Data Literacy and Research Data Management Services by Librarians in University Libraries, Lagos State, Nigeria

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Certification

This is to certify that this thesis was carried out by **Busola Olufeyi AJOKOTOLA** with Matriculation Number **LCU/PG/002112,** a student in the Department of Information Management under my supervision in the Faculty of Communication and Information Science, Lead City University, Ibadan, Nigeria.

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Dedication

This project work is dedicated to God Almighty, the Author and Finishers of our faith who in His mercy has kept me thus far.

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Abstract

Research data management service is the future of librarianship but this services may not become widespread in Nigeria unless librarians acquire the necessary skills and competencies which seems to be currently missing among majority of librarians. This study examined the influence of librarians' data literacy skills on research data management services by librarians in University Libraries in Lagos State, Nigeria. The descriptive research design was adopted for the study. A structured questionnaire was adopted as the instrument for data collection. The study population is made up of ninety-nine (99) academic librarians in universities across Lagos State. Total enumeration was employed which means all the population was sampled. The study found that data collection ($R = 0.609$, $p<0.05$), data evaluation ($R = 0.713$, $p<0.05$), and data application ($R = 0.744$, $p<0.05$) all have significant influence on research data management services. It was also found that all the elements of data literacy have significant influence on research data management services (Adj. $R^2= 0569$, $F(3,84)= 111.886$, $p= 0.000$). The study concluded the effective data management in academic libraries is highly dependent on data literacy skills of librarians. It is therefore recommended that regular training should be conducted for academic librarian so that they can continue to improve their data literacy skills and render effective research data management services to enhance research productivity.

Keywords: Data Literacy, Data management, Information Management, Research Productivity, Library Services.

Word Count: 219

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Chapter One

Introduction

1.1 Background of the Study

Research data management service is the future of academic librarian but this service may not become widespread in Nigeria unless academic librarians acquire the necessary skills and competencies which seem to be currently missing among majority of academic librarians. Research data management involves the process of planning, organising, and providing data and information to researchers by academic libraries and other information services providers. It is the type of data management performed for the sake of scientific inquiry with the main purpose of adding to the quality of research. In the context of scientific research, the term "data management" encompasses any and all procedures used to protect sensitive information. Data is created and its use is planned; data is organised and given a name; data is kept safe, accessible, saved, and backed up; information resources are discovered and shared with coworkers and other stakeholders; data is published and cited; and the process is completed. The FAIR data principle (which stands for "Findable, Accessible, Interoperable, and Reusable") is supported by research data management. Improper administration of research data can lead to serious consequences, such as the loss of valuable information, the infringement of personal data or intellectual property, or even ethical breaches.

Many scientists would rely heavily on research data management, which is the processing of all kinds of raw or primary data, produced along the research process. This has significant implications for library and information science. To prepare for the new problems of delivering

and exploiting data infrastructures in practically all scientific disciplines1, information professionals will have to train students, scientists, data managers, and information specialists[1].

Data generated in the course of scientific inquiry may be more easily shared and reused thanks to research data management, which involves using appropriate and user-friendly technologies in virtual research infrastructures to facilitate data creation, access, verification, durable storage, and reuse[2]. The curatorial process relies heavily on these details, which are handled in the following ways: research data processing entails several steps, including ideation, creation or receipt, evaluation, selection, ingestion, storage, access, use, reuse, and transformation. A scientist requires access to data in three domains—one private, one collaborative, and one public—all of which should be permeable to curation transactions[3].

Supporting researchers with data management planning (DMP) tools and data storage and preservation are two examples of the ways in which university libraries are participating in research data management services. In addition, these functions are considered as an expansion of the knowledge storage, curation, and dissemination offered by research support and scholarly communication services. This next phase of research data management services entails close collaboration with researchers by following them throughout their projects and providing them with support. Planning for a project and data management begins with data generation and continues through data processing, analysis, storage, dissemination, and reuse. Adopted from the research data lifecycle[4], these are the variables that will be utilised as indicators in this investigation[2].

When a solution incorporates data that does not already exist in the end-databases user's or mailing lists, it is data creation. Information retrieval, manipulation, and categorization are all examples of data processing. Analyzing data entails examining it, cleaning it, converting it, and modelling it so that insights may be drawn and decisions can be supported. When data is preserved, its security and authenticity are ensured. The act of making research data available to other researchers is known as data sharing, and data reuse refers to methods that prevent the same information from being kept in several internal registers or slower-access storage. It has been found that university librarians in Lagos State are deficient in managing research data, including the creation, processing, analysis, preservation, sharing, and reuse of data; this has hindered students' ability to access necessary data and information for research, leading to subpar research programmes and work.

Science journal articles and conference papers are typical final products of academic study. Too often, research data management policies throughout the data lifecycle are not implemented until after data publishing and sharing have already taken place. Therefore, there is a discrepancy between the ease with which one can gain access to data and the ease with which one can gain access to scientific publications. Data availability reduces as the age of scientific papers increases. In addition, research data are typically exclusively controlled by researchers or research groups and are not indexed as part of data preservation efforts. Consequently, there is no procedure for storing data reliably, backing it up, and restoring it, or monitoring the availability of its access. Failure to preserve data hampers its reusability. The United States, the United Kingdom, Australia, the Netherlands, Canada, Sweden, and China5 are just few of the countries where research data management practise has been applied in

higher education and research institutes. As a result, an SLR was conducted to look into leading methods for managing research data internationally. Strengths, Weaknesses, Opportunities, and Threats analyses were conducted to identify implementation strategies to help it take off in Indonesia. Prior literature in the fields of digital libraries and public diplomacy employ SWOT analysis to build strategies based on an examination of the advantages, disadvantages, opportunities, and threats facing the organisation[6]. In addition, research into B2C e-commerce customization and e-portfolio growth has involved a thorough literature assessment of research data management.

Students want information that is accessible at the appropriate time, in the right place, in the correct form, and is sufficiently thorough and of quality to carry out the present task, therefore librarians must do more than just supply information. For this reason, it is crucial to acquire the necessary digital literacy skills in order to provide effortless data access. Text, numbers, photos, video or movies, music, software, algorithms, equations, animations, models, simulations, and so on are all examples of data. Information may be gathered in a number of ways, including through observation, computing, and experimentation[7]. "data literacy comprises awareness of one's information concerns and requirements, and the capacity to identify find, analyse, organise, and effectively produce, use, and convey data to meet issues or challenges at hand," says the National Center for Education Statistics. It is necessary for full engagement in the modern information society. Literacy in the realm of data encompasses not just digital but also analogue and spoken forms of information[9]. Many library database searches result in no relevant results for data users (students), according to the literature[9]. Asking for help finding

the right data is an important part of developing data literacy. The information will be uncovered as a result of the search for it.

An individual's level of data literacy may be used as a proxy for their level of data fluency and, by extension, their level of commitment to the Dataism ideology. As it equips people to take advantage of the opportunities presented by the information age and data while also protecting them from potential harm, its value is self-evident. However, how can one acquire the skills necessary to become data literate? Many researchers and industry professionals have put up efforts to define and characterise data literacy[7]. However, data is a phrase that may refer to everything from computer science to libraries, and thus, data literacy can refer to a wide range of skills and knowledge. While this lack of definition might be viewed as "problematic," research into the field is required to determine the settings in which data literacy has been discussed. In order to make data literacy more than simply a buzzword, it is essential to grasp the nuances and rationales underlying the various approaches. Then, and only then, will individuals be able to become data-savvy and contribute to this data-driven society as active, well-informed participants.

The capacity to comprehend and apply data to make decisions is referred to as "data literacy," an interdisciplinary topic that combines data science, mathematical reasoning, and real-world context[10]. The mental traits of curiosity, resilience, and ethical decision making are all indicative of a high level of data literacy, in addition to particular skills. Several initiatives to improve undergraduate scientific teaching have included discussions on the need of developing students' data literacy skills. A data literate individual employs the same data processing phases as data scientists and is familiar with their purposes. While a "data literate" individual can get

by with an awareness of the basics, "data scientists" have extensive training and experience in data management and sophisticated statistical techniques. To fully participate in a society transformed by the availability and accessibility of huge volumes of data, it is necessary to be able to read and speak data, to comprehend data, and to utilise data effectively. Quantity of data gathered, analysed, and used in a research project is a good indicator of data literacy. Data literacy will be evaluated using these criteria, which have been borrowed from literature[11].

The purpose of data collection is to enable one to answer relevant questions and assess results by collecting and measuring information on certain variables within a predefined system. Data discovery and data sources will be used to evaluate the obtained information. Evaluating data is what's done to see whether it's good enough to use in risk assessments. In this research, evaluation of the data is based on the use of instruments and the interpretation of the results. "Data application" refers to the practise of analysing vast amounts of data to swiftly reveal valuable information or take independent action. The issue with academic libraries in Lagos state is the non-upgrading of the libraries to advance technological state which made data sourcing and collection a difficult task for the students' research. In view of the above discussion, this study tends to investigate the influence of data literacy on research data management services by librarians in University Libraries Lagos State, Nigeria.

1.2 Statement of the Problem

Research data management service is the process that involves the active organization and maintenance of data during the active stages of research work and suitable archiving of the data. Librarians are involved in the provision of customer service for library users, providing

suggestions for library users about new information to try and help library users check out books. When librarians manage research data appropriately, it makes information and data access an easy one. However, preliminary investigation, close observation and literature review have revealed a decline in the management of research data by librarians in University libraries in Lagos State. As a result, access to information has been limited for library users. As we know that the purpose of using library is for acquisition of knowledge and for research, this decline may result to non-availability of information and data for research purpose and it may eventually lead to poor development on the nation's economy and infrastructural development. Data literacy of librarians has been identified to be influencing research data management services by librarians in University libraries in Lagos State[10].

Students were perceived not to have access to necessary information and data mostly due to the fact that the libraries are not up to standard and some are also lacking ICT facilities with poor management of available data in the libraries. Several studies have been conducted on data literacy and preservation by librarians but few has been done on the influence of data literacy on research data management services[10,12]. Hence, this study tends to investigate the influence of data literacy on research data management services by librarians in University Libraries Lagos State, Nigeria.

1.3 Aim and Objectives of the Study

The aim of the study is to investigate the influence of data literacy on research data management services by librarians in University Libraries, Lagos State, Nigeria. The specific objective is to:

i. identify the level of research data management services among librarians in University libraries Lagos State, Nigeria;

ii. examine the data collection (data discovery and data sources) approach by librarians in University libraries Lagos State, Nigeria

iii. determine the data evaluation (data tools, and data interpretation) approach by librarians in University libraries Lagos State, Nigeria.

iv. identify the level of data application (critical thinking, and data ethics) approach by librarians in university libraries Lagos State, Nigeria.

v. examine the influence of data collection on research data management services by librarians in University Libraries Lagos State, Nigeria;

vi. determine the influence of data evaluation on research data management services by librarians in University Libraries Lagos State, Nigeria;

vii. determine the influence of data application on research data management services by librarians in University Lagos State, Nigeria.

viii. ascertain the combined influence of data literacy skills and competencies on research data management services among university librarians Lagos State, Nigeria.

1.4 Research Questions

The following research questions have been formulated for the study.

i. What is the level of research data management services among librarians in University libraries Lagos State, Nigeria?

ii. What is the level of data collection (data discovery and data sources) approach by librarians in University libraries Lagos State, Nigeria?

iii. What is the level of data evaluation (data tools, and data interpretation) approach by librarians in University libraries Lagos State, Nigeria?

iv. What is the level of data application (critical thinking, and data ethics) approach by librarians in university libraries Lagos State, Nigeria?

1.5 Research Hypotheses

The following hypotheses have been developed and will be tested at 0.05 level of significance

$H_0$1: There is no significant influence of data collection on research data management services by librarians University Libraries Lagos State, Nigeria;

$H_0$2: There is no significant influence of data evaluation on research data management services by librarians is University Libraries Lagos State, Nigeria;

$H_0$3: There is no significant influence of data application on research data management services by librarians in University Lagos State, Nigeria;

$H_0$4: There is no significant combined influence of data literacy skills and competencies on research data management services among University librarians Lagos State, Nigeria.

1.6 Scope of the Study

The study is focus on the influence of data literacy on research data management services by librarians in university libraries Lagos State, Nigeria. The measures of research data management services are data creation, data processing, data analysis, data preservation, data

sharing and data reuse. The measures of data collection are data discovery and data source, the measures of data evaluation are data tools, and data interpretation while the measures of data application are critical thinking and data ethics. The geographical scope will cover university libraries in Lagos State, Nigeria which include University of Lagos Library, Akoka, Lagos State University Library, Ojo, Lagos State University of Education Library, Ijanikin, Lagos State University of Science and Technology Library, Ikorodu, Caleb University Library, Imota, Trinity University Library, Sabo, Eko University Library of Medicine and Health Science Library, Ijanikin and Pan-Atlantic University Library, Lekki. The respondents will be librarians of the University libraries Lagos State, Nigeria.

1.7 Significance of the Study

Librarians of University libraries and tertiary institution libraries, researchers, and the Government will significantly profit from this research. This study is focused on data literacy, and research data management services by librarians academic in libraries in Lagos State. It will enlighten the public on how to seek the right information at the right time.

The findings of this study will help students acquire more knowledge to improve and speed up their research work. This will establish a link and basis for future researchers and governments working on relevant research topics. This study is based on current events that are still unfolding, it is expected that the research work will deliver pertinent and current data to scholars and students that would embark on researches about different phases of data literacy and research data management and raise further questions for future researchers.

1.8 Operational Definition of Terms

Research Data Management Services: It is the organisation of data, from its entry to the research cycle through to the dissemination and archiving of valuable results by librarians in University libraries Lagos State, Nigeria.

*Data creation***:** It is the use of data incorporated in a solution to create a new record or records not already held on any database or mailing list owned by or licensed to the end-user by librarians in University libraries in Lagos State, Nigeria.

*Data processing***:** It is the process of carrying out operations on data, especially by a computer to retrieve, transform or classify information by librarians in University libraries Lagos State, Nigeria.

*Data analysis***:** It is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions and supporting decision-making by librarians in University libraries in Lagos State, Nigeria.

*Data preservation***:** It is the act of conserving and maintaining both the safety and integrity of data by librarians in University libraries in Lagos State, Nigeria.

Data sharing: It is the practice of making data used for scholarly research available to other investigators by librarians in University libraries in Lagos State, Nigeria.

Data reuse: It is a technique to eliminate repeated internal registers and/or in faster access memories than where the data is originally stored by librarians in University libraries Lagos State, Nigeria.

***Data literacy*:** It is the ability to read, understand, create, and communicate data as information by librarians of University libraries Lagos State, Nigeria.

Data collection: It is the process of whereby librarians of University libraries Lagos State gather and measure information on targeted variables in an established system which then enables one to answer relevant questions and evaluate outcomes.

Data discovery: It is the process by which University librarians Lagos State collect and consolidate data from multiple databases into a single source where it becomes easier to investigate and detect patterns.

Data source: It is the name given to the connection set up to a database from a server by University librarians in Lagos State.

***Data evaluation*:** It is the process that determines whether data is usable for calculating risk estimates by librarians of University libraries in Lagos State.

Data tools: Is the software which among other features configures and runs data pipleines and collect configuration data.

Data interpretation: It the process of reviewing data that utilizes analysis, evaluate and visualization to provide in-depth finding to enhance data-driven decision making

***Data application*:** It is the process whereby librarians of University libraries Lagos State analyze large-scale data to quickly surface rich insight or take autonomous action.

Critical thinking: It is the intellectually disciplined process of actively and gathered or generated by observation, experience, reflection , reasoning , communication as a guide to belief and action.

Data ethics: It is the process that evaluates data practices, collecting, generating, analyzing and disseminating data both structured and unstructured that have the potential to adversely impact people and society.

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Chapter Two

Review of Related Literature

This chapter reviewed related literature that enabled the researcher broaden her understanding on the research problem. The chapter is presented under the following headings:

2.1 Conceptual Review

2.1.1 Overview Research Data Management Services

It is widely understood in the scientific world that quality research require data, which consists of documented, factual materials that have been collected, organisaed and stored by other researchers. Word documents, spreadsheets, lab notes, field notebooks, diaries, surveys, questionnaires, transcripts, codebooks, audio and video files, images, photographs, artefacts, samples, models, algorithms, scripts, content analyses, focus group discussions and responses, interview notes, and so on are just some of the many formats in which researchers store their information. The emergence of information technology has raised hopes that, researchers, scientists, and academics will be able to access, read, consult, utilise, and build upon carefully collected and properly preserved research data. Globally, researchers are always on the lookout for unique perspective that might help spark fresh insights. This will save them from having to go through the trouble of gathering information and starting from scratch, as well as wasting time and effort.

By fostering multidisciplinary approaches and generating new questions, making research data available for use and reuse helps and expands scholarship. Access to research data for free helps verify findings, protects academic honesty, and keeps the academic community on the right trajectory. In addition, sharing research data fosters scientific inquiry and discussion, publicity, examines research methodology and conclusions, and interactions between data consumers and providers. It helps other researchers verify and build upon published results,

which in turn aids in examining, understanding, and protecting the data. This is all made possible through research data management services

Research data management services refers to the process of organising data from the moment it enters the study cycle until it is permanently archived after producing useful results[1]. From the perspective of another scholar, research data management services refer to a range of tools and support services which libraries offer to help researchers and faculty members in organizing, documenting, preserving their data during and after their research activities are finished. It provides all the data related support which the researchers may require through the life cycle of data, its use and reuse. It is an administrative activity which includes the functions of acquiring, validating, storing, protecting, and processing required data to ensure the accessibility, reliability, and timeliness of the data for its users[9].In essence, research data management is an integrated service which encompasses processes and activities such as data creation, data processing, data analysis, data preservation, data sharing, and data reuse.

Data creation is the process of identifying and compiling data into a usable format for sharing and reusing. This involves characterising, cleansing, improving, and storing the data. It aids data discoverability which is important for researchers to be able to reuse and share data. Research data management is a part of the data-making process. Creating and maintaining datasets is an obligation shared by all academic libraries. It has been proposed that universities can offer complete research data management services by coordinating with relevant divisions to facilitate data management and development. Data creation is mainly a task for the researchers. However, in the contexrt of research data management services, data creation is

synonymous with data acquisition or data curation whereby the librarian gather data from various sources.

In order to carry out effective data creation, librarians need to understand how researchers think about and act in relation to data generation, and what kind of training and education they require in order to effectively manage and maintain research data collections. It was underlined how crucial it is for researchers and libraries to work together to facilitate data management. In order to provide creation services to researchers, library staff should have digital producing abilities, and institutions should build and maintain strong information infrastructure to support data creation.

There are a number of crucial parts of data creation that revolve around the conceptual framework and taxonomies. Data Practices and Creation Vocabulary (DPCV) was created to better describe the many forms of data that may be created and the methods used to preserve and catalogue them. Data production should be taught in library and information science programmes, so that graduates can provide these services to their communities. Open and standardised metadata formats for datasets are needed. Data privacy and ownership are principles that libraries should be familiar with.University libraries are the backbone of education in any country. There is a consistent dispute concerning the specific type and scope of library participation with research data management operations, but studies highlight the important role of academic libraries in this process. The next phase after data creation is data processing

Data processing is the act of acquiring data and transforming it into knowledge. Research data processing entails gathering and transforming raw data into actionable insights. Data visualisation is the process of transforming raw data into a more consumable format, such as a graph, report, or chart, by either hand or using an automated tool for this purpose. Data processing is often carried out by a data scientist or team of data scientists to ensure that the final result is accurate and useful. When data is processed, information is taken from its raw form and transformed into a more consumable shape (graphs, papers, etc.) that can be understood by computers and used by researchers and other information users. Data processing is an integral part of the data management cycle and it often used to represent data analysis which is a separate process entirely

Data analysis is all about cleaning, modifying, and processing raw data to obtain useful information that may guide researchers in making the right decisions. The technique provides valuable insights and data, generally displayed in charts, graphics, tables, and graphs, that aid in lowering the risks associated with decision-making. Data analysis is a cognitive activity, whenever an individual makes a choice based on an evaluation of what has happened in the past or what will happen if we make a certain choice, we are engaging in a simple form of data analysis. Decision-making is essentially the process of looking at previous or future data and acting on that information. When talking about data analysis, the term "big data" often comes up. Information gained from analysing large data sets is invaluable.

The term "data preservation" refers to the process of ensuring that data is kept in an unaltered state. Data and metadata preservation is accomplished by organised efforts that adhere to rules and standards so that they can be used for as long as possible without compromising their

integrity. Metadata are the condensed subsets of data items; or the data about the data, while data are the pieces or units from which knowledge and information are derived. Data preservation's primary objective is to keep information safe from accidental or malicious deletion while also facilitating the data's future usage and development. By definition, data sharing is making research data accessible to other academics. Because many people believe openness and transparency to be essential to the scientific process, many organisations have rules in place addressing data sharing. Large swaths of scientific inquiry are exempt from data-sharing mandates, and many such laws have broad exemptions.

