UNIVERSITY OF EDUCATION, WINNEBA

ASSESSING THE USE OF OPEN-SOURCE SOFTWARE IN LIBRARIES IN GHANA. CASE STUDY OF SELECTED UNIVERSITIES IN THE KUMASI METROPOLIS

JEMILA MARIAM MENSAH

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A DISSERTATION SUBMITTED TO SCHOOL OF GRADUATE STUDIES, AKENTEN APPIAH MINKAH UNIVERSITY OF ENTREPRENEURSHIP AND SKILLS TRAINING, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF INFORMATION TECHNOLOGY EDUCATION

DECEMBER, 2021

DECLARATION

STUDENT'S DECLARATION

I, JEMILA MARIAM MENSAH, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:…….

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SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis/dissertation/project as laid down by the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development.

SUPERVISOR: DR. FRANCIS O. BOATENG

SIGNATURE:…….

DATE:……..

DEDICATION

This research work is dedicated to my son Rahman Appiah.

ACKNOWLEDGEMENT

I am thankful to Almighty ALLAH for giving me strength, wisdom, knowledge and above all good health for the duration of the program especially in hard times like covid-19 pandemic.

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To the above personalities and all my friends who helped in diverse ways to make this work a success, I say if I can see further than others do, then it is simply because I stood on the shoulders of giants like you. I say thanks for having you around and wish everyone the best in the future.

TABLE OF CONTENT

CONTENT **PAGE**

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The introduction of Open-Source Software has provided low-cost opportunities for libraries transitioned from traditional to technology-based library services, which also give room for more efficient service provision. This study investigated the use of Open-Source Software in selected Universities in the Kumasi Metropolis. The study was based on survey research methodology and questionnaire was used to gather data from 70 respondents. The study revealed that the use of open-source software as adopted by the libraries were considered advantageous due to their flexibility, ease of modification, ease of accessibility and reliability. The study also discovered that the libraries' staff do not really utilize the adopted open software as envisioned by the library management, as staff possessed only average computer literacy skills and knowledge in the use of open-source software. On the flipside, the study found out that some limitations, such as inadequate training, lack of expertise to train for and manage the software, breakdowns which require special expertise, vulnerability to malicious users, and inadequate user-friendliness of the software as compared to proprietary software. The study recommended that management of the Academic Libraries should put measures and policies in place to address the challenges being faced in the use of the Open-Source Software, such as constant orientation and training of staff, provision of infrastructural support, and provision of technical support and installation of robust antivirus software.

LIST OF ABBREVIATIONS

BSD- Berkeley Software Distribution

CDDL- Common Development and Distribution License (CDDL)

CO- Commercial Software

GPL- GNU General Public License

ICTs- Information and Communication Technologies

OSD- Open-source Definition

OSI- Open-source Initiative

OSLMS- Open-source Library Management Systems

UTAUT - Unified Theory of Acceptance and Use of Technology

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

The library as a growing organism, has over the years proven to be accurate (Barner, 2011). According to Barner (2011), the library is an institution that is active in a constantly changing environment, and accordingly, the institution should transform and adapt itself with the spirit of time so it can serve best those who need it. Consequently, libraries have moved from traditional circulation services to present information services. As such, the introduction of Information and Communication Technology (ICT) into library services has transformed to a great extent, the nature of library operations in the 21st century.

Today, information services are strengthened due to advancement in internet, e-resources and computer software (Agrawal, 2015). Hence, almost all library functions, i.e., acquisition, processing, maintenance, and dissemination have been affected by these technological changes. This has placed a growing demand on academic libraries in particular to adapt to change, so as to effectively and efficiently serve the information needs of the scholarly community. The invention of paper in 105 AD in China by Cai Lun, and printing machine in the 15th Century in Europe, were the initial factors that changed the status and fate of libraries worldwide (Nakakoji, 2002). It has been observed that, since then, libraries have witnessed technology growth in all aspects, i.e., collection, process, and services. Agrawal (2015) suggests that collection-wise, it has grown over time from clay tablets to papyrus rolls, to paper, and now to electronic documents. Even

the process of preparation of library records has changed from handwritten records using an ink pen to typewriters and now to computers.

