors for human inspection and correction. To avoid redundant or conflicting entries and preserve data uniqueness, the system also has duplication detection capabilities that identify duplicate titles, authors, or ISBN/ISSN codes. In addition, AI-embedded OCR technology performs consistency tests to guarantee consistency among related metadata records. These checks include checking coherence in subject keywords, genres, and other descriptive metadata, as well as ensuring that an author's name is spelt correctly throughout all works. In addition, the system carries out semantic validation, which verifies topic headings, classifications, and genre tags in accordance with accepted standards and domain-specific vocabularies by comparing metadata against external knowledge bases and authority files. During the quality control process, the technology assesses contextual importance by looking at the relationships among metadata fields. It determines whether the subject keywords accurately reflect the content of the item or whether the publishing date falls within the historical context of the work. These comprehensive quality control methods support library cataloguing systems in offering precise cataloguing, efficient information retrieval, and enhanced user interfaces.

After the AI-embedded OCR technology pre-processes and carefully verified the extracted metadata, it launches the automated saving procedure. This crucial phase involves the direct integration of the expanded and validated metadata fields into the database of the library cataloguing system. This saving process is carried out by the system but requires manual assistance from metadata specialists to approve the accuracy of the metadata field before saving it on the library catalogue. Once approved

by the metadata specialist, the AI-embedded OCR technology automatically saves the metadata field, and it becomes a metadata record that can be searched for and retrieved on the library catalogue. Time and effort spent on manual data entry and management duties are greatly reduced by this autonomous functionality.

An AI chatbot, which is integrated into the library cataloguing system, is then recommended. This integration makes sure the chatbot can easily interact with the metadata records and has access to the catalogue's database. The chatbot uses NLP techniques to accurately understand and interpret user inquiries. Metadata specialists and library users will then be able to input specific requests such as author, subject, or ISBN/ISSN number when retrieving metadata using the AI chatbot. After receiving the inquiry, the AI chatbot evaluates it and uses the specific request to construct a search query. The chatbot interacts with the catalogue's database through application programming interfaces (APIs) or database queries to do the search and retrieve relevant metadata items. The AI chatbot performs the search and then retrieves the metadata records that meet the predefined parameters. Metadata fields like titles, authors, publication dates, ISBN/ISSN numbers, subject keywords, and more can be retrieved in this way. After retrieving the metadata records, the AI chatbot presents the information to the metadata specialist in a user-friendly format. This could include displaying the metadata fields in a chat interface, generating a summary report, or providing a link to access the full metadata records within the cataloguing system. The AI chatbot also offers options for refining the search results or accessing related metadata based on the specialist's preferences.

Smart computer technology can carry out a number of actions to improve the usability and accessibility of the obtained metadata once the AI chatbot obtains metadata records from a smart device, such as a smartphone, laptop, or desktop computer. Smart devices have user-friendly interfaces that offer simple navigation choices and intuitive controls for accessing and interacting with metadata records. The interface indicates where metadata records are located and whether they are accessible online, as physical resources in the library, or available on both platforms. Smart computer technology presents metadata records in an easy-to-use format, organising them in a

structured manner with standardised metadata fields such as title, author, publication date, ISBN/ISSN numbers, and subject keywords. Supplementary details such as summaries, abstracts, tables of contents, and reviews are also provided to enrich the metadata.

6.5 IMPLICATIONS OF THE RESEARCH THEORY, POLICY, AND PRACTICE

The findings of this study outlined numerous essential aspects to consider in enhancing metadata services and standards at IHEs in Namibia by adopting AI. Many of the challenges highlighted are of critical significance, as they directly impact the quality and effectiveness of metadata services within the libraries.

However, the study not only identified these challenges, but also proposed suitable recommendations and possible solutions for each one. If implemented correctly, the recommendations put forth in this study have the potential to significantly improve the management of metadata services at IHEs in Namibia. This is because these recommendations are specifically designed to address concerns such as duplication of metadata records, metadata record spelling errors, inconsistent metadata records, and discrepancies between physical and digital metadata records.

These difficulties would be overcome by AI, since the AI-embedded OCR technology would be configured to give efficient metadata record recognition, capturing, and quality assurance. Users could also benefit from an AI chatbot's speedier record retrieval and metadata record description. In order to help libraries, implement and use AI to manage their metadata services effectively and efficiently, this study also suggests an embedded framework. Furthermore, this study makes a significant theoretical and conceptual contribution to the field of metadata services in the LIS industry, especially with regard to the adoption and application of AI for metadata service improvement.