Efforts made by academic libraries to increase openness and reproducibility in the research community have led to better data management and a wider pool of shared data. Training researchers in new skills and supporting them in meeting data-related regulations and demands are two primary goals of research data management programmes offered by libraries[12]. To effectively share data, you need to allocate both time and resources to RDM, which is a significant resource in and of itself. Shared research data helps maintain the data's value by allowing others to independently evaluate and improve upon published results; this is made possible through research data management (RDM).

It was argued that university libraries and librarians play a significant role in RDM. The vast majority of librarians agreed that they should help their customers with their research data needs and work to raise their institution's profile and the influence of their research. Planning for research data services was the responsibility of librarians who provide such services.Thus, librarians should be guardians of all forms of scholarship, including data sets; the loss of data sets threatens the future of scholarship, and the library has to provide research data services in

order to maintain its relevance. Because of this paradigm shift, librarians are now playing a crucial role in data management, which was previously overlooked in favour of the more traditional emphasis on publications as the sole essential research product.

A lot of study went into figuring out what resources are necessary for managing research data. Scientists at the University of Toronto, for instance, have said they might use some help securing their data, and they also have shown a preference for straightforward software[14]. They also agreed that the university library is a great resource for learning about RDM best practises.

Establishing a strategy for managing research data and assigning responsibilities for doing so is critical. It was suggested that researchers and library personnel should work together to create anresearch data management services strategy. For instance, colleges and universities should require research data management services plans from their grantees and follow up with annual updates to the plan's requirements. These strategies are appropriate for the data that will be generated by the study and are domain-specific, reflecting best practises in the applicant's area of research. Libraries work with other major players in the research data management services ecosystem, such as the IT services department and the research support office, to create new research data management services activities and services.

In the realm of research data management services, one of the most crucial activities is the establishment of policies and guidelines. Nearly all libraries work with organisations inside and outside the institution to deliver or establish policies related to research data services, according to a survey on research data management services of directors of the Association of European Research Libraries[14]. It was stated that librarians should seek more collaboration

with academic departments, IT hubs, research offices, archival repositories, and even legal departments.

Effective research data management services regulations and procedures must be upheld for this reason. In addition, building a repository for research data is an important research data management servicesprocedure. Choosing a platform for hosting and managing the data repository within a research organisation was emphasised by the researchers. Librarians facilitate this by providing spaces to store and organise information, methods for analysing that information, and resources for interacting with like-minded people in virtual settings. Furthermore, research data management procedures involve crafting institutional policies that are relevant to the area in question.

Regulation for research data management services standards are set by governments and national funding organisations that universities and research institutes must fulfil. The Australian National Data Service (ANDS) considers institutional research data management servicespolicies and processes to be foundational to responsible RDM[15]. Research data management policies that are effective call for active curation and migration of research data throughout its lifespan, and they promote the use of a wide range of research data and original materials. Safe, reliable, and long-term stewardship of research data can only be provided by the experienced and trained professionals who work in university libraries. But this depends to a large extent on the willingness of researchers to share data.

Data sharing refers to the extent to which researchers are prepared to give out their data to others for free. Researchers in the fields of social science, natural science, engineering,

medicine and health science all have various perspectives on how research data should be managed. Tags, metadata, file naming conventions, standards, and version control systems are all areas in which they diverge and reveal varied degrees of resistance. While some researchers may be influenced by the idea of academic altruism while deciding whether or not to share their data, majority are often reluctant to share.Researchers here keep their own storage servers rather than using the data repository provided by their institutions. Within a given organisation or field, institutional support for data management varies. Institutions can be set up in a variety of ways to facilitate the administration of research data, whether it be for the organisation as a whole or for a specific field of study. There is a knowledge gap between librarians and researchers when it comes to fundamental ideas like data description utilising industry standards like Dublin core. Reaching an agreement on a uniform metadata is highly important as it facilitates data reuse

Data reuse is the practice of using data that have been reused in a previous study or studies for a newthe study. Data reuse is one of the main reason for research data management. Effective data reuse process however, demand that the proper framework be put in place to prevent misuse of data. It is not simple to automatically apply data reuse techniques due to difficulties the compiler has in identifying data reuse opportunities for some data access patterns, and this can lead to an increase in register pressure in the case of microprocessors (as we may add additional scalar variables to the code). With hardware aid, such rotating registers, data reuse efficiency may be greatly improved. In order to encourage researchers and faculty to utilise data repositories, library professionals must advocate for them, raise awareness of the

importance of research data and research data management strategies, and encourage their usage. The goal of data governance is to preserve, guarantee, and keep tabs on data quality.

Data should have the following qualities: accessibility, discoverability, trustworthiness, authenticity, acceptability, and accuracy. Libraries can make a big difference in this area by routinely checking and auditing research data for quality and by making sure the right metadata has been applied to the material. Compliance with data standards metadata and correct documenting of provenance of data are essential to effective data governance, which might vary by field of study but can be standardised via the use of guiding principles[19]. There are two types of research data management services: active and passive. It is an example of active service where libraries aid researchers in depositing data. Libraries provide passive services when they only outline data management activities and procedures and advise scholars on how to proceed.

Through a content analysis of 185 library websites, they looked at the research data management options available[20]. The research looked at four factors: services, information, education, and network, and found that libraries need to make more concerted efforts to provide research data management services, such as expanding the amount of information available on their websites and creating better educational and training programmes. When researching university libraries' data management services and programmes, the authors found wide discrepancies. Libraries in North America and Europe focus more on offering consulting services to scholars than technical seminars or practical instruction.

The team lacks the experience and knowledge to deliver the specialised data management services that are required. General and topic-specific RDM services cannot be deployed due to a lack of funding and professional human resources support21. The goal of the training is to make the library personnel competent enough to offer RDM services to the researchers. Different libraries have different data policies, and we have enlarged on what librarians need to know about intellectual property, research data, ownership, and retention. They need to be familiar with the rules of financing organisations and publishing houses. It will help them provide critical services for managing research data and ensuring researchers follow the guidelines set out by funding agencies and publications. Experts have also created pilot projects and toolkits that libraries may employ to broaden their RDM offerings.

OAI-compliant repository service that offers RDM services in fields as varied as geography, chemistry, and digital humanities through the use of a generic metadata programming interface and a generic graphical online interface. The "Data Champions" initiative[22] was just announced by Cambridge University. Data Champions are an interdisciplinary group of volunteers including researchers, supervisors, project investigators, data managers, IT pros, librarians, and data scientists. The data champions led seminars, gave presentations, provided one-on-one guidance, and contributed to the growth of the data management infrastructure. They instruct scientists on how to set up and preserve their data sets in order such that they adhere to the FAIR research principles[23].

A wide variety of data types, from statistics and experimental data to interview recordings and transcripts, are often generated over the course of research. There are several steps involved in the data lifecycle, from its conception and creation to its archiving, protection, access,

dissemination, and reuse. It also entails things like the appropriate legislative framework and the technological aptitude to implement it. Eventually, the information in these sets is archived, either in the form of hard copies or digital files, on a computer or a networked server.

The concept of research data management has gained tremendous importance in recent times. Professional bodies of information professionals such the International Federation of Library Association (IFLA) and the American College and Research Libraries (ACRL) have become champions for research data management services. Every other year, the ACRL Research Planning and Review Committee produces a report on important emerging trends which pertain to academic librarianship. The ACRL has underscored that the datasets, including the text, numeric, multimedia, social media, hypertext and hypermedia, need to be acquired and managed by the libraries

In the United States of America, there are regulations such as the one mandating researchers tosubmit a comprehensive data management strategy along with their grant proposals. Information about the types of data to be gathered during the research, the metadata standards to be used, data reusability policies and provisions, and plans for long-term data archiving are all part of the mandatory information that must be included in a proposal in accordance with the guidelines[3]. Here is where libraries and librarians may be most useful. An infrastructure of research data tools and services may be built with the help of libraries and librarians.

Research data management relies heavily on the expertise of librarians. Their work in educating researchers on the best practises for data discovery, re-use, collecting, and management led to their designation as educators. The administration of research data has

various problems that require fixing. One such problem is the difficulty of exchanging data amongst researchers, who may or may not be willing to do so. We suspect that the time-consuming nature of data documentation is to blame. Another problem is that researchers don't seem to care that much about data management because they are paid for publishing their findings. Concerns like safety and regulation also factor into the study data management procedure. In addition, practically all researchers are learning data management and curation on the job while they do their study, as not a single one of them has ever had any kind of official training in these areas. As a result, they have a limited understanding of the problem surrounding research data management and services[4]. The library's best attempts to aid in data management are hampered by the many different kinds of research and methods that are in use.

Although managing researchers' data for future use is an exciting and growing field for academic libraries, it also requires collaboration across a wide range of campus support agencies, making it a challenging endeavour. Furthermore, some have referred to research data management as the expansion of conventional services such as advising services/information literacy services to data literacy services, repository administration, metadata tagging, collection management, and data retrieval[5]. While academic libraries have traditionally played a "output" role in scholarly communication by making research resources and services available to scholars, a new "inside-out" function is emerging as a result of the pioneering work being done in the field of research data management. When it comes to university libraries, research data management unlocks the proverbial "black box" of research. Despite the research data's growing significance over the past two decades, a new study finds that librarians, especially those in less developed nations, lag significantly behind when it comes to acquiring

the necessary tools and training to effectively handle this data. Data produced throughout the study life cycle is the focus of research data management, as described by a number of researchers.

Planning, managing, processing, organising, analysing, preserving, accessing, reusing, and creating data are all part of the process. Experts are generally positive about university libraries' newfound mission to reimagine and realign their research support offerings. Improved library reputation, more educational opportunities, strengthened partnerships with researchers, and revised job descriptions are all predictable outcomes of research data management services[6]. The Association of College and Research Libraries (ACRL)'s Planning and Review Committee has identified research data management as a key development in the field of academic libraries. Open data, big data, and data management are areas that ACRL focuses on heavily. As a result, academic and research libraries are currently experiencing a paradigm shift in their services as a direct result of these data-related developments. The International Federation of Library Associations and Institutions (IFLA) Journal has also published two special issues focusing on research data management and research data management services performed by researchers and libraries. These issues also pose questions about the state of the field, the skills required to succeed, the gaps in service, and the importance of teaching people how to read and understand data.

Libraries are providing RDM support and technical services to mitigate “data dexplosion,” and support open access publishing and funder requirements. This ultimately requires the collaboration and technical support of other services departments within a campus. High perception and awareness of libraries’ roles and responsibilities relating to RDM and the

challenges for academic libraries in Jordan to provide RDM services[7]. A scholar conducted a survey to measure the attitudes and preparation of US and Canadian academic librarians toward RDM services including background, skills and education. They highlighted that librarians were considering RDM services as a part of regular library services and believed that such services will help in increasing the visibility of librarians in near future.

In an examination on the impact of research data services in academic libraries[8], Data were collected from 209 respondents in Australia, Canada, Germany, Ireland, The Netherland, New Zealand, the UK and the USA reporting RDM practices, challenges and activities[8]. The results highlighted that libraries are providing advisory and consultancy services but not technical services. They indicated that "exogenous factors could lead to a major shift in the near future, with consequences for library services".

Research Data Management is beneficial for both researchers and disciplinary progress in general. Though data management requires additional work at the beginning of a research project, it reduces difficulties and problems in the course of the project and ensures data availability after the completion of the project. The stakeholders like funding bodies, publishers, academia and industry have formulated FAIR Data principles (Findable, Accessible, Interoperable, Reusable (FAIR) research principles to guide all how to manage and maintain datasets for future use. It means that the datasets should be findable, accessible, citable and reusable by one and all[10].

An appropriate research data management system should cater to the needs of the researchers and procedures they follow in their work. It should also follow common standards. Further, the

procedures for acquiring and maintaining datasets should be automated. The use of right semantics and ontologies should facilitate timely discovery and retrieval of the required datasets. A research data management system for ensuring seamless integration of varied and legacy datasets from simulations and experiments in the field of biomedical sciences was adopted[24]. It is evident that as the scientific activities and research become more collaborative and data intensive, scientists and researchers will have serious and crucial data management needs. They will need the support system of experts, physical and computing infrastructure for data storage, archiving and ensuring integrity of data. University libraries have to play an active role in this regard. They have to implement services to attend to the full data life cycle-data management plan, digital curation, creation and addition of metadata.

Journals dedicated to publishing research data in a way that may be easily accessed, understood, reused, cited, and generally recognised as credible in the scientific community. Authors can submit their datasets to data journals for publication as a main research result. A number of free and commercial transdisciplinary repositories have been established to preserve research datasets. These includeZenodo, a repository managed by CERN. Its coverage spans the whole scientific spectrum, and researchers who are ready to publish in an open-access format can take advantage of its free data submission services. Similarly, Dryad is a database that collects and organises scientific data for a variety of uses. Each record and dataset has a corresponding article in the published literature. The data may be deposited and accessed for free on Figshare, which is accessible by anyone from any field and with any set of characteristics. It serves as a commercial archive. This indicates that there is a lack of integration across the various data stores. Because of this, it becomes increasingly difficult for humans and machines alike to find

and reuse information. Mendeley data is a public database where scientists may store and share their data. It is possible to publish datasets for public access and also to exchange them discreetly between researchers[25].

It was stated that there are too many obstacles for research data management to be a straightforward undertaking. Some websites are short-lived and have little chance of survival, while others, like university libraries, may not have the resources to keep data safe and secure over the long term. Researchers speak the language of research, not the language of libraries, which makes it more difficult for librarians and researchers to work together. More importantly, many academic libraries have difficulties due to data discrepancies and complexity. Lack of rules on good practise, poor human resources, technical obsolescence, and lack of evidence regarding best infrastructures also contribute to a wide variety of problems in digital data management. There is a significant communication gap between librarians and researchers, which is one of the key obstacles to effective RDM in Zimbabwe. It was found that libraries with well-established research data services invest in their employees by providing them with opportunity to acquire the knowledge and experience necessary to provide high-quality service. In addition, only authorised individuals were granted access to the study database to prevent unauthorised access, data loss, and data corruption. Data management plans can help researchers catalogue the information gathered throughout the course of a study. Methods to be used during the research's active phase and after it has concluded are laid out in this plan.

A lack of enough human resources to handle data whereas6 and a lack of essential knowledge, skills, and training of most data management employees have been cited as two of RDM's primary obstacles. Seminars, conferences, courses in research data services, professional

development working groups, and in-house workshops and presentations are just a few of the ways that libraries facilitate the development of expertise in research data services. There is a widespread consensus among librarians that attending relevant professional conferences, taking advantage of online resources, and gaining experience in the field is crucial for providing quality reference and discovery services (RDS). When creating data services for a campus, it is crucial to have a plan for reaching out to the college's most influential members. In light of this, libraries need to collaborate with other campus stakeholders including IT and those in charge of research on campus to present a uniform face to researchers[27].

A new era of scientific inquiry is being ushered in as a direct result of the digital revolution. Researchers all over the globe are getting enthusiastic about the expanding role of ICTs in research because it allows them to take use of advanced computers and communications systems that facilitate research activities including data collection, analysis, modelling, simulation, teamwork, and publication. Today's research environment necessitates the use of information and communication technologies (ICTs) for efficient data collection, analysis, preservation, sharing, and management, as well as access to data on a global, interdisciplinary, and multi-scale level. The Australian government claims that the proliferation of information and communication technologies (ICTs) is radically altering the research sector by establishing high-speed networks, web portals, metadata, and data repositories, all of which hold great promise for improving the generation, analysis, manipulation, sharing, and reuse of data. Data repositories, metadata, security systems, data management systems, search techniques, and community acceptability are all crucial to relational data management (RDM).

Sharing research data, forming and maintaining public-private partnerships between research institutes, and partners all need cooperation both inside and across organisations. However, RDM potential can only be realised if the numerous players involved in data production, administration, and consumption can work together to construct shared infrastructure and establish and apply optimal RDM practises. Also, the successful construction, operation, and maintenance of research data infrastructure should be ensured by excellent governance in agricultural research institutes, which would encourage collaboration inside and beyond research domains, nationally and globally. Information is critical that the new data generated by collaborative research networks in agricultural research institutes be properly managed to guarantee that it is protected, searchable, retrievable, applicable, and re-usable[28]. For the sake of minimising waste, making efficient use of existing resources, and maximising the potential impact of future research, the Australian government has called for a coordinated national strategy to fund the necessary research data infrastructure. Researchers will be able to tackle new issues in novel ways if they are able to work together effectively through agreed-upon standards and acceptable access arrangements.

Over forty years ago, the UK Data Archives was founded in Europe to maintain paper-based surveys and other data outputs, ushering in a new era in the large-scale administration of research data. The rise in digital research data and the subsequent interest in its long-term preservation, curation, and storage, with an eye toward reuse and sharing, have provided a boost to this trend[29]. The Engineering and Physical Sciences Research Council (EPSRC) on behalf of Research Councils UK established infrastructure, middleware, and documentation to promote widespread adoption of RDM30 in 2001 with funding from the United Kingdom

government under the e-Science Core Program. E-research projects are typically data-intensive, meaning they produce and make extensive use of a great deal of data, and collaborative, meaning they involve researchers from a wide variety of institutions and face transnational constraints; the e-Science Core Program funded demonstrator projects to help researchers better grasp these aspects of e-research and the immediate need to manage the data they produce. Grid-enabled refers to a system that makes use of a powerful network and aspecialised piece of software.

Together, the e-Science Core Program and the Joint Information Systems Committee (JISC) commissioned a report on the curation of e-Science data, in which the role of the Digital curation centre was emphasised along with recommendations for the development of national capacity and capability to handle RDM. Data curation, the Data Curation Centre (DCC), the Data Curation Lifecycle Model (a key recommendation in the JISC), technical infrastructure, legal issues, and human capabilities were all thrust into the spotlight thanks to RDM's prominence in the UK's e-Science Core Program and the Joint Information Systems Committee (JISC).

Data-intensive and collaborative research have emerged with the rise of digital research, prompting the formation of advisory bodies such as the National Science and Technology Council Committee (NSTCC) in the United States and the e-Infrastructure Reflection Group in the European Union to provide guidance on capability, capacity, and infrastructure in data management31. The amount spent on data management has grown as a result of these changes. In the United States, the National Science Foundation (NSF) has provided funding and cyber-infrastructure for research data curation under the DataNetprogramme. The NSF's

implementation of data management plan requirements, which have the potential to yield an efficient and effective RDM, necessitated the creation of the DataNet programme by highlighting the importance of a well-developed data management infrastructure, including the necessary hardware, skilled personnel, and policy backing. The directive from the NSF was neither the first of its kind or an isolated incident. For researchers to be in accordance with data sharing and data management procedures, the National Institutes of Health (NIH) issued the first mandate in 2003. The National Endowment for the Humanities is only one of several federal agencies that has implemented a data management plan requirement that is modelled after the NSF's[32].

In recent years, RDM services have risen in importance, especially in government organisations and universities. Despite the fact that it hasn't had national initiatives like Australia's or the UK's to build the digital infrastructure needed for e-research, there is still a rising expectation for good RDM33. The Canadian government funded the three main federal research granting council, known as the 'TriAgencies,' with the sole purpose of strengthening RDM in Canada and maintaining Canada's research excellence, in part because different aspects of digital infrastructure are operated separately at different government levels and not as part of a cohesive whole at the national and institutional levels. Canadian Institutes of Health Research (CIHR), Natural Sciences and Engineering Research Council of Canada (NSERC), and Social Sciences and Humanities Research Council of Canada (SSHRC) make up the "Tri-Agencies" (SSHRC).

The absence of a unified, national approach on RDM in Canada is highlighted by the recently released Tri-Agency Statement of Principles on Digital Data Management. The declaration

under its aegis details the agencies' broad objectives for RDM and the roles of academics, agricultural research institutes, research communities, and research funders in bolstering data management. The Canadian government further encourages and supports domestic research, research training, knowledge transfer, and innovation via its Tri-Agencies. The Canadian government and SSHRC, in line with other developed nations, argue that the TriAgencies' goal of promoting access to research results is to further knowledge, prevent research duplication and encourage reuse, maximise research benefits to Canadians, and highlight the achievements of Canadian researchers. This is significant because it shows that the Canadian government and research funders are beginning to understand the significance of research data, the benefit of encouraging the reuse of research data, and the necessity of policies to enable excellence in RDM[34].

When compared to other African countries, South Africa has been the most progressive in adopting RDM35. Several South African organisations, including research councils, institutions, and academic and research libraries, have begun RDM implementation initiatives. To help researchers find an IT solution for their work, the University of Cape Town (UCT) set up an e-Research centre; meanwhile, UNISA performed an inquiry into RDM as part of the plan to build data management[36]. There are varying degrees of preparation and rollout at the universities of Pretoria, Stellenbosch, and Witwatersrand. According to study on "Research Data Management in South Africa," several data repositories are already in place to handle this task. There's the South African National Park, the National Health Information Repository and Data Warehouse, and the Data Intensive Research Initiative of South Africa (DIRISA). One of

the programmes in place to spread awareness about RDM throughout the country is called DIRISA.