Additionally, services of librarians have changed from guardians of documents to circulators of documents, to information providers and now he or she is regarded as knowledge manager (Agrawal, 2015). The technological changes have been affecting almost every type of library including public, academic and special libraries. Gbaje (2007) in his contribution to library software stated that, the use of library application software in university libraries has evolved from managing internal library operations to providing access to information and information resources in various formats and in many locations through a combination of Information and Communication Technologies (ICTs).

Following this development, there is a paradigm shift from local collections to global information access, thus, making it possible for the removal of geographical constraints to the access of library services. Libraries as organizations are involved in information creation, processing, organizing, storage, disseminating and utilization. It has therefore become necessary for libraries to produce tools and systematic procedures for all activities to provide effective information management. The idea of computerization of libraries gave birth to the development of library application software packages (Ayodele, 2016). Though the open-source library management systems (OSLMS) have come to the limelight at the beginning of the 21st century, and library professionals are aware of their advanced features, they are still in their infancy stage in many parts of the world, particularly, Africa. The Open-source Software (OSS) has an edge over Commercial Software (CO) as they have got continuous development and regularly updated because

of community involvement. Although some external agencies are extending technical support for OSS, Commercial Software still holds in the market (Gangadhar et al., 2017).

This study will adopt the Unified Theory of Acceptance and Use of Technology (UTAUT) propounded by Venkatesh et al., (2003). One key feature of the above theory that supports this study is Social Influence. Social influence can be referred to as the change in behavior that one person causes in another, deliberately or undeliberately, as a result of the way the changed person perceives themselves in relationship to the influencer, other people and society in general. In doing so, one complies and accepts the introduction of a new system. Compliance refers to the state where a person does something that he or she is asked to do by another, with the aim of improving an existing situation. Such a person may choose to comply or not to comply, although the thoughts of social reward and punishment may compel them to comply, when in actual fact they really do not want to.

Similarly, in accepting a new technology like Open-Source Software in most cases, academic library staffs are likely to find themselves in instances where they have no choice but to comply with instructions about the introduction and/or use of new technology that a superior may instruct them to use. According to Reddy and Kumar (2013) Open-Source Software is a computer software whose source code is available under a license for users to look at and modify freely, and permits users study, change, and improve the software, and to redistribute it in modified or unmodified form. Many developers around the world are involved in the development and modifications of these programs with licenses that conform to the Open-source Definition (OSD).

From the last decade, the OSS has been spread rapidly in the whole software world (Gangadhar et al., 2017). Open source emerged as an alternative model of software development. It has transformed the development of software and offers a number of attractions for libraries, especially for developing countries.

The library landscape has dramatically changed over the last few years as a result of the introduction of LMS in libraries. A brief survey of academic libraries in the country showed that most of the universities, both private and public, were at various stages in the process of adopting a library management system for their operations. With the exception of the University of Ghana-Legon, which has the Millennium Integrated Library System, other public universities, particularly, Kwame Nkrumah University of Science and Technology (KNUST), Christian Service University and Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development have shied away from expensive library systems.

It is an open secret that all academic libraries in the country are looking at cutting costs by choosing a non-propriety library management system. Furthermore, the library supply market in Ghana is non-existent. Therefore, every choice about a library management system has to involve looking outside the country, whether that means the UK, Europe, the US or South Africa. as cited in Omeluzor, et al., (2015) who lamented that the major problem that libraries in developing countries have with international vendors relates to cost and support. This applies equally to the Ghanaian situation because the local library markets in both countries are similar as far as technical support and systems suppliers are concerned. Thus, there is an existing opportunity for libraries to look at alternate ways of integrating efficient Library Management Systems in their operations. Open source

permits a library to participate directly in the development of its systems and services in a manner consistent with the value of librarianship.