6.6 THEORETICAL AND PRACTICAL CONTRIBUTIONS AND REFLECTIONS

The findings highlight the critical state of metadata services, revealing gaps in current practices, perceptions, and infrastructure. It highlights the imperative to incorporate AI related content into educational curricula for LIS programs. This inclusion would equip future professionals with a comprehensive understanding of the potential applications, challenges, and transformative capabilities of AI in metadata services.

Drawing on the TAM theory, the study underlines the importance of adopting a positive attitude towards AI among metadata specialists. It emphasises that perceived usefulness are critical factors in encouraging the acceptance and adoption of AI in metadata services. Furthermore, the study aligns with metadata theory, demonstrating how AI can enhance the organisation, accessibility, and management of metadata to support more efficient and user-centered library services.

From the perspective of digital transformation theory, the study illustrates the transformative impact of AI on library services. It shows how AI can drive innovation, improve operational efficiencies, and respond to the dynamic needs of library users in a digital age. Collectively, these theoretical insights underline the need for systemic changes in both professional education and library practice to fully realize the benefits of AI in metadata services.

Practical implications and key takeaways include IHEs in Namibia incorporating AI in their library policies, the need for robust training and capacity building among metadata specialists to accept and adopt the effective use of AI. Furthermore, the infrastructure supporting AI must align with the unique needs of libraries in IHEs in Namibia.

6.7 SUGGESTIONS FOR FURTHER RESEARCH

There were five objectives for this study, and each objective was looked into from a scientific standpoint. Findings were given on the subjects that matched the objectives. The following suggestions are made to the libraries to help them accomplish these objectives in a scientific manner:

- The current state of metadata services at IHEs in Namibia to improve metadata services has been evaluated.
- The perceptions of metadata specialists on adopting AI to improve metadata services in libraries at IHEs in Namibia were examined.
- The usability of AI to improve metadata services in libraries at IHEs in Namibia was determined.
- The AI infrastructure needed to improve metadata services in libraries at IHEs in Namibia was identified.
- The framework for adoption of AI to improve metadata services in libraries at IHEs in Namibia was proposed.

However, there are many areas where AI can be adopted to provide effective metadata services, and studies are required to ensure intensive findings and solutions so that, eventually, libraries can create and manage metadata records efficiently. This study recommends the adoption of AI to improve metadata services at IHEs in Namibia. Further studies into the adoption of AI to improve metadata services could be extended to other libraries such as the public, national, and community libraries in Namibia, which serve the nation at large with any type of information the people might need. Library services play a crucial role in knowledge creation and innovation in the country; hence, they should have the abilities that would enable them to be productive and provide effective and efficient services.

6.8 FINAL CONCLUSION

In conclusion, this study established that IHEs in Namibia do not have proper metadata services in place. Therefore, gaps and inconsistencies in metadata records must be

addressed to ensure that metadata services are improved. Due to a lack of proper metadata services, metadata records exist both electronically and manually. However, these metadata records are not managed in a cohesive manner. Metadata records are not easily accessible, easily retrieved, and maintained. This study makes several recommendations for improving metadata services at IHEs in Namibia. AI should be adopted to manage metadata records in libraries. Adopting AI to manage metadata records will guarantee that records are created and maintained digitally. This will improve the OPAC's ability to house metadata records efficiently. The adoption of AI-embedded OCR technology and AI chatbot would also assist in metadata records maintenance and retrieval. As the only academic libraries in IHEs in Namibia, the libraries need an effective metadata services system, aided by AI to ensure students and researchers do not struggle to retrieve important metadata records for their studies. Furthermore, quicker and faster metadata records retrieval would strengthen libraries and their mandate to provide efficient and swift information dissemination and enhance the image of academic libraries. Adopting AI will improve the overall metadata services in the libraries, as it is essential in locating and correcting any errors or inconsistencies. Moreover, it is anticipated that the quality-checking features of AI-embedded OCR technology will lessen metadata duplication. Furthermore, an AI chatbot equipped with sophisticated machine learning and deep learning algorithms guarantees quick and simple information retrieval in addition to delivering reliable and correct metadata descriptions. Hence, IHEs need to adopt AI to improve metadata services in their libraries.

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APPENDICES

APPENDIX 1: LETTER USED TO REQUEST APPROVAL TO CONDUCT THE STUDY AT THE UNIVERSITY OF NAMIBIA

UNISA university of south africa

PERMISSION LETTER

Request for permission to conduct research at the University of Namibia library

Research title: "Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"
Researcher: Tissa Magano Titus

Date: October 2023

Dear Dr J. Ndinoshiho,

This letter serves to request your approval for me to conduct a research study about the adoption of artificial intelligence for improvement of metadata services at your institution library.