While efforts to promote RDM in Kenya are minimal at best, they have been made, particularly in the health and migration sectors38. While there is a fair amount of migration data stored in various Kenyan organisations, it is not being properly organised, shared, analysed, or disseminated. Access to and use of migration data is hampered by the fact that many government and public institutions lack the ability, resources, and facilities necessary for its collection, analysis, use and reuse, and sharing. Even if progress is slow, Kenya's health industry is beginning to embrace the sharing of research data. Clinical vaccination trials against malaria and HIV/AIDS might benefit greatly from access to shared research data, highlighting the need of data sharing across health researchers in Kenya. While the concept of sharing health research data is being discussed, it has not been widely accepted. To promote the deployment of resources, including qualified persons and technological infrastructure for data management[39], the World Agroforestry Centre in Kenya provided RDM training for agroforestry research scientists. By developing a training handbook for RDM, the World Agroforestry Centre has taken a giant leap toward mainstreaming RDM in the agricultural industry.

Scholars' evaluation of RDM in Kenya revealed that many organisations, and especially agricultural research institutes, possess vast amounts of valuable research data that must be managed properly to advance the institutes' mission, boost agricultural productivity, and guarantee the nation's food security by 2040. Researchers and other stakeholders in Kenya's agriculture sector have challenges gaining access to agricultural research data due to the

country's inadequate institutional capacities, legislative framework, physical infrastructure, and RDM initiatives. The Kenya Agricultural Information Network (KAINet) was set up, however, to improve the distribution, exposure, and accessibility of agricultural-related material in Kenya.

2.1.2 Overview of Data Literacy

Data has risen to prominence as this new currency for linking people and ideas. A new type of research that relies heavily on large datasets is manifestly on the rise. Text, numbers, photos, video or movies, music, software, algorithms, equations, animations, models, simulations, and so on are all examples of data. A wide range of data types, including observational, computational, and experimental, are available. The product of any scientific inquiry that use the methods of observation, experimentation, or the verification of a hypothesis is research data. In addition to the big data phenomena, other sources of data include works of art, literature, and cultural heritage objects. The ability to explore, combine, and cross-reference massive data sets referred to as big data, has become essential for researchers and information professionals. The complex nature of data has given rise to the concept of data literacy.

The term Literacy became associated with dealing with data because massive societal shifts are occurring as a result of individuals producing and interacting with data. This is one of the reasons why academics say computer science should be seen as a distinct field from data literacy when defining the latter. There are many opportunities in today's hyper-connected world, where massive volumes of data are generated every second, to improve society via

better use of information, speed up decision-making, increase openness and diversity in government, and so on. In addition, data's nature has evolved through time, with data being more accessible (albeit not completely), and data science dealing with societal problems and working for social good, both of which increase data's visibility in the public eye.

Consequently, it is accurate to argue that data literacy as a concept is becoming popular due to the growing significance and power of data and its ever-widening influence on both institutions and individuals. Literacy in the use of data is taken for granted in this context, since it is a means of engaging with our increasingly data-centric society. The ability to understand what's going on is only one part of the answer for individuals to protect themselves from the dangers of living in a data-driven society, and it can provide people more agency when working with and understanding data.

Defining who is data literate (teacher) is difficult, as their research showed, and previous inquiries into the topic have attempted to do so. This may seem like a simple question, but answering it will help define what data literacy is and what it looks like for different people. Academics have pondered the question of what it means to be "data literate," and they have come to the conclusion that there is no consensus.

Therefore, the skills and knowledge required to be data literate are affected by how we define and perceive data literacy. It has been noted that there is no agreed-upon definition of "data literacy," and that this lack of consensus persists even when attempting to specify the necessary abilities and knowledge. Data literacy is defined in a variety of ways depending on the source. Some describe it in terms of sophisticated and technical abilities, while others combine

fundamental skills with soft skills like critical thinking and questioning data. However, the task of defining data literacy can be eased by going back to the origin of information literacy.

The concept of data literacy emanated from information literacy. The commonly recognised and extensively used definition of information literacy includes the ability to detect information need, identify, search, assess, and apply information to address a specific problem, hence it is evident that these can also be applied to the concept of data literacy.Different emphasis is placed on information literacy in the newly created Framework for Information Literacy for Higher Education. A paragraph from the Framework reads: information literacy is the ability to recognize that information may be viewed differently dependent on the format in which it is packed." This remark might be read as an implicit admission that information literacy is also relevant in the realm of data.

One researcher found a number of different ideas and names that are used for defining this notion, and they voted for the usage of the term "data literacy" to be used as the unifying term. Literacies in data information, scientific data, and research data are all distinct from one another. Skills and competencies are found beyond the realm of definitions. The enumerated abilities include both broad ones and narrow ones. The first set consists of such abilities as spotting improper data usage and deriving the right conclusions from data. Appropriate chart and graph reading skills are displayed by the second set. More recent works appear to concentrate on transferable abilities that are also essential to information literacy[60].

Data literacy is defined as the ability to get access to, understand, evaluate critically, manage, handle, and responsibly apply data. This definition goes much beyond the ones given

previously since the word "managing" in it includes conservation and curation. According to the Association of College and Research Libraries (ACRL), data literacy entails not only familiarity with where to look for needed data but also an appreciation for the importance of considering such factors as the author and version of a dataset, as well as the ethical and legal implications of how that data is used. Information professionals that can effectively search, filter, analyse, create, and synthesise large amounts of data are considered "data literate."

People who are data literate may effectively gather relevant data, analyse it, and draw conclusions by integrating it with other data sets and their own background knowledge. They must be able to assess the quality of source data and have a working knowledge of the various data formats. Another authority submitted that literacy in the use of data include the ability to locate, retrieve, sort, analyse, summarise, and evaluate data. Since they are unique, no other lists cover the last two talents, which makes them all the more noteworthy. The capacity to adapt one's level of data literacy for a variety of purposes, including the formulation of hypotheses, the identification of issues, the interpretation of data, and the determination, planning, implementation, and monitoring of courses of action, are all necessary abilities. This literacy transcends both traditional discipline boundaries and the hierarchical systems of academic libraries61 in its emphasis on ownership and rights problems[65]. Data literacy, unlike information literacy, can be context specific.

This means that the scope of skills an individual is expected to have in dealing with data depends on their role in the data life cycle. For instance, a librarians is expected to have a wider or high level of data literacy than an information users reading to simply gain knowledge. The primary motivation for incorporating libraries and librarians into data-intensive research is

to give assistance that streamlines the process. Achieving good research data management is a comparable objective to data literacy. Librarians are expected to acquire competencies in all aspect relating to data creation, organisation,, preservation and dissemination. In addition, academic libraries are expected to provide services like data literacy instruction in the future. There is a recognition that experts are needed who will be conversant with all aspect of research data management, allowing data users to focus on their areas of strength.

To urther illustratethis point, it was reported that businesses are now seeking for data librarians to fill the job of data managers and data literacy instructors[62]. Those who will be putting the data to use are the primary focus of data literacy initiatives, since they are the ones who will benefit most from training in the proper use of the data. Researchers, particularly master's and doctorate students, have a tough time getting the training they need to become data literate scientists because of this. Experts have therefore emphases the need to supplement scientists' traditional education with lessons in data literacy if we want to foster an environment conducive to the development of a culture of "semantic researchers," or scientists who can effectively and efficiently approach research data.

Teaching students at both the undergraduate and graduate levels how to effectively utilise data resources is a must. This means that students who don't go on to get higher degrees still benefit from developing their data literacy abilities. In fact, a professor gave a presentation in 2004 detailing the implementation of a data literacy course into the human geography curriculum at the University of Winnipeg. Undergraduates at the University of California, Los Angeles participated in a pilot data literacy course that focused on issues and methods in sociological research. According to RECODE's (2015) suggestions, the library is where researchers should

first look for opportunities to learn new skills and become more knowledgeable about their field. Libraries might play an even larger part in encouraging citizen participation in scientific endeavours by serving as community gathering places for scientists. The Library at the Hong Kong University of Science and Technology offers a course focused on information literacy with a focus on socioeconomic data. The goals of this course are to help students understand the nature of socioeconomic data by comparing it to other scientific data, with which they are more familiar, and to assist them in data-collection, evaluation, and dissemination.

Recently, the long-term partnership between a librarian and an instructor to create two data literacy workshops to support student learning in the biological sciences across two second-year courses was reported. The study of a data literacy education programme at Purdue University's College of Agriculture shows that as data management and curation become more standard in academic work, the demand for such programmes will rise. A data literate data librarian is more equipped to help scholars in their field. Even if there are two distinct audiences, researchers and librarians, it is challenging and frequently unnecessary to treat their data literacy needs independently.

It has been noted by a scholar that librarians' knowledge in the areas of collection formation, information organisation, resource finding, repository administration, and digital preservation are invaluable. These lay the groundwork for libraries to assist researchers in producing higher quality outputs, such as more actionable data, and to take part in the pre-publication phase of research[49]. In addition, libraries have always had a reputation for housing reliable information. In offering audits and verification services for data quality, they will play a pivotal role as data quality centres serving the needs of the research community. Since libraries are responsible for

the preservation of written works, another line of reasoning was recognised. Despite this reality, librarians were not traditionally involved in literacy instruction. However, data is unique in that it needs specialised reading abilities, which librarians may need to impart to users in order to aid them in making sense of it. The concept that libraries and librarians can take the lead in the use of data resources is still prevalent in the present day, even in 2014.

Data literacy may be approached from several angles, as one might expect and as the example of information literacy illustrates. Being data literate necessitates the capacity to obtain, analyse, alter, synthesise, and display data, whereas information literacy requires just that we know how to find and use relevant information without having to rely on unfounded or incorrect assumptions. Being able to comprehend, work with, and responsibly handle (scientific) data is what we mean when we talk about data literacy. To put it simply, data literacy is "the capacity to comprehend and employ data effectively in informing decisions." However, this definition suggests that data literacy is a set of skills and body of knowledge that allows us to transform data into information and, ultimately, into actionable knowledge, which includes developing hypotheses, identifying problems, interpreting the data, determining, planning, implementing, and monitoring courses of action[55].

There are many frameworks for data literacy skills and competencies, but one prominent source is a scholarly report titled "\ Twenty-three data literacy competencies (and sixty-four associated skills, knowledge, and activities) under five key categories, including Conceptual framework, Data Collection, Data Management, Data Evaluation, and Data Application, were mapped out in the report68 after an examination of multiple sources. In addition to this document, we will also make use of Databilities (Data to the People), a data literacy

competence framework created by a commercial firm and including the practitioner's report. These two books together give a comprehensive, though not thorough, synthesis of the literature and shape the aforementioned capabilities, therefore they will serve as a guide throughout this chapter.

It's important to keep in mind that the aforementioned abilities are by no means an entire list, and that as data continues to evolve, there will very certainly be new domains in which further abilities will be needed. Our next goal will be to examine how DLSC are currently defined and discussed in the literature. This thesis will synthesise the definitions and explanations found in the academic literature in order to comprehend DLSC, and it will provide some examples from the field (practise) for each skill, in order to help readers conceptualise what it means to be data literate and to serve as a bridge to the thesis's main research question.

Since data visualisation and data translation are frequently useful methods for communicating via data, a wide variety of tools and expertise are available in these areas. Comparison of song lyrics and network visualisation using gummy bears are two examples of these straightforward approaches. Some of these techniques don't even need access to the internet, yet are nevertheless effective for learning the fundamentals of visualisation. Structured query language (SQL), relational databases, and Google Charts are examples of programmes and tools that need skill or at least a very excellent command of data[78]. Knowledge and skill with such programmes are contributed to data literacy to some level, despite their more common usage in more sophisticated situations, such as by data scientists or developers.

Raw data, main data, secondary data, and many additional categories originating from other fields make up only a few examples of the many different types and classifications of data that exist. It's been said that "everything is data," meaning that data may be generated from anything. It is considered that a brief explanation of these data categories can aid in conceptualising data literacy and other factors like skills and competences. On a side note, digitalization is not required for this kind of information, but it is becoming crucial in the Internet Age. For simplicity's sake, let's call any information included in a file or record "structured data" and say that its length is always the same. Five percent of the world's data is in this form, which can be read and understood by computers. Information like phone numbers, genders, currencies, and dates can be found in databases, spreadsheets, and web and server logs. Any information that cannot be reduced to a simple numerical value, such as that found in tables and charts, falls under this category. Semi-structured: This information is not strictly organised, but it is also not completely unstructured. There's a chance that some of the fields are blank or include data that defies conventional database categorization. As an example of this sort of data, consider hashtags (#), which are used to label images shared on social media platforms and which can serve as useful metadata for other data.[57].

Unstructured data is“everything else” and generated from an increasing number of sources such as internet clicks, mobile transactions and social media, and is often used for user analysis[58]. Online unstructured data includes images, videos, tweets, emails and so on. Most data is in this form, which is not “readily amenable for automated analysis”. Starting with the rise of Web 2.0, which is people-centric and enables people build online connections, this type of data has now become the main source to profile and understand user behaviour, and because

of this raised many concerns about privacy and ethical data usage. Depending on the characteristics, there are various types of data can be defined as well such as open data, small data, linked data, big data and so on. These types will not be explained in-depth, however it would be ignorant not to mention them when discussing data types. Overall, as the comparison of various definitions shows, data can encapsulate a very wide scope of concepts however, for the purposes of this thesis, data will be referred to what was defined under this chapter, that is to say, not equal to information and consists of the aforementioned three types.

Data made its first appearance on the stage of history in 18.000 BCE in Uganda, to manage the storage of food and supplies. Later on, the first statistical data analysis was recorded for an early warning system in 1633 and the world's first data centre was planted in 1965[64]. But data started to gain popularity in earnest after the emergence of the internet and digitalization, that have drastically changed the ways data is created and collected. This influx of data evidently brought about the socalled "data revolution" which is defined by the UN as "a world in which data is bigger, faster and more detailed than ever before". This acceleration has changed many areas in society from communication to transportation as almost every action has a digital interface that interacts with the internet. For instance, traffic lights and other sensors can help to predict the vehicle intensity of rush hours and such data can give insights into which solutions should be developed in order to prevent traffic jams.

Data visualization which is considered to be "rich" aspect of data, is complementary, if not indispensable aspect of data literacy as it makes realizing the structure and potential patterns in datasets easier and apparent[79]. An importance concept at this point is to know data does not always tell the truth, as data visualizations can be manipulated and misleading. An example

from US elections makes a stunning analysis of this case. In his work, he shows how simplifying visualizations can be deceptive, although the data that is visualized is not necessarily incorrect. Overall, while looking at any type of data visualization, or when creating one, accuracy and trustworthiness should be paid attention explicitly by data-literate individuals. When talking about data visualization, data storytelling has to be mentioned as it is getting more and more attention, particularly in the journalism area with newspapers utilizing data in various ways to their news.

Data storytelling often refers to data visualizations that are embedded in a narrative, which tells a story through data in question[80]. Yet, one point should be clarified: data storytelling is not simply about making charts and graphs and adding a bit of text next to it. There is more to it, such as communicating through that data and even mixing it with art. In this regard, data storytelling might require a combination of skills besides being able to work with/ visualize data such as contextualizing data, and to some extent design and narrating skills. But in essence, it is about informing data visualizations about the story that is to be told, giving them context in order to "back-up the facts" and clearly highlight a message in order to avoid ubiquity. After all, it will be accurate to claim data storytelling means to be able to present data with its context and being able to clearly state what the data in question tells. Another competency under this section is data analysis, which listed as one of the main parts of data literacy by many. Although this is the situation, to what extent data analysing is needed in data literacy remains unclear. Analyze them(data) in keeping with the results sought and know how to use the necessary tools". This aspect of data literacy is very prominent in job markets, as it is widely used to support businesses. Another area where data analytics plays an essential role in

tackling fake news and misinformation, as comparing statistics, eliminating data in question and reanalysing data are widely-used in such cases. As can be seen, data analytics occupy a wide-space in the digital era and yet the question "to what level of data analytics needed to becoming data literate?" remains unanswered but a researcher claims that data analysis requires literacy in statistics in order to see possible correlations and causations among elements.

Data-driven decision making (also known as data-based decision making) is where data literacy is put into action and data is implemented, meaning that data is turned into information, then knowledge and finally, a decision is made accordingly in the end[81]. But these two do not necessarily constitute each other: A decision based on data can be made without being data literate and data literacy does not necessarily lead to DDDM. In other words, individuals can be passively data literate meaning that their data analysis or data interpreting skills are unactionable.

DDDM is a systematic approach and their definition is comprised of four steps: It starts with" analysing data and evaluating the results", then these analyses are used for "setting goals" that aim to be achieved through data usage. After setting goals, a "strategy" is determined in order to accomplish these goals and lastly, the chosen strategy is "implemented and executed". Moreover, during DDDM data is also used in order to monitor and evaluate the effectiveness and outcomes of the whole process DDDM process requires certain data literacy skills namely "collecting, organizing, analysing, summarizing, synthesising and prioritizing data". Therefore, data is used for informing decisions through an individual's data literacy skills, it helps to

provide a roadmap towards, and it should not be used merely to seek confirmation of what is already believed.

Although this should be the case for individuals, it should be added that replacing algorithms as decision-makers is a phenomenal concept. Private and public entities rely on predictive algorithmic assessments to make important decisions about individuals[82]. There may be many benefits to authorizing algorithms to make decisions, however this introduces many pitfalls including "diminishing variety, social discrimination, abuse of market power and loss of human sovereignty". While keeping in mind these risks, let's now move on to the next chapter where we will bridge the aforementioned issues with critical thinking.

Data application can be claimed to be more about the "practical" aspect of data which is strongly connected to DDDM as it constitutes evaluating the decisions based on data. Therefore, applying data can be interpreted as "... translating data into actionable, instructional or administrative practice"[83].

When applying data, one of the elements which draws more attention due to extensive use of data is the ethics of data[84]. Data ethics has originally roots in "computer and information ethics", there is now a shift in ethical data for all kind of types and this shift brings ethical challenges that can be classified in three areas. "The ethics of data including big and open data (generation, analysis, recording, sharing, privacy, transparency)" "The ethics of algorithms (including artificial intelligence and agents, machine learning)" "The ethics of practices (Responsibilities and liabilities of people and organizations, strategies, policies, professional codes, consent, user privacy, secondary use)" Online personal data, for instance, leads to a

heated debate over the good versus the evil usage of data, when connected with online privacy and data ethics. By the rise of online platforms, the evil usage of this type of data has drawn more attention, particularly on the issues with platform mechanisms such as user agency, usergenerated content and dataveillance, where personal online data is used to predict people and their behaviours.

This aspect of data literacy will be discussed in-depth later, but it should be mentioned that there is a bigger problem with this aspect of data that goes beyond individuals' data literacy levels and makes a bigger maze of problems regarding "collection", "processing", "dissemination" and "invasion"[85]. There are some initiatives that create guidelines regarding data values and principles for data teams (especially for data experts) that can be helpful to decide ethical lines while working with data which includes considering carefully the ethical implications of choices that are made when using data, and the impacts of the work on individuals and society as well as behaving ethically and transparently and being accountable.

Moving on from ethics of data, here comes critical thinking which can be identified as a complementary and the inevitable aspect of data literacy. Critical thinking can be defined as "to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based.". This crucial role of critical thinking led to a growing literature on "critical data studies" as well as breeding variations in the definition of data literacy. In this case, the term "critical data literacy", which embeds being critical in every element of data literacy[86]. In their aspect, data-literate individuals do not read data as an objective fact, instead, they consider the social process of it

while communicating data (which includes understanding the message data has and finding better matches between data types).

A human being decides what is excellent and bad, what data is "worth" gathering, and so on87; this is the source of the inherent bias in all (large) data. Since people are responsible for creating, designing, and programming both datasets and algorithms, it stands to reason that they are not without flaw or prejudice. Incomplete or distorted knowledge of problems, followed by inefficient or worse, incorrect actions, can result from biases in datasets, especially when it comes to aspects like gender and ethnicity. We see that critical thinking is important to data literacy because it helps people "identify, define, enumerate, analyse, list, and self-correct" while working with data and avoiding the dangers associated with assigning data for decision-making[87]. Increases in digitalization are challenging traditional ways of thinking, such as the divisions between humans, machines, and nature. Given the circumstances, the ability to think critically distinguishes a human who can work with data from a computer programme that can do the same work. Therefore, critical thinking should be at the centre of data literacy (at all scales), protecting individuals from the pitfalls of biassed data and facilitating more wise decision-making[88].