Today, there is great demand as well as challenges, and opportunities for librarians to develop a library database for worldwide access not only bibliographic but also full text. Open-source Software enables academic libraries to automate their services. The International Encyclopedia of Information Technology and Library Science defines automation as the technology concerned with the design and development of process and system that minimize the necessity of human intervention in their operation. The fundamental unit of the requirement for automation is the technological infrastructure. The infrastructure mainly consists of computers. The computers are the essential components for the automation. It is that super product of electronics that is capable of performing the functions as desired by the user with maximum accuracy and quickness. (Sonker, 2000).

Due to the vast explosion of information, librarians are facing difficulties to meet the user demand and are forced to take up the task of systematic organization of the recorded knowledge. On the other hand, computer programmes are being very much advanced day by day in each and every activity. Librarians are also moving with this fast development of computers using various kinds of databases, software and library automation software packages and automating their diverse activities in the libraries, as a solution for this matter (Sonker, 2000). Today, Open-source Software is being widely used in the library domain. Technology has advanced, and the library faces many challenges of integrating traditional and emerging formats (Sonker, 2000). The rapid growth of the Open-source Software and explosion of web technology has provided huge opportunities for library

professionals at the same time. Open-source Software is now easily available for download with their source code free of cost which provides an opportunity to save money as well as removing the dependency on proprietary software. In this setting, it is necessary to study the major types of Open-source Software used in academic libraries in Ghana, along with a discussion on their advantages and limitations. Ray and Ramesh (2017) postulates that the value of any Open-source Software is measured in terms of its simplicity and connectivity.

Some examples of Open-source Software include Kalamazoo Optimist Hockey Association (Koha) Greenstone Digital Library (GSDL), Open Journal System (OJS) and DuraSpace (Dspace). There is, therefore, the need to conduct a study into the use of Open-source Software in academic libraries, explore the advantages and limitations of OSS within the library domain and the types of OSS used and other constructs that deem importance for further research. This study explores the use of open-source software at various academic libraries of Ghanaian universities.

1.1 Statement of the Problem

According to Sonker (2000) inadequate funding, low IT knowledge of library staff and erratic power supply contributed to the under usage of library software at various academic libraries. In effect, it rendered the Software being underutilized. Sonker (2000) suggests that Open-source Software is not widely used in many academic institutions in Africa and this includes those in Ghana. One can suggest that institutions budgetary constraints due to the lack of funds and economic hardships being experienced in developing countries.

From the researcher's own observation, it was found that, despite the phenomenal advantages of adopting open-source software in the management of the academic library, the extent of its use is considerably low. Also, it has been observed that a sizeable number of staff at various academic libraries are unable to utilize the full capabilities of open-source software for the management of their library activities. Numerous studies have been done on the adoption of other software for academic libraries; however, very few studies have been undertaken on the use of Open-source Software in academic libraries in Ghana. It is against this background that the researcher found it imperative to conduct this study and order to fill this knowledge gap.

1.2 Purpose of the Study

The purpose of this study is to examine the use of Open-Source Software at University Libraries in the Kumasi Metropolis. To achieve the purpose of the study, the researcher came out with the following specific objectives.

1. To identify the available Open-Source Software in the University Libraries.
2. To determine the extent of use of Open-Source Software provided at the Libraries.
3. To evaluate the level of IT skills of library staff in the use of Open-source Software at various libraries.
4. To identify the limitations of the use of Open-Source Software at the University Libraries.

1.3 Research Questions

1. What are the available Open-source Software available in the University Libraries?

2. To what extent do the University Libraries use Open-Source Software?
3. What is the skill level of library staff in the use of Open-source Software?
4. What are the limitations of the usage of Open-Source Software and how can they be rectified?

1.4 Significance of the Study

This study will provide enormous benefits to Ghanaian academic libraries and the public in that Librarians may see a clear parallel to their own work, which is that sharing information with the community provides a worthwhile public good that feeds back to benefit the community as a whole. Secondly this study will enhance the libraries contributions to the scholarly community (in the form of research assistance, information access, and other services) which will result in the recognition of the libraries' value as an organ of the academic enterprise.