I Tissa Magano Titus, am currently a registered Master's student in the Department of Information Science at the University of South Africa (UNISA). The study is about **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"**. The purpose of the study is to investigate, develop, and recommend an effective framework for the adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia. This will assist the UNAM library in improving their library services, enhancing effectiveness and efficiency to support teaching, learning and research. Furthermore, the UNAM library will greatly benefit fromthe data gathered and the recommendations that follow for management decision-making and problem solving.

Once the study is complete, the researcher will donate a copy of the dissertation to the UNAM library. Data collected for the study will be kept highly confidential.

Thank you, looking forward to your positive response.

Yours faithfully

Tissa Magano Titus (Miss.)
Master's Student: University of South Africa (UNISA)
Cell Number: +264813737265 | E-mail: 18035345@mylife.unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX 2: LETTER USED TO REQUEST APPROVAL TO CONDUCT THE STUDY AT THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNISA university of south africa

PERMISSION LETTER

Request for permission to conduct research at the NUST library

Research title: "Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"
Researcher: Tissa Magano Titus

Date: October 2023

Dear Sir/Ma'am,

This letter serves to request your approval for me to conduct a research study about the adoption of artificial intelligence for improvement of metadata services at your institution's library.

I Tissa Magano Titus, am currently a registered Master's student in the Department of Information Science at the University of South Africa (UNISA). The study is about **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"**. The purpose of the study is to investigate, develop, and recommend an effective framework for the adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia. This will assist the NUST library in improving their library services, enhancing effectiveness and efficiency to support teaching, learning and research. Furthermore, the NUST library will greatly benefit from the data gathered and the recommendations that follow for management decision-making and problem solving.

Once the study is complete, the researcher will donate a copy of the dissertation to the NUST library. Data collected for the study will be kept highly confidential.

Thank you, looking forward to your positive response.

Yours faithfully

Tissa Magano Titus (Miss.)
Master's Student: University of South Africa (UNISA)
Cell Number: +264813737265 | E-mail: 18035345@mylife.unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX 3: LETTER USED TO REQUEST APPROVAL TO CONDUCT THE STUDY AT THE INTERNATIONAL UNIVERSITY OF NAMIBIA

UNISA university of south africa

PERMISSION LETTER

Request for permission to conduct research at the IUM library

Research title: "Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"
Researcher: Tissa Magano Titus

Date: October 2023

Dear Ms Sitwala,

This letter serves to request your approval for me to conduct a research study about the adoption of artificial intelligence for improvement of metadata services at your institution library.

I Tissa Magano Titus, am currently a registered Master's student in the Department of Information Science at the University of South Africa (UNISA). The study is about **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia".** The purpose of the study is to investigate, develop, and recommend an effective framework for the adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia. This will assist the IUM library in improving their library services, enhancing effectiveness and efficiency to support teaching, learning and research. Furthermore, the IUM library will greatly benefit from the data gathered and the recommendations that follow for management decision-making and problem solving.

Once the study is complete, the researcher will donate a copy of the dissertation to the IUM library. Data collected for the study will be kept highly confidential.

Thank you, looking forward to your positive response.

Yours faithfully

Tissa Magano Titus (Miss.)
Master's Student: University of South Africa (UNISA)
Cell Number: +264813737265 | E-mail: 18035345@mylife.unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX 4: LETTER OF APPROVAL TO CONDUCT THE STUDY AT THE UNIVERSITY OF NAMIBIA

CENTRE FOR RESEARCH SERVICES
Office Of the Pro-Vice Chancellor: Research, Innovation & Development
University Of Namibia. Private Bog 13301, Windhoek. Namibia
☎ +264 61 206 4673; E-mail:kmbulu@unam.na; URL.: http//www.unam.edu.na
340 Mandume Ndemutayo Avenue,
Pioneers Park, Office f-223 - Fblcck, Second Floor UNAM +264 61 206 4673:

UNIVERSITY OF NAMIBIA

RESEARCH PERMISSION LETTER

Date: 07/12/2023

Researcher's Name: Ms Tissa Magano Titus

Academic Institution Registered with: University of South Africa (Unisa)

Academic Programme: Masters, Information Science

Approved Research Title: ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICE IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA.

TO WHOM IT MAY CONCERN

I hereby confirm that the abovementioned researcher has requested to be issued with the Research Permission from the University of Namibia, having already obtained an Ethical Clearance Certificate from the university the student is currently registered with, namely, the University of South Africa (Unisa).

The Ethical Clearance Certificate was duly attached, as required by UNAM.

Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

Dr. AEE Shikongo

Head: Postgraduate Research Support Services

Tel: +264 61 206 3129

Email: aeshikongo@unam.na

APPENDIX 5: LETTER OF APPROVAL TO CONDUCT THE STUDY AT THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Office of the Registrar

13 Jackson Kaujeua Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 2118
F: +264 61 207 9118
E: registrar@nust.na
W: www.nust.na

05 December 2023

Ms Tissa Magano Titus
Email: 18035345@mylife.unisa.ac.za
Windhoek
NAMIBIA

Dear Ms Titus

RE: CONSENT TO CONDUCT YOUR RESEARCH WITH THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY STAFF AND STUDENT

Approval is hereby granted for you to conduct the research on *"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia"*.

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.

I wish you all the best with your research.

Yours sincerely,

Ms Selma Heelu
ASSISTANT REGISTRAR: Academic Administration

CC:
Deputy Vice-Chancellor: Research and Innovation
Assistant Registrar

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
Private Bag 13388
Windhoek
NAMIBIA
2023 -12- 05
REGISTRAR
OFFICE OF THE REGISTRAR

APPENDIX 6: LETTER OF APPROVAL TO CONDUCT THE STUDY AT THE INTERNATIONAL UNIVERSITY OF NAMIBIA

IUM
THE INTERNATIONAL UNIVERSITY OF MANAGEMENT

OFFICE OF THE DIRECTOR: RESEARCH AND CONSULTANCY
Tel: +264 61 4336000
E-mail: rc@ium.edu.na
Windhoek – Namibia

Dear Ms Titus

7.12.2023

SUBJECT: ACADEMIC RESEARCH PERMISSION

TITLE: ADOPTION OF ARTIFICIAL INTELLEGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA.

This letter confirms the approval of your proposal by the IUM Research Ethics Committee. The proposal demonstrates an awareness of ethical responsibilities and a commitment to ethical research processes. The approval of the proposal by the committee thus constitutes ethical clearance and permission to conduct the study.
In order to acquire the information from different sources that you have requested the following offices of the International University of Management needed to be contacted;

Prof C Makanyeza (PVC)for any polices or documents from the university.

Email address: c.makanyesza@ium.edu.na

Mr H Hainghumbi (Deputy Director Human Resources) for entering the data base of staff members to distribute questionnaires and to conduct interviews with staff.

Email address: h.hainghumbi@ium.edu .na

Dr A Nashilundo (Registrar) for entering the data base of students for distribution of questionnaires and to conduct interviews with students.

Email address: a.nashilundo@ium.edu.na

All information released is subjected to policies of the International University of Management. Because of our own interest in research we expect you to share your findings with us on completion of your research study.

Yours Sincerely

Prof A van Dyk

Chairperson: Research Ethics Committee

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Fax: +264 61 433 6152
rc@ium.edu.na
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Fax: (+264 61) 433 6152
E-Mail: ium@ium.edu.na

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Fax: (+264 61) 248 112
E-Mail: ium@ium.edu.na

Coastal Campus
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Getrud Kandanga Road
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Fax: (+264 64) 206 647
E-Mail: adm.wbay@ium.edu.na

IUM Ongwediva Centre of Excellence for Education
4380 Dr.Libertina Amathila Str
P.O. BOX 2775, Oshakati
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Fax: (+264 65) 230 159
E-Mail: adm.ong@ium.edu.na

Nkurenkuru Campus
678 Nkurenkuru
P.O. BOX 6038, Nkurenkuru
Tel: (+264 66) 264500/264957
E-Mail: adm.nku@ium.edu.na

Website: www.ium.edu.na

APPENDIX 7: ETHICAL CLEARANCE LETTER FROM UNISA DEPARTMENT OF INFORMATION SCIENCE ETHICS REVIEW COMMITTEE

UNISA university of south africa

COLLEGE OF HUMAN SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

20 October 2023

NHREC Registration # : Rec-240816-052

CREC Reference # :

Dear Ms Tissa Magano Titus

Decision:

Ethics Approval from 20 October

Researcher(s): Name: Ms. T. M. Titus

Contact details: 18035345@mylife.unisa.ac.za

Supervisor(s): Name: Dr. M. T. Modiba

Contact details: modibmt@unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

Title: Adoption of artificial intelligence for improvement of metadata services in libraries at institutions of Higher Education in Namibia.

Degree Purpose: Masters

Thank you for the application for research ethics clearance by the Unisa College of Human Science Ethics Committee. Ethics approval ***is conditionally granted for one year, subject to ethical approval from the study country's local ethics committee***. ***DATA CANNOT BE COLLECTED UNTIL A FINAL ETHICS CERTIFICATE IS ISSUED BY CREC.***

The ***low-risk application*** *was reviewed by* College of Human Sciences Research Ethics Committee, in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) 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 should be communicated in writing to the College Ethics Review Committee.