Education for data literacy include not just students, but also teachers and school administrators. It also include academics, librarians, and policymakers in the field of education. A data-literate education emphasises data-driven decision making and the application of data to "real-world issues" via data manipulation, questioning data, cleaning and organising data, and statistical analysis. From the perspective of the classroom educator, the "data" in data literacy education is comprised of student achievement data; thus, data-literate educators are those who

utilise student assessment data to tailor curricula to the individual needs of their students, as well as to evaluate and inform their own teaching methods and strategies. Knowledge and abilities to "summarise and interpret data, identify patterns and trends, communicate inferences and conclusions" are only a few examples of what is required of teachers who are data literate. What matters now is that educators aren't making decisions based on instinct alone. Teachers can't evolve into "more than simply an opinion" if they don't have access to evidence to back up their judgments. Without multidisciplinary cooperation and multi-stakeholder methods, including governors and school principals, data literacy cannot be integrated into education systems and will remain a passing fad[89].

Critical thinking skills that help students prioritise information and "combine various bits of information into a broad picture of the world" should be at the heart of any curriculum aimed at fostering data literacy. There are two main components of data literacy training: The first section focuses on students' time spent online, which is crucial because students are too young to give consent, but their data can have long-lasting consequences in the form of personalised content, online surveillance and manipulation, and other forms of discrimination and classification. When it comes to this kind of data, it's important to teach students about the ethics of data collection and usage, as well as who collects and owns it, what it's used for, digital footprints, and more. Second, in a data-driven future, when not just technical skills but also problem-solving and computational thinking will be indispensable, today's students will one day be the workforce[90]. In this light, it is important that students acquire, via hands-on and experiential learning, the skills and knowledge necessary to deal with data(sets), statistics, and fundamental data analysis. Engaging with data actively and "by doing" will first aid in

internalising learning and using the DLSC in practise. The fact that all of these people (citizens, workers, users) must go through schooling highlights the centrality of education in fostering a culture of data literacy in a given country. Just as knowledge is vital to freedom and independence, so too is access to information.

2.2. Theoretical Review and Framework

2.2.1 Research Data Life Cycle

This is a model that illustrates the stages of data management and describes how data flow through a research project from start to finish91. Data management refers to the process of deciding and documenting how data will be collected organized, stored and shared as given in figure 1 below;

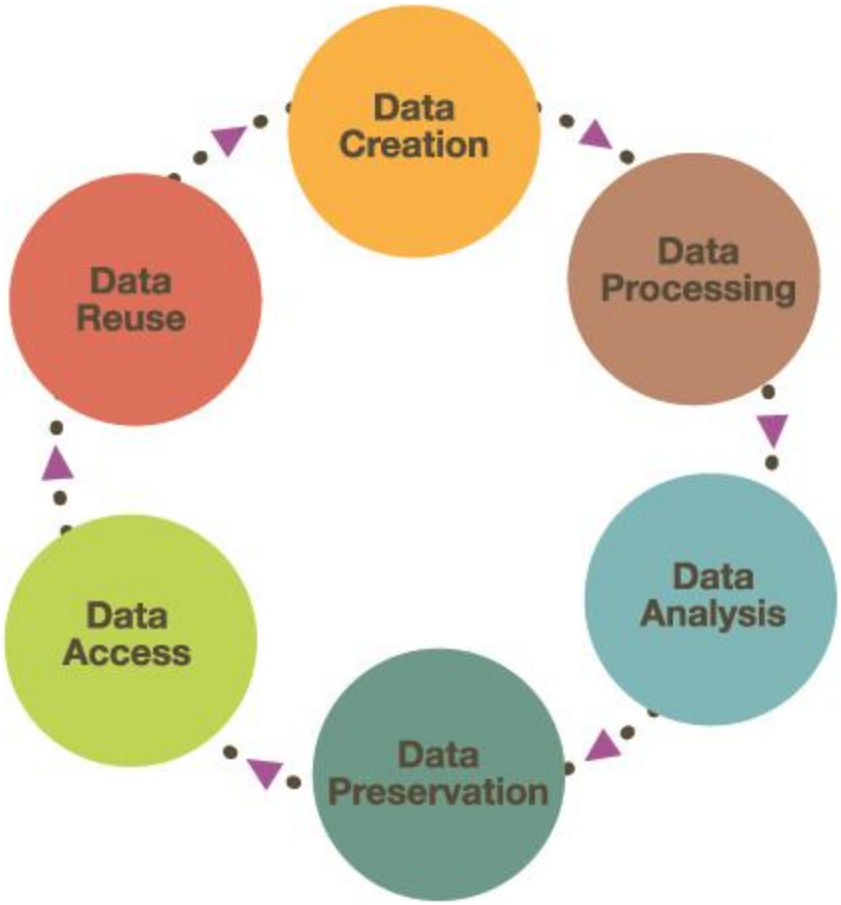

Figure 2.1: Research Data Life Cycle by J. Ridsdale.

Data creation include deciding what information is needed to answer a research question, deciding how that information will be gathered, and making a strategy for how that information will be managed over the course of the project's lifespan. A data management strategy is developed at this point. As part of the application process for public research funding, many organisations need a data management strategy. Here, we do experiments, make observations, conduct surveys, gather secondary materials, etc. Instruments and procedures used to gather

data, as well as background knowledge required to make sense of the data, will need to be documented.

Data processing is the process of transforming raw data into a form that can be used. Methods for this include data validation and quality control, data transformation (such as format conversion), and data cleaning to remove unwanted elements. It will be necessary to record the steps used to process the data so that the final result can be reproduced using the original data.

Research outputs, such as written summaries or digital repositories, are the products of the study process, while data analysis is the phase in which the research's raw materials are probed to yield insights that form the research's results. Data analysis and visualisation code may need to be archived and made publicly available to back up study findings, and tools used for analysis should be recorded.

*Data Preserving***:** As researchers round up their studies, they often set aside any relevant data that may be used to back up their conclusions in the future. For data to be kept for the long term, it must be formatted appropriately and stored safely. This usually entails submitting the digital files to a data centre or repository. Data quality assurance, file format conversion, metadata record development, Digital Object Identifier (DOI) assignment, licencing datasets for reuse, and implementing necessary access restrictions are all examples of preservation tasks. When dealing with sensitive information, whether digital or not, it is important to have a responsible individual or team in charge of its safekeeping.

Publications relying on data should provide a data reference or a statement about how and where the data may be obtained. Through the publication of metadata on the internet, a data

repository makes the data under its care discoverable, and grants access to the data when permission is granted. Data may be made publicly available or, if the data are particularly sensitive or secret, access may be restricted. It is important to organise data in a way that allows others to find and request access to it, whether it is stored locally or in a secure place.

Data re-use refers to the practise of re-examining previously collected information for the purpose of verifying or expanding upon previously established conclusions. Eventually, the information gathered at this stage may serve as raw materials for use in a subsequent study cycle. It's possible that research data might be useful in other contexts as well, such as policymaking, commercial product/service creation, and education. This approach is useful for our investigation since it provides a systematic breakdown of how to store and organise data for later usage.

2.2.2 Data Literacy Skills and Competency Model

The data literacy skills and competency model was developed by Ridsdale et. al. in 2015.The model was developed by critically assessing thirty-two sources of information on data literacy and identifying key themes that they embodied[92]. The initial model extracted twenty-three data literacy competences and sixty-four related skills, knowledge, and tasks out in the report.After an in-depth analysis of a wide variety of sources fell into five broad categories. These are; conceptual framework; data collection; data management; data evaluation; and data application (see figure 2). The key concepts are discussed as they relate to this study

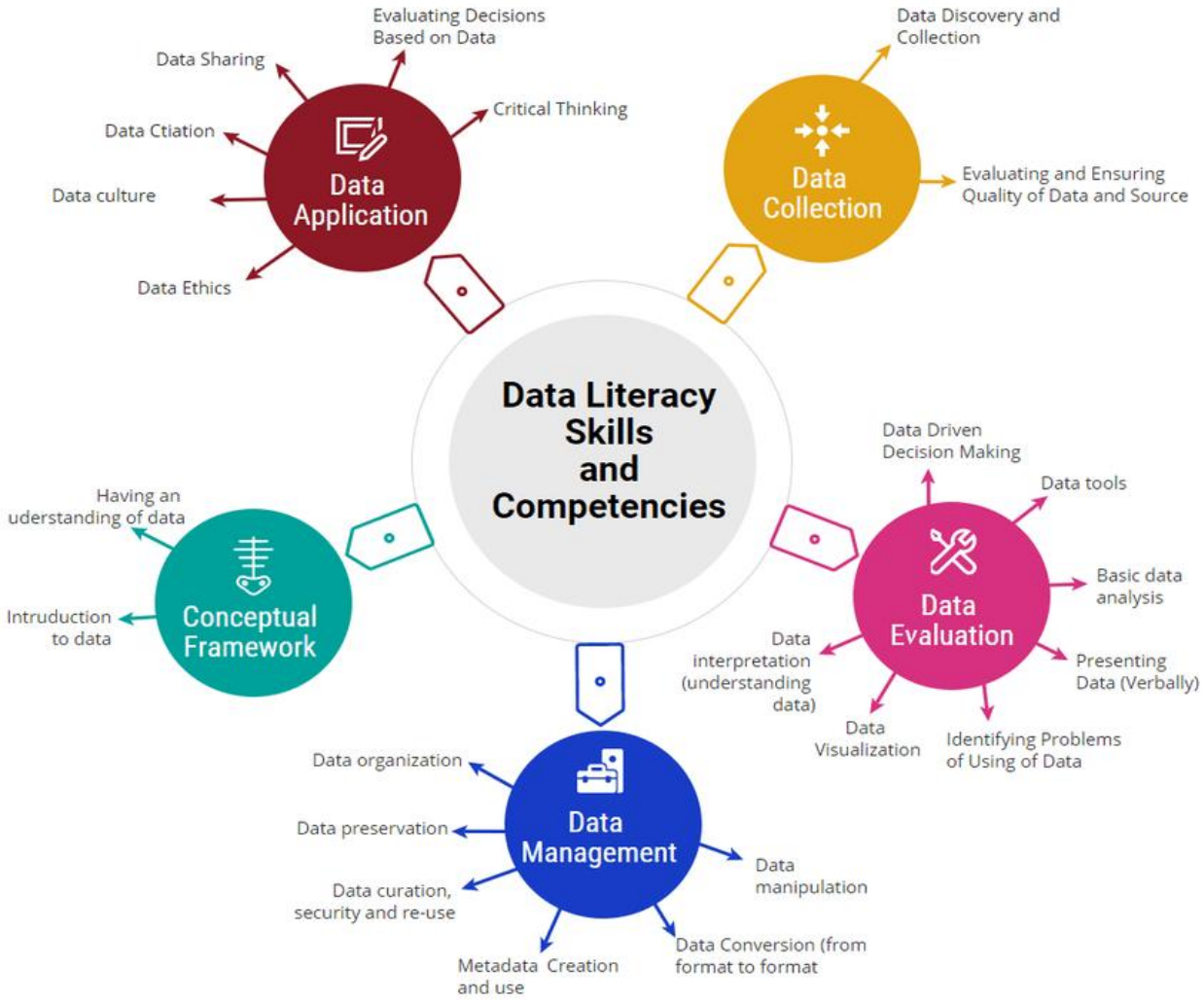

Figure 2.2: Schematic Representation of Data Literacy Skills and Competencies.

Introduction to Data and Conceptualization Understanding what data is, its significance in society, and how shifting definitions can affect data collecting and spark new debates is the first step toward being data literate. In order to better understand the data at hand, it is recommended that "data biographies" be created, which would explain who gathered the data, why it was collected, what it was used for, and what constraints are now understood to exist.

At this stage, it is crucial to be cognizant of the relationship between data and society, including how and by whom it is created, its potential uses, and the ramifications of its usage. This is only one piece of the puzzle; comprehending data also necessitates familiarity with data's many forms, its history, its sources, its collecting techniques, and the many creative ways it may be put to use.

Who owns the data has a significant impact on the power-relationships that determine prejudices and inequities, and yet this is one of the less-emphasized topics. After all, having the desire and curiosity to learn more about data—the first step toward being data literate—can be attributed to asking the questions discussed in this chapter and having the knowledge and understanding of data. It's now obvious that those who are data literate are able to go further along the data literacy spectrum, while those who aren't will only "memorise" data chores rather than confidently using their abilities in real-world situations.

Data collecting is a subset of data discovery and collection that involves checking the authenticity of the sources used to acquire data and ensuring that it is of sufficient quality, relevance, and validity. Data can answer many questions, but only those it has records and relevant variables on, so it's important to know why you're collecting it before you start. Thus, guiding individuals through data and giving them agency in the future requires making explicit the aim of data collection before to collection, understanding what relevant data is, where to get it, and critically evaluating the data source where it is obtained.

Accessibility has become crucial in data gathering as a lack of it is typically the result of inadequate technical and organisational infrastructure. As a result, having access to data is

highly dependent on macrostructures as well as individual talents and abilities. The use of data depends on its discoverability and accessibility, both for people and for groups working together. There is a wide range of approaches to data gathering, from the very simple (such as jotting down the shapes of various fruits) to the really complicated (which may involve expertise with software or an in-depth understanding of statistics and mathematics). It is now obvious that there is no way to define the concept of "data collecting," and therefore overarching statements about this topic are bound to misunderstanding.

It's fair to argue that no matter the amount or kind of data, accuracy is vital since it illuminates problems and helps to develop an action plan or remedy. Working knowledge of "data correctness, appropriateness, and completeness," and the ability to identify and retrieve data, are crucial for ensuring the validity of inferences generated from acquired data. Even though anybody may be a data collector, the fact that most data in the modern era is gathered and collected digitally adds a new dimension to the process.

Persons whose information is being collected should be informed of the data sources, the methods used to gather it, and the potential outcomes of such an undertaking. However, it's important to note that automated data collecting is not always concerned with private information. Data gathering is facilitated in part by sensors; this data is typically collected anonymously or with the purpose of documenting specific behaviours, innovations, recognising trends, and/or preparing for the future, as is the case in a "Smart City" setting. The growth of "open governments" means that governments are more willing to disclose such data (which is typically anonymous and acquired automatically) so that it may be put to better use. There are also worries regarding privacy in relation to data collecting inside smart cities and

governments, especially when the word "surveillance" is used. Aware of privacy concerns and legal constraints, as well as knowing how to query this data and where to find it, is essential for anyone planning to work with such data, despite the fact that legislation like the EU regulations regarding the processing of personal data, known as General Data Protection Regulation (GDPR), tries to cover these concerns.

Data management occurs either after (or concurrently with) data collection or acquisition. The term "data management literacy," which is more closely aligned with big data and places an emphasis on the importance of the data lifecycle while managing data, exemplifies the breadth of its applicability. Data conversion, metadata (and types of metadata), and metadata use are all examples of the kinds of IT and CS knowledge that are necessary for this subfield of data literacy. With the advent of free access to data, data management is becoming a buzzword even among non-IT organisations, such as librarians, educators, and academics. The New England Collaborative Data Management Curriculum (NECDMC) is one such curriculum that aims to educate people on the ins and outs of data management by covering topics including data kinds, forms, and phases, data contextualization, data storage and security, data archiving, and data presentation.

Scholars consider "management of data quality" to be a more sophisticated concept than "data management" since it encompasses not just the administration of data but also its quality and correctness. With the growing interest in both personal data and online data security brought on by the popularity of cloud computing, it is essential that the "securing data" section of "data management" receives the attention it deserves. The fundamental idea of privacy is in danger, therefore people need to know their options for protecting their personal information,

especially online. Owners of data, on the other hand, have an obligation to ensure data is managed securely for the sake of their data's veracity and their rights to privacy and other legitimate interests. You might say that data management is a vague term, the precise meaning of which is still up for debate. But you'll need technical expertise, software know-how, a solid data grasp, and savvy digital navigation abilities to get it out.

Data Evaluation: To evaluate data, one must first be able to interpret it and grasp its significance. Although it is easier to effectively evaluate data when background information is available, being data literate also entails being able to construct hypotheses accordingly and uncover relationships that are not immediately obvious. Under "interpreting and comprehending data," Databilities (Data to the People) places special emphasis on visual features of data, such as the ability to grasp tables, graphs, and charts, all of which need statistical and mathematical knowledge. Understanding data, however, requires more than just a head for numbers; it also necessitates the ability to inquire about the data's provenance, the rationale behind the chosen method of data visualisation, the availability of alternative indicators, the applicability of the selected indicators, and so on. *Data cleaning*, or the "detection and removal of mistakes and inconsistencies from data in order to improve the quality of data," is a common step in the review process that should be taken before actually working with the data. One may argue that several levels of "data cleansing" exist. Cleaning data might involve sifting through it, filtering out the information that isn't relevant, and verifying the reliability of data sources. Data Journalism's lesson provides a useful illustration of data cleansing by removing extraneous information from a sample (in this case, identifying donors to political campaigns and the amounts they contributed).

Data Visualisation: Because it makes the structure and possible patterns in datasets more obvious, data visualisation is an ancillary, if not essential, part of data literacy. Realizing that data does not always reveal the truth, especially when presented visually, is a crucial idea right now. A spectacular study of this problem is provided by an example from US elections. His study demonstrates how misleading oversimplification of visualisations may be, even if the data itself is true. Overall, data-literate people should pay special attention to accuracy and trustworthiness while examining any data visualisation or making one of their own. Because of its growing prominence, data storytelling must be included in any discussion of data visualisation. This is especially true in the realm of journalism, where data is increasingly being incorporated into the news in a variety of forms.

Data evaluation is at the heart of data-driven decision making (DDDM), and one could argue that data application is more concerned with the "practical" side of data. Thus, "translating data into practical, educational or administrative practise" might be a definition of "data application."

The ethics of data collection and usage have recently come to the forefront of discussions about data applications. While the term "data ethics" may have originated in the context of "computer and information ethics," the proliferation of different kinds of data has resulted in new ethical concerns. Data ethics, encompassing the production, analysis, recording, sharing, privacy, and openness of both large and open data. "Algorithm ethics" (encompassing AI, agents, and ML) "The Ethics of Practices" (Corporate and Individual Accountability, Risk Management, Policy

and Procedure, Professional Standards, Consent, User Privacy, and Secondary Use) When it comes to internet privacy and data ethics, for example, personal data may spark a passionate discussion about the good and bad uses of data. The proliferation of online platforms has increased awareness of the pernicious potential of this data, particularly concerning the problems that might arise when users' online activities are monitored in order to make predictions about them.

2.3 Review of Empirical Studies

2.3.1 Data Literacy and Research Data Management Services

Researchers in the field of library and information science have long held that the task of managing research data should rest on librarians due to the competencies they have developed in managing various types of information resources. However, others have highlight the need for librarians in charge of data management to exhibit the right level of competence in managing the research data. Researchers in South Africa examined the readiness of academic libraries in Southern Africa to offer services related to the management of research data. The study's goal was to assess the level of preparedness of academic and research libraries to take the lead and actively participate in research data management services. Fifty-nine university librarians and library directors from academic libraries in Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe were given a questionnaire to fill out. These findings highlight the fact that the development of services for managing research data is still in its infancy, with different nations and institutions at varying degrees of preparedness for service provision and some countries and institutions not yet ready to

implement any services at all. Only a few of organisations either have policies in place or are making plans to do so.

The findings of the study suggested low level of data literacy among the respondents as `majority of them indicated that they are training current library employees to handle the increased workload, while others are actively seeking for specialists to oversee data management initiatives. Data literacy, as simple as it may sound, has not totally become commonplace due to the kind of training received by most librarians in Africa.

There is a discrepancy between the information technology abilities taught in many MLIS schools and the skills anticipated by employers, according to prior studies. MLS programmes should demand and make use of information technology to foster technological literacy among its students. There is a lack of study on how information technology is portrayed in Master of Library and Information Science (MLIS) programmes, which may explain why some students are dissatisfied with their education. Both IT and general data literacy abilities are important for public librarians to have. The need of teaching students "how to truly be able to stay up with technology, make sound judgments about its implementation, use it, and sell it to others" has been brought up as an example of a topic that should receive more attention in the classroom. All MLIS graduates should have what the American Library Association calls "technology knowledge and abilities," which is one of the ALA's Core Competencies of Librarianship.

Knowledge of "information, communication, assistive, and related technologies," as well as knowledge of "professional ethics and prevailing service norms," "methods for assessing and

evaluating the specifications, efficacy, and cost efficiency of technology based products and services," and "the principles and methods for implementing technology-based pr" all fall under this umbrella of competencies.

Researchers from Tanzania examined the state of research data management practices in the country's academic libraries. The study found that many African colleges and research institutes have not even begun to deploy the most fundamental data management systems. The factors behind this according to the author, the challenges include, the lack of political will and national government mandates on data management frequently. Also, research funding agencies aren't putting enough pressure on Africa to make sure researchers there deposit their data in reputable databases. The library staff at the University of Dodoma understood the significance of the setting and grasped the necessity of being ready for the day when research data management (RDM) will be mandated in order to get financial support for research. This article reports on studies done at the University of Dodoma in[94].