Finally, this study will provide the basis for all academic libraries in the country to adopt open-source systems; these systems run on more devices, are transparent in their functions and less susceptible to information restriction, and in general is ethically and philosophically compatible with libraries' mission of information neutrality source. This in effect will cajole government investments into the open-source architecture.

1.5 Delimitation

This study will be conducted at the main Academic Libraries of Christian Service University, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, (AAMUSTED) and the Kwame Nkrumah University of Science and Technology (KNUST). These are some of the few libraries that have adopted the open-source software for its activities.

1.6 Organisation of the Study

This study is grouped into five (5) chapters.

Chapter One comprises, the background of the study, statement of the problem, the purpose of the study, objectives of the study, research questions, scope of the study, significance of the study and organization of the study.

Chapter Two presents a review of related literature on the topic under study. This chapter reviewed the existing literature relevant to the study. The topics were discussed from a world point of view, African and Ghanaian point of view under the subheadings: General Concepts about Open Software, the use of Open-source Software in in Academic Libraries, funding and maintenance of Open-source Software, and IT skills required to work as a library staff.

Chapter Three elucidates the methodology that was followed for the study which includes:

Research design, the population of the study, sample size, data collection instrument, data collection procedure, analysis and presentation of data.

Chapter Four deals with the presentation of data and discussion of the findings of the study. Chapter Five provides a summary of the findings, conclusion, and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This study is aimed at assessing examining the use of Open-source Software at Academic Libraries in the Kumasi Metropolis. This chapter of the project critically reviews the literature concerning the key areas of managing academic libraries. The literature of this study has been reviewed along the line of world, African and Ghanaian views of the use of Open-Source Software in Academic Libraries. The literature was reviewed along with the following concepts.

- Concept of Open-Source Software
- Advantages of open-source software in academic libraries
- The extent of the use of open-source software in academic libraries
- ICT skills and competencies of library staff
- Sources of funding for open-source software in academic libraries
- Limitations of Open-source Software for library work

2.1 Theoretical Framework of the Study

This section generally presents the theories and concepts associated with the integration of open-source software systems in managing academic libraries. Moreover, the relationships between theories as they relate to this research study are analysed.

2.1.1 Concept of Open-Source Software (OSS)

The proliferation of the internet has vastly changed the way of service delivery and it is greatly evidenced in the area of the library. This has led to the provision of digital

libraries where users, patrons or clientele can get access to library resources irrespective of the geographical location or period of time. Over the last few decades, libraries have evolved from traditional, paper-based institutions primarily serving needs of "digital fugitive" patrons into a web-accessible, multiformat repositories that hold a wide variety of physical (books, periodicals, magazines) and virtual/digital collections (e-books, audio, videos, music) catering to the needs of their growing "digital immigrant" and "digital native" customers (Upasani, 2016).

According to Omeluzor et al., (2012) Koha is the first open-source integrated library software (ILS) in use worldwide by public, schools and special libraries which its development was steered by a growing community of libraries and users collaborating to achieve their technological goal. The developers of KOHA and other Open-source software released their source codes so they could become publicly owned and thus stimulate innovation and capacity development.

2.1.2 Open-source Software Concept and Technologies

The term "open-source software" (OSS) refers to computer applications and operating systems released under terms allowing users to use, modify, or redistribute the software in any way they see fit, without requiring users to pay the creators a fee. It is known as "open-source" because the source code is made available for examination or alteration along with the ready-to-use software itself (Puckett, 2018).

Open-source software is a software that users can run, copy, distribute, study, change, share and improve for any purpose. Open-source library software's does not need the initial cost of commercial software and enables libraries to have greater control over their

working environment" (Randhawa, 2018). In Randhawa's (2017), Open-source software is computer software whose source code is available under a license (or arrangement such as the public domain) that permits users to study, change, and improve the software, and to redistribute it in the modified or unmodified firm. It is often developed in a public, collaborative manner.