3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. 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.
5. 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.
6. 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 require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date **(20 October 2024).** Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **18035345_CREC_CHS_2023** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature:

Signature: PP

Prof. KB Khan
CHS Research Ethics Committee Chairperson
Email: khankb@unisa.ac.za
Tel: (012) 429 8210

Prof ZZ Nkosi
Executive Dean: CHS
Email: nkosizz@unisa.ac.za
Tel: 012 429 6758

APPENDIX 8: SURVEY QUESTIONNAIRE/INTERVIEWS INFORMED CONSENT FORM

QUESTIONNAIRE INFORMED CONSENT FORM

"ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA''

I am Tissa Magano Titus, a master's student at the University of South Africa (Unisa) conducting research titled **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia''.** The purpose of the study is to investigate the adoption of artificial intelligence (AI) technologies to improve metadata services in libraries at Institutions of Higher Education in Namibia and to draw recommendations from the results of the study. The outcomes may be useful to Institutions of Higher Education in Namibia in adopting AI for the improvement of metadata services. Participation in this study is completely voluntary.

The data collected from this questionnaire shall not be used for anything else other than the purpose of this study. You are not mandated to provide your name or any other information that could be used to identify you, hence you will remain anonymous. The objective of the questionnaire is to assess your opinion, perspective, and attitude toward the adoption of AI in the improvement of metadata services at Institutions of Higher Education in Namibia.

This study's results are intended to provide valuable information to libraries to improve their metadata services. An advantage of participating in this study is that you can share knowledge and contribute to improving metadata services in libraries. On the basis of these considerations, the researcher is humbly requesting you, the study participant, to consent to your participation in the study by signing this form. For more information and enquiries, please do not hesitate to contact the researcher, Tissa Magano Titus on +264813737265 or 18035345@mylife.unisa.ac.za or alternatively, her supervisor Dr. M. Modiba on 012 433 4752 or modibmt@unisa.ac.za.

I hereby give consent for me to participate in this study and that the information I provide in the questionnaire will be used for completion of this research project.

The information provided will be treated with high degree of confidentiality as stated in this consent form and will therefore remain anonymous. Please put a cross (X) next to the following question.

• I need to receive copy of research report summary in completion of the study

Yes	
No	

_____ _____

Participant signature Date

INTERVIEW INFORMED CONSENT FORM

"ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA''

I am Tissa Magano Titus, a master's student at the University of South Africa (Unisa) conducting research titled **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia''.** The purpose of the study is to investigate the adoption of artificial intelligence (AI) technologies to improve metadata services in libraries at Institutions of Higher Education in Namibia and to draw recommendations from the results of the study. The outcomes may be useful to Institutions of Higher Education in Namibia in adopting AI for the improvement of metadata services. Participation in this study is completely voluntary.

The data collected from this interview shall not be used for anything else other than the purpose of this study. You are not mandated to provide your name or any other information that could be used to identify you, hence you will remain anonymous. The objective of the interview is to assess your opinion, perspective, and attitude toward the adoption of AI in the improvement of metadata services at Institutions of Higher Education in Namibia.

This study's results are intended to provide valuable information to libraries to improve their metadata services. An advantage of participating in this study is that you can share knowledge and contribute to improving metadata services in libraries. On the basis of these considerations, the researcher is humbly requesting you, the study participant, to consent to your participation in the study by signing this form. For more information and enquiries, please do not hesitate to contact the researcher, Tissa Magano Titus on +264813737265 or 18035345@mylife.unisa.ac.za or alternatively, her supervisor Dr. M. Modiba on 012 433 4752 or modibmt@unisa.ac.za.

I hereby give consent for me to participate in this study and that the information I provide in the interview will be used for completion of this research project.

The information provided will be treated with high degree of confidentiality as stated in this consent form and will therefore remain anonymous. Please put a cross (X) next to the following question.

• I need to receive copy of research report summary in completion of the study

Yes	
No	

_____ _____

Participant signature Date

APPENDIX 9: SURVEY QUESTIONNAIRE

SURVEY QUESTIONNAIRE

"ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA''

I am Tissa Magano Titus, a master's student at the University of South Africa (Unisa) conducting research titled **"Adoption of artificial intelligence for improvement of metadata services in libraries at Institutions of Higher Education in Namibia''.** The purpose of the study is to investigate the adoption of artificial intelligence (AI) technologies to improve metadata services in libraries at Institutions of Higher Education in Namibia and to draw recommendations from the results of the study. The outcomes may be useful to Institutions of Higher Education in Namibia in adopting AI for the improvement of metadata services. Participation in this study is completely voluntary.