Another study conducted in Pakistan also indicated low level of research data management services. the study is a survey research using Google Docs survey, a self-created questionnaire was utilised to conduct the survey. The study outlines the primary arguments in favour of RDMS, the areas in which training is required, the most effective means of obtaining training, the motivating factors, and the potential obstacles that may arise while planning and executing RDMS. It found that research data management services are not widely used in these countries and would benefit from a strong push to get them off the ground. The study also implied that the level of data literacy is responsible for the low level of research data management services in the library.

The study therefore suggested that highest possible number of training opportunities should be made available to librarians and information managers, thanks to the efforts of higher education commissions/departments, university administrations, and donor agencies. [95.] The authors identify differences in age and gender by examining official information from the Netherlands. Scholars identify four distinct access gaps: insufficient exposure to digital technologies, lack of personal computers and Internet connectivity, insufficient digital literacy, and insufficient opportunity for meaningful use. They sought to examine digital divides by looking at people's backgrounds and preconceptions about the internet in an effort to better understand the complexities of this gap. "the capacity to use digital means to better one's place in society, in job, in education, and in cultural activities," they defined as the "strategic talent." An individual's social capital and resources are directly linked to this type of strategic ability.

After broad use of the internet and the computer and mobile phone, academics began to investigate additional factors that may be at play, such as the types of use, and found that divisions persisted[96]. Inequalities relating to the usage of digital technologies have been the subject of a new generation of research. Other factors, including as the political economy, gender, online cultures, class and status, and the consequences of life cycles like ageing, parenthood, and jail rehabilitation, have started to be considered in studies of digital disparities.

The third wave can be framed as new divides and negative consequences on society as it “became clear that the digital divide was not a static phenomenon but one heavily influenced by changes taking place on both the national and the global level (uneven development of the internet connection in different regions, the growth of e-commerce and e-democracy, changing audience behaviour and consumption practices under the influence of non-linear digital

services, the spread of digital content flows, etc". Others call this a third level digital divide whereby "the possibilities that the Internet offers to citizens in economic, political, social and cultural areas are not exploited by everybody in the same way. Social strata that already enjoy social advantages become further privileged. The Internet influences possibilities for citizens to improve their life chances, but in a vicious circle, based on their original social position"[97]. This stage can be characterized as focusing on intersectional inequalities.

A new framework to discuss such issues has arisen from data justice, led by the scholar argue, the concept of data justice is a response to various societal consequences of data driven technologies and services. As they suggest, the framing of 'data justice' helps to open the debate to multiple fields such as inequalities, discrimination as well as automation and algorithmic decision-making. They aim to pay particular "attention to structural inequality, highlighting the unevenness of implications and experiences of data across different groups and communities in society"[98]. Similarly, a scholar examines the digital divide in the context of wider social and information inequalities.

A recent study of ACRL library directors shows that almost 75% of survey respondents were not involved in RDS[99]. These numbers changed little from an earlier study, completed in 2011, that assessed the percentage of libraries that currently offer, plan to offer, or do not plan to offer RDS, and which revealed that there was little or no demand for RDS from patrons at many institutions. Conversely, a separate study of science librarians affiliated with ARL libraries found that approximately 60% of respondents indicated that their university provided data management assistance, and approximately 20% were planning such services. Despite the conflicting accounts reported, library directors agree that the issues of RDM are important, and

that directors at research institutions in particular see that the library needs to participate in RDS in order to remain relevant within their academic institution.

In one study, it was suggested that, "the absence of RDS would adversely affect the institution's perception of the library in terms of relevance and prestige, that provision of RDS would augment the institution's research impact, and that the absence of RDS would put the institution at a disadvantage for grants"[100]. Without the assistance of the library to curate, advise on and preserve the manifold outputs of scholarly activity, while individual scholars may still manage to thrive and build their reputations, they will do so within an impoverished infrastructure for scholarship, using a compromised archive, and their legacy to future scholars will be insecure. Case studies of current RDS illuminate the role academic libraries have been playing in RDM[101]. Two articles highlight RDS at the Johns Hopkins University: the development of data management services encompassing data storage, data archiving, data preservation, and data curation, and the development of data management consultation services[102]. A scholar highlightsthe implementation of data management infrastructure at the University of Oxford [103].

According to a study done on RDM competencies, the training needs of RDM occasioned by the influence of ICTs needs to address data generation, processing, preservation, dissemination, sharing and reuse[104]. This view is consistent with the argument advanced by another researcher that skills acquired to curate, access, reuse, and share research data with the advent of new technologies remains one of the major challenges. Taylor continues to explain that researchers, librarians, archivist and IT specialists are deficient in knowledge and skill that pertains manipulation, interpretation and long term access to research data collected. Researchers often

require training to enable them to acquire knowledge and skills needed to make their research data available and accessible or how to reuse data and incorporate data in their research process. Also, librarians, IT specialists and archivists require training on provision of research data services[105].

A scholar studied the institutional and individual factors which influence the data sharing practices among 1317 scientist from 43 discipline[106]. The individual factors include how the researchers perceive the benefits, risks and efforts involved in data sharing. The institutional factors are policies of journals and funding bodies which mandate that research data should be made available in the public domain. They have reported that there is no positive correlation between funding agencies' policies for data sharing and data sharing behaviour of the researchers. But the journals' policies for data sharing influence researchers' data sharing practices.

A scholar surveyed 864 researchers of seven Australian universities and reported that the data sharing was not a priority for them; just 9 per cent of them shared data with others[107]. The difference in data sharing practices among the researchers have been underlined[108].The researchers share their datasets on request or submit to the journals as supplementary content A study reviewed 88 websites of journals covered in the 2014 edition of Journal Citation Report (JCR) in the dentistry subject area for data sharing editorial policies. The authors also surveyed the PubMed Central repository to get information about the characteristics of the supplementary material of 88 journals. Their study reported that there were more chances of getting supplementary or additional material in the first quartile journals. Only 7.6 per cent of the records covered in PUBMED had supplementary material.

Research is a way of developing knowledge that is both deliberate and scientific; it is often supported by governmental or non-governmental organisations. The information gathered via studies is invaluable. Services for managing, storing, processing, and reusing crucial research data are known as Research Data Services (RDS) or Research Data Management (RDM) and are provided by many university libraries. This research analyses the present implementation of RDS or RDM services in 186 Indian academic libraries, including all 54 Central Universities and 132 Institutes of National Importance in India. The research team utilised a method triangulation strategy to compile their data, gathering information from a variety of sources such a literature review, an analysis of library websites, an online survey, and a series of phone interviews with LIS experts working in academic libraries in India. The research shows that academic libraries in India are lagging behind their counterparts in industrialised countries when it comes to implementing RDM services due to a lack of RDM policy, weak institutional support, and technical difficulties. Library roles and responsibilities in RDM are defined, and recommendations are made to policymakers, academic administrators, and the government.

Another scholar reported that authors of papers published in high impact journals neglected the publishers' policies of providing underlying data of their articles in open access repositories for others to access and reuse. The authors reviewed 500 paper from 50 original research journals. Out of the 50 journal 44 had mentioned that the datasets should be available for reuse. While some journals simply stated that data should be made available upon request. A researcher has surveyed the researchers of Science, Engineering, Humanities, Social and Health Sciences at the University of British Columbia and has found that the majority of researchers use less than 50 GB storage while some use 1TB storage for their research projects[109]. The researchers want

assistance in drafting their data management plans. They use cloud-based solutions like Dropbox, Google Drive etc. and flash drives. The researchers also want support from their universities in their data management activities and are also keen on attending the workshops on best practices in data management. The 1372 researcher spread across different stages in Earth Sciences from 116 countries have reported that they do not share data because it might be misused. Further, they are unaware of the data-sharing tools and policies[110]. The researchers are ignorant about different aspects like automatic data backups, ownership of data, data management plans, FAIR data principles and research data repositories.

A study examined the five determining factors like the mutual benefit, anticipated relationship, recognition, altruism and fear of being scooped influence researchers' intention to share implicit and explicit knowledge[111]. The authors used the method of Partial Least Square (PLS) method on 142 survey responses in the field of life and health sciences and highlighted that the mutual benefit and fear of being scooped were important factors which influenced knowledge sharing in the life and health sciences.This means that some researchers may be unwilling to share their research data for fear of copyright infringement.

In the same vein, a number of studies have examined and analysed the types of RDM services which the university libraries provide across the globe. Libraries are the best agents to handle such activities as the library professionals are trained in the skills of organizing and preserving information; their very mission is to preserve knowledge for posterity. They have worked successfully to set up institutional repositories and data archiving and curation work is just an extension of the work which they have already been doing efficiently since long. Data Management offers a beautiful opportunity to library professionals to support the research

endeavours of their universities. The library professionals have the requisite expertise to take the lead and initiate the work of data management; this will also bridge the chasm which generally exists between the library professionals and the researchers[112].

A scholar interviewed 26 respondents with regard to collaborative partnerships. The findings revealed that collaborative partnerships on one hand have benefits such as metadata exchange, sharing, and reuse of research data and on the other hand, challenges such as lack of teamwork and policies governing collaborative partnerships.Studies done on RDM landscape in South Africa, shows that there are high levels of awareness of RDM in research and academic institutions with notable activities of Network of Data and Information Curation Communities (NeDICC) in most agricultural research institutes.NeDICC aims to promote the development and use of research data including curation standards and practices of agricultural research institutes to ensure the long term preservation and accessibility of digital research outputs[113].

A scholar conducted a content analysis of the literature about knowledge management and information literacy published in the period of 1990- 2016[114]. His study confirmed a strong link between these fields which was supported by another scholar who believed that information literacy was “an essential and integral competency for both knowledge worker and effective knowledge management“ or a scholar who acknowledged corporate information literacy as one of main knowledge management areas where library and information science professionals can contribute. A researcher in his doctoral thesis even claims that “knowledge management seemed to be a natural extension to the field of library and information sciences“. Nevertheless, it was concluded that research of information literacy in the context of knowledge management was insufficient and short of empirical studies and he naturally followed the call for further

research in this topic of several authors before him. The study that tackled this issue in practice, by interviewing young people and found out how little they know about data, let alone data literacy.Some scholars suggested classifying data literacy depending on the context, so that required skills and competences could be defined accordingly. Moving on from this structure, there will be two main topics under this chapter. Firstly, the aforementioned sub-abilities (collect, manage, evaluate, and apply data) of data literacy will be discussed in-depth.

A study observed that most students concentrate on using particular materials recommended by either their lecturers or colleagues who have used them before, rather than searching to find the most appropriate document to use[115]. The way students organize their learning and search for information is crucial to their overall performance. Though undergraduate students in the humanities do turn more frequently to librarians, they do so with some reluctance. According to the findings almost all participants (98.6%) reported using Wikipedia as an information source, while (95.7%) of the participants reported that Face book is an important source of information to them. These researchers agreed that social media is an important source of information for undergraduate students. A scholar highlights ways in which students can seek for information, which include colleagues, the Internet, library, friends, family members, recognized institutions, agencies, and private organizations.

It was posited that most researchers, even with computers, find only a fraction of the sources available to them. He explained that undergraduates tend to work within one or another mental framework that limits their basic perception of the universe of knowledge available to them. Students according to him use a subject-disciplinary method that leads them to a specific list of sources on a particular subject. He points out that while this method allows students and

researchers to find more specific sources, it is limiting in that they may not realize that work of interest to their own subject appears within the literature of many other disciplines. He also observed that users want 'good enough' sources, not necessarily the best sources available. The evaluation of 'good enough' is based on a number of factors, the most important being ease of access and availability of full-text sources[116]. The sources chosen follow the principle of Least Effort; they tend to choose perceived ease of access over quality of content in selecting an information source or channel.

A study found out from their research on university undergraduates that 12 percent of the students required information for their personal development, while 11.25 percent claimed that they sought information on health matter, and 64.1 percent sought for information for their academic development, 9.3 percent to secure employment. A study pointed out factors such as: information illiteracy among library users; absence of computer systems with Internet connectivity in the university libraries; poorly conducted user education programmes; reliance on manual information retrieval tools which leads to poor filing and slow retrieval; and limited sensitization of the library information resources and services as factors that hinder the effective utilization of library resources and services[117]. This makes it difficult for undergraduate students to meet their information needs. A study established that a majority of students show a very low level of competence in the use of a library and display poor information seeking patterns. It could be assumed that students could be experiencing technical problems in accessing information resources; being card catalogues, the library catalogues do not provide adequate access to the libraries' collections; or students are information illiterate and lack the required library literacy skills.

A scholar concluded in his study that undergraduates encounter technical problems trying to locate materials from university libraries[118]. Beyond the problem of facilities is the inability of students to use different search strategies to source information and how to source the academic information needed for them to excel. Scholars found out that information barriers transcend access to information to constraining forces which affects the information search of students. A scholar concluded in a study that undergraduate students experienced difficulty in locating items from the library collection and do not understand the processes for retrieving journal articles[119]. According to a study, undergraduates face the following barriers in their access to information; limited borrowing of the most relevant books in the closed access section; insufficient copies of the relevant information materials (books); out–dated (old) information materials dominating the stock; poorly conducting user education; reliance on manual information retrieval tools which lead to poor filing and slow retrieval; and, limited sensitization of the library information resources and services[120].

Many researchers have shown interest in users' information seeking behaviour. A study found out that undergraduates use the library mostly as a place to study and make photocopies, but do not make great use of some of the available library services, such as interlibrary loan and the reference desk[121]. Another study examined the information seeking behaviour of undergraduate students in the University of Botswana[122]. The result of the study revealed that the internet is the most consulted source, followed by students' class notes and handouts. This finding is further confirmed by another scholar who conducted a similar study and found out that researchers looked for the fastest way that would lead to satisfactory results when doing research by going for electronic information sources first. A scholar researched into the

information needs and sources of information used by veterinary students at the University of Zimbabwe. Findings from the study revealed that writing assignments and studying for tests or examination were the primary tasks for which they required information and the major sources used to obtain information were books, videos, lecture notes, handouts, the internet, projects, CD-ROM database and journals. The students confirmed making little use of indexes, abstracts and dissertations.

It was noted that most students use a subject–disciplinary method in seeking for information which leads them to specific lists of resources on particular subjects. The author points out that while this method allows students and researchers to find more specific sources, it limits their knowledge of the fact that work of interest to their subject appears within the literature of many other disciplines which impinges on how much they get out of the library system. A scholar examined the information-seeking patterns of final year undergraduate engineering students split evenly between two engineering institutes in Irish universities. It was reported that engineering students seem to have a preference for channels that require the least effort, such as the Internet[123]. They explained that the result was due to the fact that student engineers viewed the Internet as a speedy, current information source which fed initial information needs quickly. On the other hand, comparism was made on the information-seeking patterns of physical and social scientists and found out that there is no essential difference between the two disciplines.

A researcher analyzed information seeking behaviour of academic researchers in the field of molecular biology, literacy theory, and computer science and their use of digital libraries[124]. The result of the study indicated differences in the search strategies employed and the types of

material selected among the researchers in the various academic disciplines. Researchers also investigated the information-seeking behaviours of people in the humanities. They generally reported that humanities scholars did not use indexes and abstracts or consult. In a study at the East African School of Library and Information Science Library, Makerere University, Uganda observed that more than half of the students experience problems locating library information materials. He noted that the majority of them either located materials through browsing the shelves or sought assistance from library staff, but they did not make full use of the card catalogue. A scholar made similar observation at Makerere University library. The author noted that although the catalogue was the most essential library tool in accessing library collections, it was the most avoided and least consulted by undergraduates. On the other hand, identified problems associated with availability and access to resources. According to the author, what a user actually needs may not tally with what is practically available, due to constraints either within the stock or due to the users own inability.

A study concluded that undergraduate students experienced difficulty in locating items from the library collection and did not understand the processes for retrieving journal articles[125]. In another study, attention was drew to the fact that there are spectrums of factors affecting information needs and this include age, educational level and linguistic ability of the user as well as other job related factors such as rank and length of experience, the nature of work (i.e. management, research or teaching) the subject field, the stage that a project has reached, size of the immediate work team, nature of the institution where the user works (academic or industrial), size of the institution and the communication structure within the institution[126]. People essentially need information for five broad functions and these functions are the fact-

finding function, which provides answers to specific question, the current awareness function, which keeps information up-to-date, the research function, which investigates a new field in-depth, the briefing function, which obtains a background understanding of an issue, and the stimulus function, which provides ideas to obtain stimulus.

In a study on information seeking behaviour of Polytechnic students discovered that 285 (59.4%) of their respondents needs information in relation to their academic. It shows that students use information primarily for academic purposes[127]. The study concluded that students at the polytechnic seek information to improve their academic performance. In a different study, the findings show that 30 (50%) of the respondents seeks information on career development and other reason include seeking information for problem solving, keeping up-to-date and the need to write an article or research paper. A study conducted on university undergraduate's information-seeking behaviour show that 12% of the respondents (researchers) required information 6 for their personal development, while 11.25% claimed that they sought for information on health matter, and 64.1% sought for information for their academic development, 9.3% seeks information to secure employment[128].

Also, a scholar using faculty members at the Islamia University of Bahawalpur, respondents indicated their purposes of seeking information 88% sought information for teaching purpose (preparing class lectures), 68 percent for literature searches, 43% to borrow books or journal articles, fifty-four percent of faculty members consult the library for research and 43% for keeping their knowledge up to date, and 27 percent visit the library for reading newspapers and magazines (recreational purposes)[129]. This clearly show that nearly all the respondents use

library resources or seek for information for teaching with more than half seeking information for research and a smaller number for various other purposes.

A study also revealed that lecturers of OlabisiOnabanjo University, Ogun State seek for information in order to get information on teaching and research, while in an empirical research on information needs and seeking behaviour of library users reveals that greater percentage of the respondents usually seek for information concerning their course. To her, this is not unexpected because the quest for certificate in their respective field of study forms their primary aim of being in the college. From the various studies carried out by various authors in different places, it is quite obvious that the reasons why individuals seek for information varies in line with the educational and economic background of the individual. Therefore, it is not safe to generalize the reasons for seeking information. From the various studies carried out by various authors in different places, it is quite noticeable that the reasons why individuals seek for information varies in line with the educational and economic background of the individual. Therefore, it is not sound well to generalize the type and reasons for seeking information in Nigeria libraries. Factors that influence information needs and seeking behavior of researchers include age, gender, type of libraries, educational level, professional work experience and situation[130].

A scholar conducted a survey concerning teachers and research scholars in the Department of Chemistry, University of Delhi[131]. The important finding of this survey was quite a large percentage of research fellows do not use the library as much as they ought to. The majority of researchers (71%) feel the need to improve their skill in the use of science-technology literature. A research conducted among a survey of 100 readers at Rajasthan University

Library, Jaipur. The study revealed that generally the readers showed interest in using the library at college level. As result, university libraries are functioning at a sub-optimal level or their effectiveness is not at the required level[132]. Sethi studied the information-seeking behavior of social science faculty in Indian universities. Respondents preferred journals, books, government documents and reference sources for meeting their information needs. Thomas investigated in his research that students perceived the faculty as very approachable but the information available for them was fragmented. He also observed that students have a wide range of needs.

A scholar conducted a study about Information Seeking Patterns of Researchers in the University Libraries in Karnataka state[133]. The study reveals that the research scholars depend upon their respective university library as their channel of information which is followed by Internet facility. The research scholars prefer to gather research articles which serve their research purposes and to visit the library to borrow books. Further the responses show that web pages are their preferred mode of communication. The research scholars visit less frequently and less time in the library. The results show the significant differences among the research scholars of various disciplines with regard to the library use patterns for information. Based on the use patterns of university libraries care has to be taken to attract the research scholars to visit the library to exploit the university library information resources, facilities and services to meet their research needs. Further to match the information requirements of the research scholars, the university libraries have to equip with world class information services at their desk tops.Some scholars conducted a study on information-seeking behavior of basic science

researchers, in this study examines the information-seeking behaviors of basic science researchers to inform the development of customized library services.

A scholar studied the information needs and information seeking behavior of research scholars in university. The study revealed that about the type of information resources preferred by the users, which are most e-resources besides highlighting problems faced by them[134]. The information seeking behavior among engineering faculty to examine literature searching experience and skills among them besides assessing satisfaction level regarding their library. In tune with same the previous scholar assessed the information seeking behavior of research Scholars to gauge the level of awareness regarding varied library resources and services among them. In tune with it numerous studies brought out the findings regarding the information seeking behavior of students mostly undergraduates and observed that they mostly needed academic and job-related information. Besides, highlighting about their information proficiency which emerged to be poor in addition to lack of proper awareness regarding library resources[135]. Moreover, information seeking behavior and satisfaction of library users in digital era and found out that respondents were not satisfied with the ICT based infrastructure, resources and services in the library was investigated. Contrarily, it was revealed that preponderance of the respondents is aware and have plenty of knowledge regarding e-information resources.