Lochhaas (2017) explained that open-source software is software that provides access to the source code, meaning that users are free to see how the product is made. Additionally, users have the right to modify the product (change the code) to their liking, experiment with different versions, and give away or resell the new product with the guarantee that they must also provide their source code, and so on. Modifying the product and redistribution are the two main components of open-source software.

The decision to make a piece of software open-source carries with it some implied stances on issues of freedom of information. Making the decision to share the source code for an application implies that the creator believes that sharing information is a worthwhile good. Sharing access to a program's code does not simply make it available for examination; it usually signifies that collaborative development is possible—that the software's community of users may participate in its development.

These values of free access and collaboration align with many of the tenets central to the profession of librarianship and with academic librarianship in particular. In practical terms, both the OSS community and the profession of librarianship value open standards for their ability to promote accessible information. OSS tends to be more compatible with open data standards, providing better long-term accessibility and preservation of data.

In actual terms, OSS itself is amenable to long-term preservation, since any interested party may save, examine, or archive the software's code. OSS is more likely to be developed for multiple platforms, allowing longer-term compatibility with new and future technology. OSS represents a manifestation of the same cultural and economic factors behind other movements toward free information in academic librarianship, like open access (OA) journal publishing. Open-source code, like OA journals, is freely disseminated, easily archived on multiple sites, and its integrity and authenticity can be checked against versions from other archives to guard against alteration or deletion (Morgan, 2004).

2.1.3 Open-source Initiative (OSI)

Open-source is a term describing a means of developing and distributing software that ensures software is available for use, modification, and redistribution by anyone. Generally, anyone can download open-source software for free or a small fee, and can use, share, borrow, or change it without restriction. Open-source practice promotes software reliability and quality by supporting independent peer review and rapid evolution of source code.

The Open-source Initiative (OSI) is a non-profit corporation whose goal is to promote the use of open-source software in the commercial world. To accomplish this goal, OSI maintains and promotes the Open-source Definition and offers the OSI Certified Open-source Software Certification Mark and Program. To be OSI certified, the software must be distributed under a license that guarantees the right to read, redistribute, modify, and

use the software freely. The Open-source Definition provided by OSI contains the following elements:

- Free redistribution
- Source code
- Derived works
- Integrity of the author's source code
- No discrimination against persons or groups
- No discrimination against fields of endeavor
- Distribution of license
- License must not be specific to a product
- License must not restrict other software
- License must be technology-neutral

2.1.4 Open-Source Licenses

Open-source licenses are legal and binding contracts between the author and the user of a software component, declaring that the software can be used in commercial applications under specified conditions (Goldstein, 2019). The license is what turns code into an open-source component. Without an open-source license, the software component is unusable by others, even if it has been publicly posted.

According to Goldstein (2019) each open-source license states what users are permitted do with the software components, their obligations, and what they cannot do as per the terms and conditions. Varying in complexity and requirements, it is up to organizations

to choose which licenses are most compatible with their policies to ensure that they remain compliant.

2.4.1 Types of Open-Source Licenses

Open-source licenses can be divided into two main categories: copyleft and permissive. This division is based on the requirements and restrictions the license places on users.

- **Copyleft License**

Copyright is a law that restricts the right to use, modify, and share creative works without the permission of the copyright holder. When an author releases a program under a copyleft license, they make a claim on the copyright of the work and issue a statement that other people have the right to use, modify, and share the work as long as the reciprocity of the obligation is maintained.

- **Permissive Open-source License**

A permissive open-source license is a non-copyleft open-source license that guarantees the freedom to use, modify, and redistribute, while also permitting proprietary derivative works. Permissive open-source licenses, otherwise referred to as “Anything Goes”, place minimal restrictions on how others can use open-source components. This type of license allows varying degrees of freedom to use, modify, and redistribute open-source code, permitting its use in proprietary derivative works, and requiring nearly nothing in return in regards to obligations moving forward.