The data collected from this questionnaire shall not be used for anything else other than the purpose of this study. You are not mandated to provide your name or any other information that could be used to identify you, hence you will remain anonymous. The objective of the questionnaire is to assess your opinion, perspective, and attitude toward the adoption of AI in the improvement of metadata services at Institutions of Higher Education in Namibia.

It would be highly appreciated if you could answer all the questions as honest and responsively as you can. Please feel free to share your true thoughts as this will assist me in achieving the purpose of the study. For more information and enquiries, please do not hesitate to contact Tissa Magano Titus on +264813737265 or 18035345@mylife.unisa.ac.za or alternatively Dr Mashilo Modiba on 012 433 4752 or modibmt@unisa.ac.za. I would like to thank you for your willingness and your participation in this regard is highly valued.

COMPLETE THIS QUESTIONNAIRE AS GUIDED BELOW

1. Please answer questions by making a cross next to the correct answer and explain where necessary.

2. Use “N/A” for not applicable questions, please answer all questions.

3. If writing space is not enough, please use a separate page and write the question number next to the answer.

4. Please sign the consent form at the end of this questionnaire.

SECTION 1: DEMOGRAPHIC INFORMATION

1.1 AGE GROUP

18 – 24	
25 -30	
31 – 35	
36 – 40	
41 -45	
46 – 50	
51 – 55	
56 – 60	
60+	

1.2 GENDER

Male	
Female	

1.3 HIGHEST QUALIFICATION

Grade 12	
Bachelor's Degree	
Honours Degree	
Master's Degree	
PhD	
Other, specify	

1.4 JOB TITLE

University metadata specialist	
Library director	
Head of department	
Senior metadata specialist	
Metadata specialist	
Senior library assistant	
Library assistant	

Other, please specify	

1.5 HOW LONG HAVE YOU BEEN WORKING ON YOUR CURRENT POSITION?

0-2 years	
2-5 years	
5-7 years	
7-10 years	
10 years+	

2. SECTION 2: CURRENT STATE OF METADATA SERVICES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA.

2.1. How are metadata records created at your library?

Manually	
Electronically	
Both	
Others, specify	

2.1.1. Based on the answer you provided at #2.1, how effective are metadata records created at your library?

_____

_____

2.2. In which format is metadata managed at your library?

Manually	
Electronically	
Both	
Others, please specify	

2.2.1. Based on your answer at #2.2, how effective is the format in which metadata is managed at your institution?

2.3. How do you assess the accuracy of metadata records in your library's catalogue?

2.4. How are metadata records retrieved by users at your library? (Tick all that are applicable)

Physically	
Online	
Email	
Others, please specify	

2.4.1. Based on your answer in #2.4, which method of accessing metadata records is effective at your library?

2.5. How long does it take to retrieve metadata records at your library?

5-10 minutes	
10-30 minutes	
30- 1 hour	
1 hour+	

2.6. What is the state of the metadata records at your library?

Good	
Bad	
Others, please specify	

2.6.1. Rate the library's current state of metadata records in the figure below. Please put a cross (X) in the column that describes your response using the following scale: 1 = Agree; 2 = Unsure; 3 = Disagree.

STATEMENT	**1**	**2**	**3**
Metadata records are in good condition			
Metadata records are easily accessed			
Metadata records are easily retrieved			
Metadata records are maintained			
Metadata records are saved and protected			

2.7 Are there any challenges you face in managing metadata records for library resources?

Yes	
No	

2.7.1 Based on your answer at #2.7, what kind of challenges are you facing in managing metadata records for library resources?

_____

_____

_____

_____

2.8 In your opinion, what improvements could be made to enhance metadata services in your library?

SECTION 3: PERCEPTIONS OF METADATA SPECIALISTS ON ADOPTING ARTIFICIAL INTELLIGENCE TO IMPROVE METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA

Note: Artificial intelligence in computers or machines refers to their ability to do particular tasks in the image and pace of humans, or faster (Omame & Alex-Nmecha 2020). AI in the context of metadata services refers to the integration of sophisticated computer tools and algorithms to automate, enhance, and optimise the management, extraction, analysis, and utilisation of metadata.

3.1 Are you familiar with artificial intelligence and its applications in library metadata services?

Yes	
No	

3.1.1. If yes, what is your understanding about the adoption of artificial intelligence for the improvement of metadata services in your library? (Tick all that are applicable)

Artificial intelligence manages metadata records effectively	
Artificial intelligence makes metadata creation faster	
Artificial intelligence ensures accuracy and consistency in metadata records	

Artificial intelligence provides security for the metadata records	
Others, specify	

3.1.2. If your answer is No at 3.1, what do you think should be done for you to familiarise yourself with the adoption of artificial intelligence of improvement of metadata services in the library? (Tick all that are applicable)

Attending workshops and conferences on artificial intelligence and metadata services	
Attending training on artificial intelligence and metadata services	
Studying the adoption of artificial intelligence and metadata services	
Writing papers on artificial intelligence and metadata services	
Others, specify	

3.2 Do you think artificial intelligence can be effective if properly implemented to improve metadata services at your library?