The Information Learning/Seeking Behavior of researchers was studied and revealed that they mostly believe that it is easier to use electronic resources compared to print owing to various advanced features of electronic resources like ease of searching and browsing, etc. However, it is also observed that not many scholars are aware of various searching techniques and face

many problems while seeking information in electronic environment including slow internet connectivity and electricity disruption. A study intended to explore the possible relationship between student's information needs and their information seeking behavior. The findings indicate that types of information, Information Sources used, user awareness, and user education have positive relationship with information needs of users. Moreover, it was highlighted that student's information seeking behaviors include "active search, passive search, and ongoing search". It was observed that the core information needs of students include "career information, self-development, employment, course information, health, entertainment, sports, and religion while as their information seeking behaviors include active search, passive search, and ongoing search"[136].

2.4 Conceptual Framework

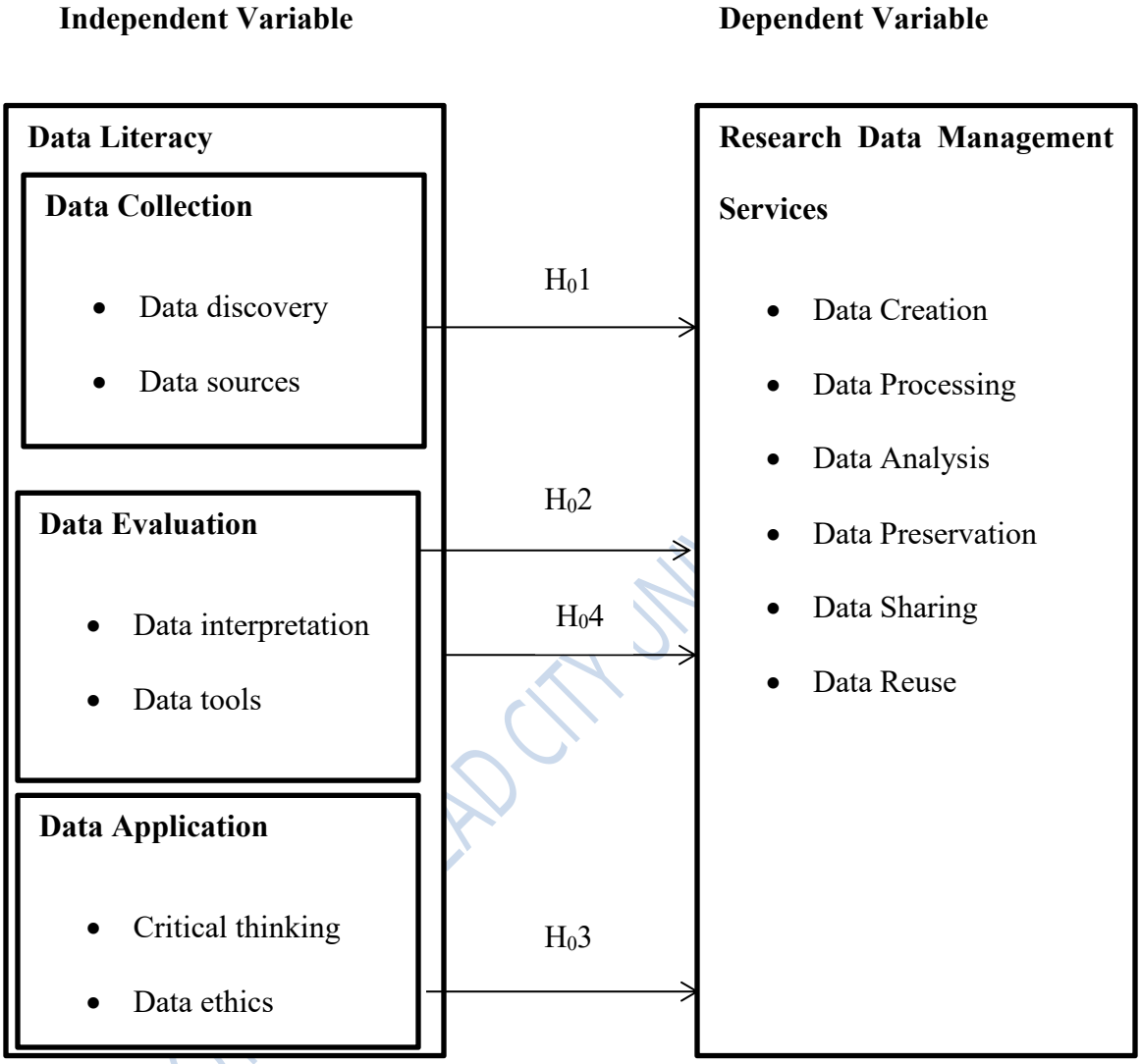

Figure 2.3 Conceptual Model on Data Literacy and Research Data Management Services

Source: Researcher, 2022

The conceptual model of this study was developed based on the tittle of the research which is the influence of data literacy on research data management services by librarians in University Libraries in Lagos State, Nigeria. The independent variable is data literacy which will be measured with data collection, data evaluation, data management, conceptual framework and data application[92] while research data management services, the dependent variable will be measured with data creation, data processing, data analysis, data preservation, data sharing and data reuse[91].

Therefore, the five hypotheses were linked as follows: in hypothesis one; data collection will be tested on research data management services, in hypothesis two; data evaluation will be tested on research data management services, in hypothesis three; data management will be tested on research data management services, in hypothesis four; conceptual framework will be tested on research data management services and in hypothesis five; data application will be tested on research data management services by librarians in University Libraries in Lagos State, Nigeria. Overall, these formulated hypotheses will be subjected to a statistical test to determine the direction of results, conclusion, and possible recommendations for this study.

2.5 Summary of Reviewed Literature

This chapter highlights scholars' opinions about the topic of this research which is the influence of data literacy on research data management services by librarians in University libraries in Lagos State, Nigeria. The review shows that research data management services is one of the emerging areas in which is been claimed by a lot of professionals. However, there is a general believe that librarians and information professionals are better placed to carry out all

the research data management due to the skills that they have built over the years. Library and information professional are more equipped to carry out services such as data creation, data evaluation, data analysis, data sharing and data visualization all of which have been identified as integral part of research data review shows the importance of data literacy on research data management services by librarians.

Meanwhile, a lot has been written on the modalities and structure of research data management in libraries but little has been done in term of a consistent and comprehensive research data management services. scholars have identified two type of data services, in libraries, namely; passive and active service. Passive services which is common in many libraries see librarians granting access or guiding researchers towards data sources without intervening or being involved in data management activities.

Active or technical services requires the involvement of librarians in all aspect of the data lifecycle. The librarian is expected to build data repositories, collate data from various sources, transform them and use them expertly to meet the needs of the use. It also involves collaborating with researchers as they create data in order to ensure that data are created in the right format, properly organized and duly preserved.

This level of service has not taken root yet The review of literature also show that few library has put in place any framework for the provision research data management serr review on the conceptual framework has clarified the concepts data literacy, and research data management services of librarians). It shows the relationship between the dependent variable (research data management services) and the independent variable (data literacy).The reason has been

attributed to a lot of factors some of which include the need to develop the necessary level of data literacy among librarians.

Scholars have found that many libraries, including those in the developed world, are finding out that librarians need to be retrained for effective data services. There is a consensus that data literacy is essential for effective research data management and low level of data literacy is the reason why research data management has not become common around the world.

The gap noted in literature is that few studies, especial in Nigeria, has examined the role of data literacy among librarians and how it affects research data management services. Few of the studies available have only examined perception of librarians toward data literacy and the level of data services available in which is generally found to be low or non-existent in most cases. The implication is that this research will fill the knowledge gap created by the lack of studies on the influence of data literacy on research data management in academic libraries in Lagos state.

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Methodology

The methods employed in this investigation are presented in this chapter. It covers the research design methodologies used, the population, sample, data collection, and variable operation.

3.1 Research Design

This study used a descriptive survey research design. The method is adopted because it is the most appropriate choice or this type of research which seeks to identify characteristics, frequencies, trends, and relationships between variables. It also enables the collection of data from many respondents through the use of instruments such as questionnaire. The design used to determine the influence of data literacy on research data management services by librarians in University Libraries in Lagos State, Nigeria.

3.2 Population of the Study

The population of the study is 99 and the participants in this study were the librarians of University Libraries in Lagos State, Nigeria which include University of Lagos Libraries, Akoka, Lagos State University Library, Ojo, Lagos State University of Education Library, Ijanikin, Lagos State University of Science and Technology Library, Ikorodu, Caleb University Library, Imota, Trinity University Library, Sabo, Eko University of Medicine and Health Science Library, Ijanikin, Agustine University Library, Epe, Pan-Atlantic University Library, Lekki and Anchor University Library, Ayobo Ipaja.

Table 3.1 Population of Respondents in the college Libraries

S/N	Academic Libraries	Librarians
1	University of Lagos Library, Akoka	23
2	Lagos State University Library, Ojo	26
3	Lagos State University of Education Library, Ijanikin	15
4	Lagos State University of Science and Technology Library, Ikorodu	11
5	Caleb University Library, Imota	5
6	Trinity University Library, Sabo	4
7	Eko University of Medicine and Health Science Library, Ijanikin	3
8	Augustine University Library, Epe	3
9	Pan-Atlantic University Library, Lekki	5
10	Anchor University Library, AyoboIpaja	4
	Total Population	99

Source: Lagos State Library Board, 2022.

3.3 Sample Size and Sampling Technique

The population size is 99 respondents which is made up of all librarians in the ten University libraries for the study. Total enumeration was adopted since the population is just few.

3.4 Description of Research Instrument (s)

The instrument utilized is a structured questionnaire, which was used to collect data from respondents because it allowed the researcher to readily assess the structured questions and responses in order to meet the study's goal. The 4-point Likert type scale design that was used in this study allows the researcher to give options for respondents to choose from. Data on the factors under study was collected using self-reported questionnaires. In this study, the Data Literacy, and Research Data Management services scale is employed.

Section A: This section was self-developed by the researcher to collect demographic information from respondents, and it provides biodata about respondents based on four factors: gender, age, educational qualifications, and years of experience.

Section B: Research Data Management Services scale, which Indicates how the librarians manage the data in the libraries for accessibility by students, has four-point Likert type scale which are: Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1. The scale covers six dimensions which are: data creation, data processing, data analysis, data preservation, data sharing and data reuse. The research instrument was adapted[1]. Cronbach Alpha will be reported.

Section C: Data Literacy scale, which indicates how impactful the data and information acquired are on the students, also has four-point likert type scale which are: Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1**.** The scale has 3 sub-variables with each variable having two dimensions. The dimensions of data collection are data discovery and data source. The dimensions of data evaluation are data tools and data interpretations while the

dimensions of data application are critical thinking and data ethics. The instrument was adapted from an exsiting study. [2].

3.5 Validity of Research Instrument

The instrument's items acquired through a survey of related literature and adaptations of questionnaires used by other researchers. The supervisor and other specialists in the field of information management provided the necessary input on both the face and content validity. Corrections were integrated into the final questionnaire before it was administered on the study participants.

3.6 Reliability of the Instrument

The researcher run the questionnaire through a reliability test to ensure that all of the items assessing each variable in the study are consistent. The instrument's reliability was tested in a pilot study with 30 copies of the questionnaire which were administered on librarians in Kenneth Dike Library, UI which is not part of the population of the study. The result of the reliability test revealed a Cronbach's alpha score of 0.721 for the Data literacy scale and 0.832 for the Data Management Service Scale. These scores show that the research instrument is reliable for the task for which it was designed

3.7 Method of Data Collection

The Department of Information Management, Lead City University, will provide a letter of introduction and a project attestation form, which was utilized to request authorization to conduct the survey from the management of the ten university libraries in Lagos State. A two-

day training session was held for five (5) research assistants to help with questionnaire administration, retrieval, and initial sorting. The researcher and research assistants engage with the institution's HR department to protect the anonymity of their responses while also advising them on the importance of adequate responses and the benefits embedded in the study's findings. The librarians of the ten university libraries in Lagos State, Nigeria, were given a total of 99 copies of the questionnaires.

3.8 Methods of Data Analysis

The data was analyzed using descriptive and inferential statistics by the researcher. For research questions one to four, descriptive statistics (mean, frequency distribution, standard deviation, and percentage) was used. The four null hypotheses will be tested using regression analysis. All hypotheses in the study were assessed at a significance level of 0.05. Statistical Package and Service Solution (SPSS) Version 25 was used to analyze the data collected for the thesis.

Endnotes

1. P .Calzada & M. A. Marzal, Incorporating data literacy into information literacy programs: **Core competencies and contents. Libri 63(**2): I

2. B. Christensen-Dalsgaard, M. van den Berg, R. Grim, Ten Recommendations for Libraries to get Started with Research Data Management. **LIBER**, 2018.

Chapter Four

Results and Discussion of Findings

This chapter presents the results of the empirical data collected in the course of this study. A structured questionnaire was used for the purpose of data collections. Ninety-nine (99) copies of the research questionnaire was administered to the respondents. However, eighty-five copies were fully filled and returned. This represents 85.8% return rate which is considered adequate for generalization. The analysis is done in line with the research questions and hypotheses. Discussion of findings is also done against the background of the literature reviewed in this study.

4.1 Demographic Information

Table 4.1 Demographic Information of the Respondents

Items	Frequency	Percentage
Gender		
Female .	32	37.6
Male	53	62.4
Total	85	100.0
Age Range		
20-25	2	2.4
26-30	13	15.3
31-35	19	22.4
36-40	23	27.1
41-45	8	9.4
46 AND ABOVE	20	23.5
Total	85	100.0
Academic Qualification:	Frequency	Percentage
Bachelor's Degree	21	24.7
Master's Degree	50	58.8
Ph.D.	14	16.5
Total	85	100.0
Years of Experience:		
5-10	27	31.8
11-15	20	23.5
16-20	23	27.1
21-25	8	9.4
26-30	7	8.2
Total	85	100.0

Source: Fieldworks, 2022.

Table 4.1 presents the demographic distribution of the respondents. The table shows that 32 (37.6%) of the respondents were Female while 53 (62.4%) were Male suggesting that more male librarians were involved in research data management services than female librarians. Furthermore, the age distribution of the respondents shows that 2 (2.4%) were between 20-25 years, 13 (15.3%) were between 26-30; 19 (22.4%) were between 31-35years; 23 (27.1%)were between 36-40 years while 8 (9.4%)were between 41-45years of age and 20 (23.5%) were aged between 46 years and above. This shows that there is a blend of youths and older librarians in the study sample. In term of academic qualifications, 21 (24.7%)of the respondents reported that have Bachelor's Degrees, 50 (58.8%) have Master's Degree while 14 (16.5%) of the respondents indicated that they have Ph.D. The experience of the respondents was also analysed. It can be seen that 27(31.8%) of the respondents have work experience of between 5-10 years, 20 (23.5%) have work experience of between 11-15 years, 23 (27.1%)have work experience of between 16-20 years, 8 (9.4%) 21-25, while 7 (8.2%) of the respondents have work experience of between 26-30 years.

4.2 Presentation of Research Questions

4.2.1. Research Question One: What is the level of Research Data Management Services of Librarians in University Libraries in Lagos State, Nigeria.

Table 4.2: Level of Research Data Management Services of Librarians in University Libraries in Lagos State, Nigeria.

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean
Data Creation					
It is easy to locate and use data sources	42 (49.4%)	40 (47.1%)	2 (2.4%)	1 (1.2%)	3.45
Library provide an Institution repository for data management	44 (51.8%)	31 (36.5%)	4 (4.7%)	6 (7.1%)	3.33
Library offers guidance on data documentation standards e.g. creating metadata	15 (17.6%)	46 (54.1%)	19 (22.4%)	4 (4.7%)	2.86
Weighted Mean					**3.21**
Items	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**Mean**
All electronic documents are easily processed	37 (43.5%)	44 (51.8%)	4 (4.7%)	-	3.39
Available ICT facilities are used effectively for processing of data	47 (55.3%)	29 (34.1%)	8 (9.4%)	-	3.81
There are laid down information management procedure by the school management e.g. format of document	3 (41.2%)	37 (43.5%)	13 (15.3%)	-	3.26
Documents produced are usually properly proof read and cross checked before release	48 (56.5%)	27 (31.8%)	10 (11.8%)	-	3.45
Weighted Mean					**3.47**
Data Analysis					
I have the ability to analyze current research	33 (38.8%)	50 (58.8%)	2 (2.4%)	-	3.36
I have the ability to use digital technologies for research planning	42 (49.4%)	42 (49.4%)	1 (1.2%)	-	3.48
I have skills mastery in working with scientific literature and ability to compile lists	37 (43.5%)	46 (54.1%)	2 (2.4%)	-	3.41
I have skills to apply digital technologies to solve a specific research problem	42 (49.4%)	39 (45.9%)	4 (4.7%)	-	3.45
Weighted Mean					3.43

Decision Rule: 1.00 – 1.49 (Very low), 1.50 – 2.49 (Low), 2.50 – 3.49 (High), 3.50 – 4.00 (Very High)
Source: Field Survey, 2022

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean
Data Preservation					
There are enough data storage facilities or specific institutional data	42 (49.4%)	26 (30.6%)	17 (20.0%)	-	3.29
Availability of skilled staff to assist researchers with data storage and preservation techniques	25 (29.4%)	47 (55.3%)	13 (15.3%)	-	3.14
Data are stored in traditional formats(e.g text documents, spreadsheets, graphics and databases	37 (43.5%)	42 (49.4)	6 (7.1%)	-	3.36
Data can be safely stored (determining storage and back-up options for keeping your data secure)	45 (52.9%)	40 (47.1%)	-	-	3.53
Weighted Mean					3.33
Data Sharing					
Library has helpful data repositories for data sharing	37 (43.5%)	34 (40.0%)	14 (16.5%)	-	3.27
After processing data are released almost immediately they are requested for	29 (34.1%)	44 (51.8%)	12 (14.1%)	-	3.20
Documents needed are easily retrieved and disseminated to where requested	44 (51.8%)	34 (40.0%)	7 (8.2%)	-	3.44
Majority of data is disseminated electronically	13 (15.3%)	39 (45.9%)	33\ (38.8)	-	2.76
Weighted Mean					3.17
Data Reuse					
University library allow us to archive research data for future use	18 (21.2%)	33 (38.8%)	34 (40.0%)	-	2.81
Data are stored for easy retrieval	45 (53.6%)	28 (33.3%)	11 (13.1%)	-	3.40
Unused data are disposed off	7 (8.2%)	17 (20.0%)	58 (68.2%)	3 (3.5%)	2.33
Data contents are effected before disposal or recycling	6 (7.1%)	41 (48.2%)	37 (43.5%)	1 (1.2%)	2.61
Weighted Mean					2.79
Grand Mean					3.23

Decision Rule: 1.00 – 1.49 (Very low), 1.50 – 2.49 (Low), 2.50 – 3.49 (High), 3.50 – 4.00 (Very High)
Source: Field Survey, 2022

Table 4.2 presents the responses on the level of research data management services of librarians in university libraries in Lagos State, Nigeria. Research data management services in this study is measured by data creation, data processing, data analysis, data preservation, data sharing and data reuse. From the responses to the metrics of data creation, it can be seen that 42 (49.4%) of the respondents strongly agreed that it is easy to locate and use data sources, 40(47.1%) agreed, 2(2.4%) disagreed and 1(1.2%) respondent strongly disagreed to this. On the average, the perception of the respondent that it is easy to locate and use data sources has a mean score of 3.45. Also, 44(51.8%) of the respondents strongly agreed that their library provide Institution repositories for data management, 31(36.5%) agreed, 4 (4.7%) disagreed and 6 7.1%) respondent strongly disagreed to this. On the average, the perception of the respondent that that their library provide Institution repositories for data management has a mean score of 3.33. In the same vein, 15(17.6%) of the respondents strongly agreed that their library offers guidance on data documentation standards e.g. creating metadata, 46(54.1%) agreed, 19(22.4%) disagreed and 4(4.7%) of the respondent strongly disagreed. On the average, the perception of the respondent that that their library offers guidance on data documentation standards e.g. creating metadata has a mean score of 2.86. Overall, data creation has a weighted mean of 3.21 indicating a high level of data creation practice among the respondents.

On the aspect of data processing, 37(43.5%) of the respondents strongly agreed that all electronic documents are easily processed, 44(51.8%) agreed to this while, 4(4.7%) disagreed to the statement. On the average, the perception of the respondent that all electronic documents are easily processed has a mean score of 3.39. Also, 47(55.3%) of the respondents strongly agreed that available ICT facilities are used effectively for processing of data, 29(34.1%)

agreed to this while 8(9.4%) disagreed to the statement. On the average, the perception of the respondent that available ICT facilities are used effectively for processing of data has a mean score of 3.81. Furthermore, 3(41.2%) of the respondents strongly agreed that there are laid down information management procedure by the school management e.g. format of document, 37(43.5%) agreed to this while 13(15.3%) disagreed to the statement. On the average, the perception of the respondent that there are laid down information management procedure by the school management e.g. format of document has a mean score of 3.26. Overall the weighted mean score of data processing as a construct of research data management services is 3.45. this is indicating that data processing is highly practiced in the libraries.