_____

_____

_____

_____

3.3. What are your general opinions about artificial intelligence to enhance metadata services in the library?

Artificial intelligence can provide effective metadata services in the library	
Metadata records can still not effectively be created and improved by artificial intelligence	

Metadata specialists can lose their jobs if artificial intelligence are applied to improve metadata services at the library	
Others, specify	

3.4. In your view, what could be the benefits of using artificial intelligence to improve library metadata services? (Tick all that are applicable)

Easy creation of metadata records	
Easy retrieval of metadata records	
Faster retrieval of metadata records?	
Accurate and consistent metadata records	
Others, specify	

3.5 What factors, in your opinion, might have negative influence on the adoption of artificial intelligence for metadata services?

Limited budget	
Lack of training and unfamiliarity	
Complexity of AI systems	
Unwillingness and resistance to change of metadata specialists	
Others, specify	

3.6 Would you be willing to actively participate in the implementation of artificial intelligence for metadata services improvement?

Yes	
No	

3.6.1 If yes, kindly elaborate why you be willing to actively participate in the implementation of artificial intelligence for metadata services improvement.

_____

_____

_____

_____

3.6.2 If no, kindly elaborate why you are not willing to actively participate in the implementation of artificial intelligence for metadata services improvement.

_____

_____

_____

_____

SECTION 4: THE USABILITY OF ARTIFICIAL INTELLIGENCE TO IMPROVE METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA.

4.1 Which of these activities can be performed through artificial intelligence to improve metadata services in your library?

Automated metadata creation	

Enhanced keyword extraction		
Duplicate detection		
Semantic tagging		
Others, specify		

4.2 How can the abovementioned metadata services in #4.1 be performed through artificial intelligence?

4.3 Why should the abovementioned metadata services in #4.1 be performed through artificial intelligence?

SECTION 5: ARTIFICIAL INTELLIGENCE INFRASTRUCTURE NEEDED TO ADOPT ARTIFICIAL INTELLIGENCE FOR THE IMPROVEMENT OF METADATA SERVICES

Note: Artificial intelligence infrastructure is the hardware, software, and networking systems required to support the development, deployment, and operation of AI applications (Hofstee 2022). The infrastructure includes powerful processors, storage devices, and algorithms that are designed to enable machines to learn and reason like

humans. Examples of AI tools in metadata services in libraries include NLP, OCR, deep learning and robotics.

5.1. Do you know of any artificial intelligence infrastructure that can be used for metadata services?

Yes	
No	

5.1.1. If your answer is yes at #5.1, which of the artificial intelligence infrastructures listed below is more familiar to you (Tick all that are applicable)

Robotic machines	
Machine learning	
Black box	
Automated classification	
Machine learning	
Automated classification	
Natural language processing	
Deep learning	
Optical character recognition	
Others, specify	

5.1.2. If your answer is no at #5.1, what do you think can be done to familiarise yourself with the artificial intelligence infrastructure that can used to improve metadata services?

5.2 How can artificial intelligence infrastructure be used in metadata services? (Tick all that are applicable)

To automate metadata creation	
To automate metadata enrichment	
For quality control and validation	
To Automate language translation	

5.3 Why do you think artificial intelligence infrastructure can be important for the improvement of metadata services?

APPENDIX 10: SURVEY INTERVIEW SCHEDULE

SURVEY INTERVIEW SCHEDULE FOR THE MANAGEMENT AT THE INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA

"ADOPTION OF ARTIFICIAL INTELLIGENCE FOR IMPROVEMENT OF METADATA SERVICES IN LIBRARIES AT INSTITUTIONS OF HIGHER EDUCATION IN NAMIBIA''