The third construct of research data management services examined in this study is data analysis. The responses show that 33 (38.8%) of the respondents strongly agreed they have the ability to analyze current research, 50(58.8%) agreed to this while 2(2.4%) disagreed to the statement. On average, the perception of the respondent that they have the ability to analyze current research has a mean score of 3.36. In addition, 42 (49.4%) of the respondents strongly agreed to have the ability to use digital technologies for research planning, 42 (49.4%) also agreed to this while 1 (1.2%) disagreed to the statement. he average, the perception of the respondent that they have athe bility to use digital technologies for research planning has a mean score of 3.48. Furthermore, 37(43.5%) of the respondents strongly agreed have the skills mastery in working with scientific literature athe nd ability to compile lists, 46(54.1%)agreed to this while 2(2.4%) disagreed to the statement. the average, the perception of the respondent that they have skills mastery in working with scientific literature and ability to compile lists has a mean score of 3.41. Furthermore, 42(49.4%) of the respondents strongly agreed have the

skills to apply digital technologies to solve a specific research problem, 39(45.9%) agreed to this while 4(4.7%) disagreed to the statement. On the average, the perception of the respondent that they have skills to apply digital technologies to solve a specific research problem has a mean score of 3.45. Overall, the weighted mean score for data analysis is 3.43 which also indicate a high level of data analysis practice in the library.

On the aspect of data preservation42(49.4%) of the respondents strongly agreed that to availability of skilled staff to assist researchers with data storage and preservation technique, 26(30.6%) agreed to this while 17(20.0%) disagreed to the statement. On the average, the perception of the respondent that there are enough data storage facilities or specific institutional database has a mean score of 3.29. In the same vein, 25(29.4%) of the respondents strongly agreed that there are enough data storage facilities or specific institutional database, 47(55.3%) agreed to this while 13(15.3%) disagreed to the statement. On the average, the perception of the respondent on the availability of skilled staff to assist researchers with data storage and preservation techniques has a mean score of 3.14. Also, 37(43.5%) of the respondents strongly agreed that data are stored in traditional formats (e.g text documents, spreadsheets, graphics and databases, 42(49.4) agreed to this while 6(7.1%) disagreed to the statement. On the average, the perception of the respondent that data are stored in traditional formats (e.g text documents, spreadsheets, graphics and databases has a mean score of 3.36. Similarly, 45(52.9%) of the respondents strongly agreed that data can be safely stored (determining storage and back-up options for keeping your data secure), 40(47.1%) also agreed to this. On the average, the perception of the respondent that data can be safely stored

(determining storage and back-up options for keeping your data secure), has a mean score of 3.53. Overall, the weighted Mean for data preservation is 3.33.

Table 4.2 also shows the responses to the statement on data sharing. The responses show that 37(43.5%) of the respondents strongly agreed that their library has helpful data repositories for data sharing, 34(40.0%) also agreed while 14(16.5%) disagreed to this. On the average, the perception of the respondent that their library has helpful data repositories for data sharing has a mean score of 3.27. Also, 29(34.1%) of the respondents strongly agreed that after processing, data are released almost immediately they are requested for, 44(51.8%) also agreed while 12(14.1%) disagreed to this. On the average, the perception of the respondent that after processing, data are released almost immediately they are requested for has a mean score of 3.20. Also, 44(51.8%) of the respondents strongly agreed that documents needed are easily retrieved and disseminated to where requested, 34(40.0%) also agreed while 7(8.2%) disagreed to this. On the average, the perception of the respondent that Documents needed are easily retrieved and disseminated to where requested has a mean score of 3.44. Furthermore, 13(15.3%) of the respondents strongly agreed that majority of data is disseminated electronically, 39 (45.9%) also agreed while 33 (38.8) disagreed to this. On the average, the perception of the respondent that majority of data is disseminated electronically has a mean score of 2.76. Overall, the weighted Mean for data sharing is 3.17. This also suggests a high level of data sharing among the libraries.

Table 4.2 also shows the responses for data reuse. It can be seen that of 18(21.2%) of the respondents strongly agreed that the university library allow its staff to archive research data for future use, 33(38.8%) agreed to this while 34 (40.0%) disagreed. On average, the

perception of the respondent that the university library allows its staff to archive research data for future use has a mean score of 2.81. In addition, 45 (53.6%) of the respondents strongly agreed that data are stored for easy retrieval, 28(33.3%) agreed to this while 11(13.1%) disagreed. On average, the perception of the respondent that the university library allows its staff to archive research data for future use has a mean score of 3.40. Also, 7(8.2%) of the respondents strongly agreed that unused data are disposed off17(20.0%) agreed to this while 58(68.2%) disagreed and 3(3.5%) strongly disagreed. On average, the perception of the respondent that unused data are disposed off has a mean score of 2.33. This is a low mean score indicating that unused data are not disposed off in the libraries.

Also, 6(7.1%) of the respondents strongly agreed data contents are vetted before disposal or recycling, 41(48.2%) agreed to this while 37(43.5%) disagreed and 1(1.2%) strongly disagreed. On average, the perception of the respondent that data contents are vetted before disposal or recycling has a mean score of 2.61. This is a moderate mean score indicating that the practice is not highly followed. Overall, the weighted Mean for data reuse is 2.79 which indicate a moderate level of data reuse. Also the grand mean for research data management services is 3.23 which can be taken to mean that there is a high level of research data management among the responding institutions.

4.2.2 Research Question Two: What is the level of data collection (data discovery and data sources) approach by librarians in university libraries in Lagos State, Nigeria?

Table 4.3 Level of Data Collection approach by Librarians in University Libraries In Lagos State, Nigeria

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean
Data collection					
I have knowledge and understanding of data	42 (49.4%)	39 (45.9%)	3 (3.5%)	1 (1.2%)	3.44
I usually perform data exploration	29 (34.1%)	44 (51.8%)	6 (7.1%)	6 (7.1%)	3.13
I know how to identify useful data	40 (47.1%)	36 (42.4%)	7 (8.2%)	2 (2.4%)	3.34
I assess sources of data for trustworthiness	33 (39.8%)	41 (49.4%)	9 (10.8%)	-	3.29
I critically evaluates quality of datasets for errors	14 (16.5%)	69 (81.2%)	2 (2.4%)	-	3.14
I know how to collect relevant data	41 (48.2%)	43 (50.6%)	1 (1.2%)	-	3.47
Weighted Mean					**3.30**

Decision Rule: 1.00 – 1.49 (Very low), 1.50 – 2.49 (Low), 2.50 – 3.49 (High), 3.50 – 4.00 (Very High)
Source: Field Survey, 2022

Table 4.3 presents data on the data collection approach adopted by the respondents. the responses show that 42(49.4%) of the respondents strongly agreed they have knowledge and understanding of data, 39(45.9%) agreed to this while 3(3.5%) disagreed and 1(1.2%) strongly disagreed. On average,the perception of the respondent that they have knowledge and understanding of data has a mean score of 3.44. This is a high mean score indicating that the practice is highly followed. In the same table, it can be seen that 29(34.1%) of the respondents strongly agreed they usually perform data exploration, 44(51.8%) agreed to this while 6(7.1%)

disagreed and 6(7.1%) strongly disagreed. On average, the perception of the respondent that they usually perform data exploration has a mean score of 3.13. This is a high mean score indicating that the practice is highly practiced. Furthermore, 40(47.1%)of the respondents strongly agreed they know how to identify useful data, 36(42.4%) agreed to this while 7(8.2%)disagreed and 2(2.4%)strongly disagreed. On average, the perception of the respondent that they know how to identify useful data has a mean score of 3.34. This is a high mean score indicating that the skill is high among the respondents. Also, 33 (39.8%) of the respondents strongly agreed they always assess sources of data for trustworthiness, 41 (49.4%) agreed to this while 9 (10.8%) disagreed. On average, the perception of the respondent that they always assess sources of data for trustworthiness has a mean score of 3.29. This is a high mean score indicating that the practice is common among the respondents. In addition, 14(16.5%) of the respondents strongly agreed they always critically evaluates quality of datasets for errors, 69(81.2%) agreed to this while 2(2.4%) disagreed. On average, the perception of the respondent that they always critically evaluate quality of datasets for errors has a mean score of 3.14. This is a high mean score indicating that the practice is common among the respondents. Finally, 41(48.2%) of the respondents strongly agreed they know how to collect relevant data, 43(50.6%) agreed to this while 1(1.2%) disagreed. On average, the perception of the respondent that they know how to collect relevant data has a mean score of 3.47. Overall, the weighted mean for data collection is 3.30. This indicated a high level of data collection practice among the respondents.

4.2.3 Research question three: What Is the Level of Data Evaluation (Data Tools and Data Interpretation) Approach by Librarians in University Libraries in Lagos State, Nigeria?

Table 4.4: What Is the Level of Data Evaluation (Data Tools, And Data Interpretation) Approach by Librarians in University Libraries in Lagos State, Nigeria?

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean
I have knowledge of data analysis tools	28 (32.9%)	52 (61.2)	5 (5.9%)	-	3.27
I know how to select appropriate data analysis tools	30 (35.3%)	48 (56.5%)	7 (8.2%)	-	3.27
I know how to apply data analysis tools	28 (32.9%)	50 (58.8%)	7 (8.2%)	-	3.25
I know how to read and understand tables and graphs	30 (36.1%)	49 (59.0%)	4 (4.8%)	-	3.31
I know how to identify key points and integrate	34 (40.0%)	46 (54.1)	5 (5.9%)	-	3.34
I know how to identify discrepancies within the data	29 (34.1%)	51 (60.0%)	5 (5.9%)	-	3.28
Weighted Mean					**3.29**

Decision Rule: 1.00 – 1.49 (Very low), 1.50 – 2.49 (Low), 2.50 – 3.49 (High), 3.50 – 4.00 (Very High)
Source: Field Survey, 2022

Table 4.4 presents data on the data evaluation practice among the respondents. The responses show that 28 (32.9%) of the respondents strongly agreed they have knowledge of data analysis tools, 52 (61.2%) agreed to this while 5 (5.9%) disagreed. On average, the perception of the respondent that they have knowledge of data analysis tools has a mean score of 3.27. This is a high mean score indicating that the respondents are highly skilled in data analysis tools. Similarly, 30(35.3%) of the respondents strongly agreed they know how to select appropriate data analysis tools, 48(56.5%) agreed to this while 7(8.2%) disagreed. On average, the perception of the respondent that they know how to select appropriate data analysis tools has a

mean score of 3.27. This is a high mean score indicating that the respondents are highly skilled in data analysis tools. Also, 28(32.9%) of the respondents strongly agreed they know how to apply data analysis tools, 50 (58.8%) agreed to this while 7(8.2%) disagreed. On average, the perception of the respondent that they know how to select appropriate data analysis tools has a mean score of 3.25. This is a high mean score indicating that the respondents are highly skilled in the application of data analysis tools.

In relation to data interpretation, 30(36.1%) of the respondents strongly agreed they know how to read and understand tables and graphs, 49(59.0%) agreed to this while 4(4.8%) disagreed. On average, the perception of the respondent that they know how to read and understand tables and graphs has a mean score of 3.31. This is a high mean score indicating that the respondents are highly skilled in reading and understanding tables and graphs. In the same vein, 34(40.0%) of the respondents strongly agreed they know how to identify key points and integrate, 46(54.1) agreed to this while 5(5.9%) disagreed. On average, the perception of the respondent that they know how to identify key points and integrate them has a mean score of 3.34. This is a high mean score indicating that the respondents are highly skilled in identifying and integrating key research findings. Finally, 29(34.1%) of the respondents strongly agreed they know how to identify discrepancies within the data, 51(60.0%) agreed to this while 5(5.9%) disagreed. On average, the perception of the respondent that they know how to identify discrepancies within the data has a mean score of 3.28. This is a high mean score indicating that the respondents are highly skilled in identifying within the data. Overall, the weighted mean of data evaluation is 3.29. This indicate the that level of data evaluation skill among the respondent is high.

4.2.3 Research Question four: What is the Level of Data Application (Critical Thinking, And Data Ethics) Approach by Librarians in University Libraries in Lagos State, Nigeria?

Table 4.5: What is the Level of Data Application (Critical Thinking, And Data Ethics) Approach by Librarians in University Libraries in Lagos State, Nigeria?

Items	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean
I am aware of challenges associated with data	18 (21.2%)	66 (77.6%)	1 (1.2%)	-	3.20
I think critically when working with data	25 (29.8%)	59 (70.2%)	-	-	3.30
I believe there are high level issues associated with use of data	37 (43.5%)	46 (54.1%)	2 (2.4%)	-	3.41
I am aware of legal and ethical issues associated with data	47 (55.3%)	36 (42.4%)	2 (2.4%)	-	3.53
I usually read ethical issues associated with data before use	26 (30.6)	51 (60.0%)	8 (9.4%)		3.21
I apply and work with data in an ethical manner	37 (43.5%)	43 (50.6%)	5 (5.9%)		3.38
Weighted Mean					3.39
Grand Mean	**Data literacy of librarians**				**3.32**

Decision Rule: 1.00 – 1.49 (Very low), 1.50 – 2.49 (Low), 2.50 – 3.49 (High), 3.50 – 4.00 (Very High)
Source: Field Survey, 2022

Table 4.5 presents the result of data application (critical thinking, and data ethics) approach by librarians in university libraries in Lagos state, Nigeria. The responses show that 18 (21.2%)of the respondents strongly agreed they are aware of challenges associated with data, 66 (77.6%) agreed to this while 1(1.2%)disagreed. On average, the perception of the respondent that they are aware of challenges associated with data has a mean score of 3.20. This is a high mean score indicating that the respondents are highly aware of challenges associated with data. Similarly, 25(29.8%) of the respondents strongly agreed they think critically when working with data, 59(70.2%) also agreed to this while no one disagreed. On average, the perception of

the respondent that they think critically when working with data has a mean score of 3.30. This is a high mean score indicating that the respondents are always thinking critically when working with data. Also, 37(43.5%) of the respondents strongly agreed they believe there are high level issues associated with use of data, 46 (54.1%) agreed to this while 2 (2.4%) disagreed. On average, the perception of the respondent that there are high level issues associated with use of data, has a mean score of 3.41 . This is a high mean score indicating that the respondents are highly aware that there are high level issues associated with use of data.

In the same vein, 36(42.4%) of the respondents strongly agreed that they are aware of legal and ethical issues associated with data, 47(55.3%) agreed to this while 2(2.4%) disagreed. On average, the perception of the respondent that there legal and ethical issues associated with data, has a mean score of 3.53. Likewise,26(30.6) of the respondents strongly agreed they usually read ethical issues associated with data before use,51(60.0%) agreed to this while 8(9.4%) disagreed. On average, the perception of the respondent that they usually read ethical issues associated with data before use has a mean score of 3.21. Also, 37(43.5%) of the respondents strongly agreed they apply and work with data in an ethical manner,43(50.6%) agreed to this while 5 (5.9%) disagreed. On average, the perception of the respondent that they apply and work with data in an ethical manner has a mean score of 3.38. Overall, the mean score for all the metric used to measure data application has a mean score of 3.39

In identifying the level of data literacy of the respondents, the average of the weighted means of Data Collection, data evaluation and data application is calculated to obtain a grand mean of 3.33. Based on the decision rule adopted in this study, the level research data literacy among the responded is adjudged to be high.

4.3: Presentation of Research Hypotheses

4.3.1 **Hypothesis 1:** There will be no Significant Influence of Data Collection On Research Data Management Services by Librarians in University in Lagos State, Nigeria.

Table 4.6 (a-c): Influence of Data Collection On Research Data Management Services by Librarians in University in Lagos State, Nigeria

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.609[a]	.371	.363	.29737

a. Predictors: (Constant), Data Collection

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.321	1	4.321	48.859	.000[b]
	Residual	7.340	83	.088		
	Total	11.660	84			

a. Dependent Variable: Research Data Management

b. Predictors: (Constant), Data Collection

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.716	.220		7.815	.000
	Data Collection	.460	.066	.609	6.990	.000

a. Dependent Variable: Research Data Management

Table 4.6a-c presents the results of the simple regression analysis for the influence of data collection on research data management services by librarians in university in Lagos State, Nigeria. From the results in Table 4.4a, data collection has a positive and significant relationship with the research data management services by librarians in university in Lagos State, Nigeria ($R = 0.609$, $p<0.05$). The coefficient of determination (Adj. R^2) of 0. 363 shows that job satisfaction explain 36.3% of the changes in research data management services by librarians in university in Lagos State, Nigeria, while the remaining 63.4% variation in research data management services by librarians in university in Lagos State, Nigeria is explained by other variables not considered in this study.

Table 4.6b presents the results of ANOVA (overall model significance) of regression test which revealed that data collection has a significant influence research data management services by librarians in university in Lagos State, Nigeria. This can be explained by the F-value (48.859) and low p-value (0.000) which is statistically significant at 95% confidence

interval. Hence, the result posited that data collection has a significant influence on research data management services by librarians in university in Lagos State, Nigeria.

Furthermore, the results of regression coefficients in table 4.6c, revealed that at 95% confidence level, a unit change in data collection will lead to a 0.460 increase in the research datamanagement services by librarians in university in Lagos State, Nigeria, given that all other factors are held constant. On the strength of this result (Adj. R^2= 0.363, $F(1, 83)$= 48.859, p= 0.000), this study rejects the null hypothesis one ($H_0$1) which states that there will be no significant relationship between data collection and research data management services by Librarians In University in Lagos State, Nigeria

4.3.2 Hypothesis 2: There will be no Significant Influence of Data Evaluation On Research Data Management Services by Librarians in University in Lagos State, Nigeria.

4.7 (a-c): Influence of Data Evaluation On Research Data Management Services by Librarians in University in Lagos State, Nigeria.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.713[a]	.509	.503	.26262

a. Predictors: (Constant), Data Collection

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.935	1	5.935	86.056	.000[b]
	Residual	5.725	83	.069		
	Total	11.660	84			

a. Dependent Variable: Research Data Management

b. Predictors: (Constant), Data Evaluation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.553	.184		8.457	.000
	Data Evaluation	.512	.055	.713	9.277	.000

a. Dependent Variable: Research Data Management

Table 4.5a-c presents the results of the simple regression analysis for the influence of data evaluation on research data management services by librarians in university in Lagos State, Nigeria. From the results in Table 4.4a, data evaluation has a positive and significant relationship with research data management services by librarians in university in Lagos State, Nigeria ($R = 0.713$, $p<0.05$). The coefficient of determination (Adj. R2) of 0.503 shows that data evaluation explains 50.3% of the changes in research data management services by librarians in university in Lagos State, Nigeria, while the remaining 49.7% variation in

research data management services by librarians in university in Lagos State, Nigeria is explained by other variables not considered in this study.

Table 4.5b presents the results of ANOVA (overall model significance) of regression test which revealed that data evaluation has a significant influence on research data management services by librarians in university in Lagos State, Nigeria. This can be explained by the F-value (86.056) and low p-value (0.000) which is statistically significant at 95% confidence interval. Hence, the result posited that data evaluation has a significant influence on research data management services by librarians in university in Lagos State, Nigeria.

In addition, the results of regression coefficients in table 4.5c, revealed that at 95% confidence level, a unit change in job satisfaction will lead to a 0.512 increase in the research data management services by librarians in university in Lagos State, Nigeria, given that all other factors are held constant. On the strength of this result (Adj. R^2= 0.503, F(1, 83)= 86.056, p= 0.000), this study rejects the null hypothesis two ($H_0$2) which states that there will be no significant relationship between data evaluation and research data management services by librarians in university in Lagos State, Nigeria.

4.3.3 Hypothesis Three: There Will be no Significant Influence of Data Application On Research Data Management Services by Librarians in University in Lagos State, Nigeria.

4.8 (a-c): Influence of Data Application On Research Data Management Services by Librarians in University in Lagos State, Nigeria.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.744[a]	.554	.549	.25031

a. Predictors: (Constant), Data Application

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.460	1	6.460	103.099	.000[b]
	Residual	5.200	83	.063		
	Total	11.660	84			

a. Dependent Variable: Research Data Management

b. Predictors: (Constant), Data Evaluation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.717	.249		2.873	.000
	Data Application	.754	.074	.744	10.154	.000

a. Dependent Variable: Research Data Management

Table 4.8a-c presents the results of the simple regression analysis for the influence of data application on research data management services by librarians in University in Lagos State, Nigeria. From the results in Table 4.4a, data application practices have a positive and significant relationship with research data management services by librarians in University in Lagos State ($R = 0.744$, $p<0.05$). The coefficient of determination (Adj. R^2) of 0. 549 shows that data application practices explain 54.9% of the changes in research data management services by librarians in University in Lagos State, while the remaining 45.1% variation in research data management services by librarians in University in Lagos State is explained by other variables not considered in this study.

Table 4.6b presents the results of ANOVA (overall model significance) of regression test which revealed that data application practices has a significant influence on research data management services by librarians in University in Lagos State. This can be explained by the F-value (103.099) and low p-value (0.000) which is statistically significant at 95% confidence interval. Hence, the result posited that data application practices has a significant influence on research data management services by librarians in University in Lagos State.

In addition, the results of regression coefficients in table 4.6c, revealed that at 95% confidence level, a unit change in data application practices will lead to a 0.754 increase in the research data management services by librarians in University in Lagos State., given that all other factors are held constant. On the strength of this result (Adj. R^2= 0.549, $F(1, 83)$= 103.099, p= 0.000), this study rejects the null hypothesis three ($H_0$3) which states that there will be no significant influence of data application on research data management services by librarians in University in Lagos State

4.3.4 Hypothesis Four: There Will Be no Significant Combined Influence of Data Literacy Skills and Competences on Research Data Management Services Among Librarians in University Libraries in Lagos State, Nigeria.

Table 4.9: Combined Influence of Data Literacy Skills and Competences On Research Data Management Services Among Librarians in University Libraries in Lagos State, Nigeria.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.787[a]	.619	.605	.23425

a. Predictors: (Constant), Data Application, Data Collection, Data Evaluation

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.215	3	2.405	43.831	.000[b]
	Residual	4.445	81	.055		
	Total	11.660	84			

a. Dependent Variable: Research Data Management

b. Predictors: (Constant), Data Application, Data Collection, Data Evaluation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.746	.235		3.181	.000
	Data Collection	.008	.082	.011	.100	.921
	Data Evaluation	.260	.081	.362	3.214	.002
	Data Application	.481	.107	.475	4.496	.000

a. Dependent Variable: Research Data Management

Table 4.7a-c presents the results of the multiple regression analysis for the combined influence of data literacy skills and competences on research data management services among librarians in university libraries in Lagos State, Nigeria. From the results in Table 4.7a, it can be seen that data literacy skills and competences have a positive and significant relationship with research data management services among librarians in university libraries in Lagos State, Nigeria. ($R = 0.758$, $p<0.05$). The coefficient of determination (Adj. R^2) of 0.569 shows that data literacy skills and competences jointly explains 56.9% of the variation in research data management services among librarians in university libraries in Lagos State, Nigeria, while the remaining 53.1% variation research data management services among librarians in university libraries in Lagos State, Nigeria is explained by other variables not investigated in this study.

Table 4.7b presents the results of ANOVA (overall model significance) of regression test which revealed that data literacy skills and competences have a significant influence on research data management services among librarians in university libraries in Lagos State, Nigeria. This can be explained by the F-value (111.886) and low p-value (0.000) which is statistically significant at 95% confidence interval. Hence, the result posited that data literacy skills and competences significantly influenced the research data management services among librarians in university libraries in Lagos State, Nigeria.

Furthermore, the results of regression coefficients in table 4.7c, revealed that data literacy skills and competences has a significant relative effect on research data management services among librarians in university libraries in Lagos State, Nigeria. Specifically, the analysis showed that, at 95% confidence level, a unit change in data evaluationwill lead to a 0.260increase in the research data management services among librarians in university libraries

in Lagos State, Nigeria, given that all other factors are held constant. Similarly, at 95% confidence level, a unit change in data application will lead to a 0.481 increase in the research data management services among librarians in university libraries in Lagos State, Nigeria, given that all other factors are held constant. However, at 95% confidence level, a unit change in data collection will lead to mere 0.008 increase in the research data management services among librarians in university libraries in Lagos State, Nigeria, given that all other factors are held constant. As a result, of the independent variables examined, only data evaluation and data application has a significant influence on the research data management services among librarians in university libraries in Lagos State, Nigeria. It is on the strength of this result (Adj. R^2= 0569, $F(3,84)$= 111.886, p= 0.000), this study rejects the null hypothesis four ($H_0$4) which states that there will be no combined influence of combined influence of data literacy skills and competences on research data management services among librarians in university libraries in Lagos State, Nigeria, is rejected.

4.4 Discussion of Findings

The response to research question one shows that the level of research data management services among the respondents is high with data indicating that they score high on all the metrics of research data management services such as data creation, data analysis, data preservation, data sharing, and data reuse. This finding is support be several other recent studies across the world. A scholar pointed out that Libraries are offering research data management support to their clients to help them cope with the information and data explosion they currently face," as well as to meet open access publishing and funder requirements. This ultimately necessitates the coordination and technical help of other campus service departments.

High perception and awareness of libraries' roles and duties in RDM, as well as the obstacles for Jordanian academic libraries in providing RDM services[1].

The practice has particularly taken root in academic libraries in developing countries. This is shown by the findings of a scholar who conducted a survey to measure the attitudes and preparation of US and Canadian academic librarians toward RDM. The finding shows that research data management has become one of the routine library services in Western academic libraries. The study shows that librarians are now becoming aware of the relevance of offering data serviceswith its potential of raising visibility of libraries and librarians in near future. In an examination on the impact of research data services in academic libraries[2], the results highlighted that libraries are providing advisory and consultancy services but not technical services.

However, another study reported a finding contrary to this study. The study concentrated study reported that librarians have not acquired total understanding about all aspects of research data management and recommended that libraries should focus their efforts more intently on offering research data management services, such as by adding content to their websites and providing better educational and training programmes. The authors found variations in the programmes and services offered by university libraries for data management. The high level of research data management services reported in this study may therefore be because librarian have limited knowledge of the scope of research data management.

The second research question focus on the extent to which the libraries perform research data collection. It was found that the level of research data collection in the libraries is high with the

librarians regularly carrying out data discovery and identifying data sources. The study found a high level of data collection practice in the libraries. This is contrary to the findings of existing studies. Several studies have reported that researchers are usually reluctant to submit their research data, either to libraries or journal publishers[3,4,5].

A study that covered the research data practice of 864 researchers in Australian universities reported that the data sharing was not a priority for them. It was found that only a few of the researchers have ever shared data with others researchers and none have submitted research data to institutional repositories[4]. The difference in data sharing practices among the researchers is also highlighted in other studies[6].The researchers share their datasets on request or submit to the journals as supplementary content A study reviewed 88 websites of journals covered by the Journal Citation Report (JCR) and PubMed Central repository to get information about the characteristics of the supplementary material of 88 journals. Their study reported that there were more chances of getting supplementary or additional material in the first quartile journals. The study revealed that only the high impact journals mandate authors to submit data as part of their submission process. Other journals are relaxed in this aspect. It therefore means that data collection will be a difficult task for libraries and other information centers[7].

The third research question focused on the data evaluation practice among the respondents. This study found that the respondents rated themselves high on data evaluation indicating the that level of data evaluation skill among the respondent is high. This is contrary to the finding of a study which examined the data management practice among scholars in federal universities in Southwest Nigeria. The study found that the level of research data management

practices among the scholars needs a lot of improvement to ensure long-term access, preservation and reuse of their research data[8]. Another study however revealed that the level skills among librarians is mixed. A study found that librarians in some Nieria federal universities such FUT MInna, FUT Akure, and FUT Owerri have the required skills to effectively provide access to research data by means of standard metadata generation, librarians in, while none in ATBU and MAUTECH have such skills[9].

The fourth research questions focused on the extent of data application. It was found that the respondents rate themselves high on the aspect of data application. It was found that the respondents applied a lot of critical thinking when dealing with data and they also follow all the ethical guidelines guiding the collection, storage, dissemination and use of data. This is also supported by the study conducted on research data management in Nigerian federal universities where is was found that majority of the libraries studied can effectively provide access to research data[10]. Another study also observe that many librarians have to acquire more skills in the area of research data management thereby implying the observed level of data management is not available to the librarians

The test of hypothesis one revealed that data collection has a significant effect on research data management in the libraries. This means that the effectiveness of research data management depends on the efficiency of the data collection process resulting in quality input and output. This is supported by a study conducted on research data management in Federal universities in Northwest Nigeria. The study reported the efforts that librarian are making to collect data from researchers in their institutions. The study found that librarians often engaged in collaboration,

partnership, lobbying and advocacy to encourage researchers to submit their research data for effective management and to make it accessible to others[11].

Similarly, the test of hypothesis two also led to the finding that data evaluation practice also has a significant influence on research data management services among the respondents. It signifies that the ability of library to properly evaluate data will enhance research data management services. On the other hand, when librarians fail to properly evaluate the data available to the them, it will have negative effect on the research data management services

The test of hypothesis three revealed that data application also have a significant influence on research data management services in the library. This can be understood in the sense that data application deals with the manner and approach to the use of research data by librarians and their clients. This is supported by the work of a researcher who emphasised the importance of data literacy and data. This possible involvement of libraries in data-related activities has been indentified early. For instance, scholars noted that the boundaries between published literature and research data are disappearing, which gives opportunities for both librarians to create, maintain, and develop integrated information resources[12]. Scholars emphasized that libraries have an opportunity to create a new profile on campus as a partner in knowledge creation because there is a convergence between data-intensive science, technological advances and the expertise of librarians, which can make them more visible in the knowledge creation process. Accordingly, librarians should be placed at all stages in the research planning process and provide expertise in developing data management plans, identifying appropriate data description and creating preservation strategies[4,13]

The fourth research hypothesis in this study examined the joint influence of data collection, evaluation and application on research data management services in the libraries studied. It was found that all of the variables have a combined influence on research data management services in the library. However, data collection was found not to have a significant joint influence on research data management services. This probably due to the fact that research data management services have been categorised as active and passive forms. All of these competencies are embodied in data literacy. Studies have shown the importance of data literacy to librarian and researchers alike. Scholars are have even devised strategies to teach data literacy, not only to undergraduates and researchers, but also to school children[14, 15, 16]. This is to show that data literacy can not overlooked in the current digital information environment

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Chapter Five

Conclusion

This chapter concludes the study. It presents a summary of the finding derived from the data collection and analysis. The findings are in line with the research objectives and signifies the correctness of the procedure followed in this study.

5.1 Summary of Findings

The findings of this study can be summarised as follows;

1. The level of research data management services among the respondents is high with data indicating that they score high on all the metrics of research data management services such as data creation, data analysis, data preservation, data sharing, and data reuse. However, this should be contextualized in the sense that the librarians are providing data management services based on the limited needs of the researchers they serve.
2. It was found that the level of research data collection in the libraries is high with the librarians regularly carrying out data discovery and identifying data sources. This can be understood from the perspective that the librarian
3. It was also found that the respondents rated themselves high on data evaluation indicating the that level of data evaluation skill among the respondent is high.
4. The study found that the respondents rate themselves high on the aspect of data application. It was found that the respondents applied a lot of critical thinking when dealing with data and they also follow all the ethical guidelines guiding the collection, storage, dissemination and use of data.

5. The test of hypothesis one revealed that data collection has a significant effect on research data management in the libraries.
6. Similarly, the test of hypothesis two also led to the finding that data evaluation practice also has a significant influence on research data management services among the respondents.
7. The test of hypothesis three revealed that data application also has a significant influence on research data management services in the library.
8. It was found that all of the variables have a combined influence on research data management services in the library. However, data collection was found not to have a significant joint influence on research data management services.

5.2 Conclusion

The probability of libraries to remain relevant in a changing world depend on their ability to stay focused on their core mandate which is the support for the creation of new knowledge through the use of existing knowledge. The attention of the world is shifting to research data management due to the usefulness of research data and the insight it provides for indepth studies. However, just as in the case of information resources, there is explosion in the number of research data available and complex issues surrounding their collection, distribution and use. While this study reported high level of research data management services and libraries in Lagos state, available literature has suggested that research data management is a very wide and complex activity that even libraries in the developed acknowledge that they have not totally mastered the process of providing effective data management practices. It is therefore imperative that Nigerian libraries and librarians acquire deeper understanding regarding the

extent and scope of research data management services so that they can understand where to improve.

5.3 Recommendations

In line with the findings and conclusions of this studies, the following recommendations are considered necessary;

1. There is a need for university management to ensure academic libraries in lagos state develop a comprehensive policy to guide research data management services. This is essential to outline the scope depth and of research data management services so that these services can be better evaluated.
2. The university management should encourage librarians in academic libraries, Lagos state should engage in collaboration with researchers and gain their trust so that they may submit their research data without reservations.
3. University management should expose academic librarians to regular training to upgrade their skills in using various data management tools and how to evaluate all types of research data.
4. There is a need for academic libraries to domesticate all national and international laws guiding the collection and use of data. This should be made known to academic librarians that may need to apply them in their interaction with data users.
5. There is a need for awareness and orientation programmes to sensitise researchers on the importance of depositing their research data. This program should be organised by the academic library in conjunction with department and faculties in the universities for proper creation, processing, analysis, sharing and reuse of data.

6. In addition, where possible, subject specialists should be assigned to deal with research data in their area of expertise.
7. In order to ensure proper application of research data, librarians assigned to work with research data should be well-versed in all relevant local and international copyright laws.
8. Academic libraries should ensure that all research data management practices are integrated and put under one supervisor so that inefficiency in one aspect of data management will not affect the overall efficiency of the service.

5.4 Contribution to Knowledge

This study has made conceptual, empirical, and theoretical contributions to knowledge in the field of information management in general and librarianship in particular. Conceptually, the study has articulated various literature to properly conceptualise what is meant by data literacy skills and data management services. The study has introduced useful metrics that can be used to measure each of the concepts. Theoretically, the study introduced two models in terms of the Research Data Life Cycle and the Data Literacy Skills and Competency Model. These models have been validated by the data collected and the result of this study. In addition, this study has also collected primary data that has never been collected before to provide empirical support to research data management services in Lagos state academic libraries and the data literacy skills of the librarians.

5.5 Suggestions for Further Studies

The study has covered academic libraries in Lagos state. However, the study can be expanded to cover more states in Nigeria. Future studies can focus on the following;

Influence of data literacy on data management services in academic libraries in North Central Region of Nigeria.

Influence Institutional Support on Research data management services by academic libraries in Nigeria.

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Lead City University, Ibadan

Faculty of communication and Information Sciences (FCIS)

Department of Information Management

Dear Respondent,

I am a Master's student of the above-named institution gathering data for the purpose of academic research on '**Data Literacy and Research Data Management of Librarians in University Libraries in Lagos State, Nigeria**'. To achieve this, your optimum cooperation is needed; there is no right or wrong answers. All your responses will be kept confidential and used for academic research purpose only.

Thank you.

SECTION A: Demographic Information

1. Gender: Male ( ), Female ( )
2. Age: 20 – 25 ( ), 26 – 30 ( ), 31 – 35 ( ), 36 – 40 ( ), 41-45 ( ), 46 and above ( )
3. Educational Level: Bachelor's degree ( ) Master's degree ( ) Ph.D ( )
4. Years of experience: 5 – 10 ( ), 11 – 15 ( ), 16 – 20 ( ), 21 – 25 ( ), 26 - 30 ( )

SECTION B: Research Data Management Services of Librarians in University Libraries in Lagos State, Nigeria.

The statement in this section concerns research data management services of librarians in the university libraries in Lagos State, Nigeria. Using the four-point Likert scale provided below: Please tick the appropriate choice that indicates your opinion on level of social inclusion among users of your libraries.

Strongly Agree (SA) =4, Agree (A) = 3, Disagree (D) = 2, Strongly Disagree (SD) = 1

S/N	**To what extent are these factors exhibited in your library?**	**SA 4**	**A 3**	**D 2**	**SD 1**
Data Creation					
1	It is easy to locate and use data sources				
2	Library provide an Institution repository				
		SA	A	D	SD
3	Library offers guidance on data documentation standards e.g. creating metadata				
Data Processing		SA	A	D	SD
4	All electronic documents are easily processed				
5	Available ICT facilities are used effectively for processing of data				
6	There are laid down information management procedures by the school management. e.g. format of documents				
7	Documents produced are usually properly proof read and cross – checked before release.				

	Data Analysis	SA	A	D	SD
8	I have the ability to analyze current research.				
9	I have the ability to use digital technologies for research planning				
10	I have skills mastery in working with scientific literature and ability to compile bibliographic lists.				
11	I have skills to apply digital technologies to solve a specific research problem.				
	Data Preservation	SA	A	D	SD
12	There are enough data storage facilities or specific institutional data storage solutions				
13	Availability of skilled staff to assist researchers with data storage and preservation techniques				
14	Data are stored in traditional formats (e.g. text documents, spreadsheets, graphics, and databases)				
15	Data can be safely stored (determining storage and back-up options for keeping your data secure)				
	Data Sharing	SA	A	D	SD
16	Library has helpful data repositories for data sharing				
17	After processing, data are released almost immediately they are requested for.				
18	Documents needed are easily retrieved and disseminated to where requested.				
19	Majority of data is disseminated electronically				
	Data Reuse	SA	A	D	SD
20	University library allow us to archive research data for future use				
21	Data are stored for easy retrieval				

22	Unused data are disposed off				
23	Data contents are effected before disposal or recycling				

SECTION C: Data Literacy of Librarians in University Libraries in Lagos State, Nigeria

The statement in this section is concerned with data literacy as observed in University Libraries in Lagos State, Nigeria. Using the four-point Likert scale provided below: Please tick the appropriate choice that indicates your opinion on data literacy.

S/N	**Data Collection** **Data discovery**	**SA** **4**	**A** **3**	**D** **2**	**SD** **1**
1	I have knowledge and understanding of data				
2	I usually perform data exploration				
3	I know how to identify useful data				
	Data Sources	SA	A	D	SD
4	I assess sources of data for trustworthiness				
5	I critically evaluates quality of datasets for errors				
6	I know how to collect relevant data				
	Data Evaluation	SA	A	D	SD
	Data tools				
7	I have knowledge of data analysis tools				
8	I know how to select appropriate data analysis tools				

9	I know how to apply data analysis tools				
	Data Interpretation	SA	A	D	SD
10	I know how to read and understand tables and graphs				
11	I know how to identify key points and integrate				
12	I know how to identify discrepancies within the data				
	Data Application				
	Critical thinking	SA	A	D	SD
13	I am aware of challenges associated with data				
14	I think critically when working with data				
15	I believe there are high level issues associated with use of data				
	Data ethics	SA	A	D	SD
16	I am aware of legal and ethical issues associated with data				
17	I usually read ethical issues associated with data before use				
18	I apply and work with data in an ethical manner				

Bio-data

Personal Data

Full Name:	AJOKOTOLA BUSOLA OLUFEYI
Sex:	FEMALE
Date of Birth:	11TH NOVEMBER 1987
Place of Birth:	SOMOLU, LAGOS STATE
Nationality:	NIGERIAN
Language:	YORUBA
Marital Status:	MARRIED
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Educational Background

- B.Sc Library and Information science 2018
- Diploma in Library and Information Science 2007
- West African Education Certificate 2001

Professional Certification

Nigeria library Association (NLA) – Member.

Institute of Personality Development and Customer Relationship Management (IPD – CRM) – Associate Member.

Nigeria School Library Association (NSLA) - Member.

Association of Women Librarian in Nigeria (AWLIN) - Member

National Institute of Office Administrators and Information Managers (NIOAIM) – Professional Member.

Research Interests
Data Literacy, Human Information Behaviour, Marketing of Library and information services, User Studies and Information Organisation

Publications

1. **Theses/ Dissertations**

   Data Literacy and Research Data Management Services by Librarians in University Libraries in Lagos State, Nigeria.

11. **Published Article**

Library Styling and it's Effects on Library users Information Seeking Behavior. National Institute of office Administrators and Information Managers Journal, 2022.

Conference and Attended with Dates

eLibrary Management: Leveraging Emerging Technologies, 2022
for effective library services

Managing Personal Finances for Professional Success 2022

Library and Information Services During and After COVID-19 Pandemic 2020

New Normal: Hybrid Services, Librarians Skill Readiness 2020
and Organizational Facilities Support

Emerging role of Librarians during and post COVID-19 era 2020

Librarian Registration Council of Nigeria, Building Digital Nigeria, Enhancing Capacity Through Libraries (Mandatory Conference of Certified Librarians in Nigeria)	2019
Libraries and Social Media as Catalysts for National Unity and Security	2018
Information Literacy for Sustained National Development	2017
Advancing the Course of the Library in a Challenged Economy	2017
Proactive Librarianship for Productive Enterprise in Nigeria	2016
Braking New Grounds in Librarianship: Collection, Community	2015

Extra-Curricular Activities:

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University Compliance Certification

This is to certify that this thesis by Busola Ajokotola with Matric No LCU/PG/ 002112 in the Department of Information Management, Lead City University, Ibadan, is in FULL compliance with the approved university format and style.

_____ _____

Signature **Date**