ANSWER THIS INTERVIEW QUESTIONS AS GUIDED BELOW

1. Please respond to only asked questions.

2. Kindly answer follow up questions.

3. Please sign the consent form at the end of this interview.

SECTION 1. INTERVIEW DETAILS

1.1. Interviewer: _____

1.2. Date: _____

1.3. Time: _____

1.4. Place: _____

1.5. Mode of interview: _____

SECTION 2. DEMOGRAPHIC INFORMATION

2.1. What is your gender?

_____

2.2. What is your highest qualification?

_____

2.3. What is your job title or position at the library?

_____

2.4. What is your role at the library?

_____

2.5. How long have you been working in the library?

_____

SECTION 3: STATE OF METADATA SERVICES

3.1 How are metadata records created at your library?

_____

_____

_____

_____

3.2 In which format is metadata managed at your library?

_____

_____

_____

_____

3.3 How do you assess the accuracy of metadata records in your library's catalogue?

3.4 How are metadata records retrieved by users at your library?

3.5 How long does it take to retrieve metadata records at your library?

3.6 Are there any challenges or issues you face in managing metadata records for library resources?

3.7 In your opinion, what improvements could be made to enhance metadata services in your library?

SECTION 4: PERCEPTIONS OF METADATA SPECIALISTS ON ADOPTING AI TO IMPROVE METADATA SERVICES

Note: Artificial intelligence in computers or machines refers to their ability to do particular tasks in the image and pace of humans, or faster (Omame & Alex-Nmecha 2020). AI in the context of metadata services refers to the integration of sophisticated computer tools and algorithms to automate, enhance, and optimise the management, extraction, analysis, and utilisation of metadata.

4.1 What do you think artificial intelligence is? Give a brief explanation.

_____

_____

_____

_____

4.2 What is your understanding about the adoption of artificial intelligence for the improvement of metadata services in your library?

_____

_____

_____

_____

4.3 In your view, what could be the benefits of using AI to improve library metadata services?

_____

_____

_____

_____

4.4 What factors, in your opinion, might negatively influence the adoption of AI for metadata services?

4.5 Would you be willing to actively participate in the implementation of AI for metadata improvement? Kindly elaborate your answer.

SECTION 5: THE USABILITY OF AI TO IMPROVE METADATA SERVICES

5.1 Which activities can be implemented through AI to improve metadata services in your library?

5.2 How can the abovementioned metadata services be performed through AI?

5.3 Why should the abovementioned metadata services be performed through AI?

SECTION 6: ARTIFICIAL INTELLIGENCE FOR THE IMPROVEMENT OF METADATA SERVICES

Note: Artificial intelligence infrastructure is the hardware, software, and networking systems required to support the development, deployment, and operation of AI applications. The infrastructure includes powerful processors, storage devices, and algorithms that are designed to enable machines to learn and reason like humans (Hofstee 2022). Examples of AI tools in metadata services in libraries include natural language processing, optical character recognition, deep learning and robotics.

6.1. What kind of artificial intelligence infrastructure is used for metadata services?

6.2. How is AI infrastructure used in metadata services?

6.3 Why do you think artificial intelligence infrastructure could be important for the implementation of metadata services?

APPENDIX 11: SURVEY OBSERVATION SCHEDULE

OBSERVATION CHECKLIST

Title:	**Review date:**
Observer:	

	Yes	**No**	**Comments**
Does the library have enough staff?			
Are the metadata specialists qualified for their position?			
Are the metadata records retrieved easily?			
How long does it take to retrieve metadata records?			
Are the metadata records in good condition?			
Do the metadata records have any errors, inconsistencies or any duplicates?			
Do the metadata specialists have acceptable knowledge and skills to adopt AI?			

APPENDIX 12: SYSTEM CHECKLIST

SYSTEM CHECK

Title:	**Review date:**
System checker:	

	YES	**NO**	**COMMENT**
Is the library management system integrated in a good working condition?			
Are metadata records effectively recorded and clear?			
Does the system retrieve information in a timely manner?			

APPENDIX 13: RESEARCH DASHBOARD

RESEARCH OBJECTIVES, RESEARCH QUESTIONS AND POSSIBLE DATA SOURCES

Objective	Research Question	Models	Methodologies	Data collection
Evaluate the current state of metadata services at Institutions of Higher Education in Namibia.	How is the current state of metadata services at Institutions of Higher Education in Namibia?	Metadata Theory	Qualitative method	Interviews, Observa
Examine the perceptions of librarians on adopting AI to improve metadata services at Institutions of Higher Education in Namibia.	What are the perceptions of the librarians on adopting artificial intelligence to improve metadata services at Institutions of Higher Education in Namibia?	TAM (Perceived ease of use)	Qualitative methods	Interviews

Determine consideration in the usefulness of AI to improve Institutions of Higher Education in Namibia.	How can AI be used to improve metadata services at Institutions of Higher Education in Namibia?	TAM (Perceived usefulness)	Quantitative and Qualitative method	Questionnaire and Interviews
Establish the AI infrastructure needed to improve metadata services at Institutions of Higher Education in Namibia.	Why is AI infrastructure needed to improve metadata services at Institutions of Higher Education in Namibia?	Digital Transformation Theory	Qualitative method	Interviews and Questionnaires