Most Commonly used Open-source Licenses

- **GNU General Public License (GPL)**

The GNU's General Public License is the most popular open-source license around. GPL was created by Richard Stallman to protect the GNU software from becoming proprietary, and it is a specific implementation of "copyleft" concept.

This means that any software that is written based on any GPL component must be released as open-source. This implies that any software that uses any GPL open-source component required to release its full source code and all of the rights to modify and distribute the entire code.

- **The Apache License**

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- **Eclipse Public License (EPL)**

The Eclipse Public License (EPL) is an open-source license developed by the Eclipse Foundation. It's derived from the Common Public License (CPL). The Eclipse codebase now available under the EPL was formerly licensed under the CPL. The EPL license is a copyleft license.

A user is required to disclose the modified code under EPL if they modify the component and distributed it in the source code form. Moreover, when a program is distributed in the object code form, the user is required to state that the source code can be made available to the recipient upon request. You're also required to share the method for requesting the source code.

2.2 Empirical Basis of the Study

This section of the study derives conclusions based on experiences on the application of open-source software in various academic libraries. The inferences drawn by quantification and observation of the usage of open-source systems are subsequently provided in this section of the study. Inferences are drawn based on the specific objectives of the study.

2.2.1 Application of Open-Source Software in contemporary libraries

Open-source Software used in libraries are as follows: Integrated Library Management Systems (Library Automation), Content Management System, Digital Library, Learning Management System, E-publishing etc.

1. Library Automation

Automation of library services and the use of open-source software are essential for efficiency and effectiveness and at a minimal cost, too. Library automation benefits both the library staff and the users as it reduces the level of job stress on the staff and enhances remote and timely provision of up-to-date information to the users.

Libraries presently are confronted with issues which cut across; geometrically progressive information growth and shrinking space, change in users' information

behaviour, means of organizing the flood of information, Cost hike of printed reading materials and need for resource sharing. The need to overcome these issues and make the library more efficient and effective in their service delivery, makes automation of library services imperative. The traditional method of managing the library is no longer efficient as the use of computers and other technologies is conventionally adopted to enhance services provided by the library. Library automation enhances the speed, productivity, adequacy, and efficiency of the library staff. Time and the manpower that could be expended in performing some technical and readers services routine and clerical tasks such as filing, sorting, duplicating, etc, are conserved when the library is automated. According to Aswal (2006), library automation is pivotal to library effectiveness because it increases staff productivity, enhances housekeeping operations, enables advancement in technology, and enables access to external information through the Internet. Sudhamani (2010) supporting the above enumerated the following as relevance of library automation

- It improves the quality, speed and effectiveness of service
- Improves access to remote users
- Facilitates wider dissemination of information products and services
- Facilitates resource sharing among libraries
- Enables rapid communication with other libraries
- Improves the management of physical and financial resources
- Facilitates generation of reports for better decision making and effective management of the library

It is in line with the above that Neelakandan et al., (2010) also stated that for expeditious retrieval and dissemination of information and better services to the clientele, application of modern techniques in the form of automation has become absolutely indispensable. An automated library will help its users with quick, accurate and prompt services. Automating the information available in the library benefits both the staff and users alike.

The researcher recognizes the crucial role library automation plays in library management as enumerated below:

a) **Improves access:** Automated libraries enable faster, more efficient and more comprehensive searches. It retrieves and sorts materials using the varying access points such as: the title, author, International Standard Book Number (ISBN) numbers, keywords, publisher and publication date by mere simple mouse clicks. Posting the electronic catalog on the Internet also enables easy access to the library holdings. B

b) **Improves the quality and effectiveness of services to remote users:** Automation improves library services in line with new forms of learning, such as e-learning and distance education. It enables libraries to satisfy the demand for ready reference/information services.

c) Saves professional manpower time: professional staff time that could have been spent in performing routine and repetitive technical works such as bibliographic verification/searching, order placement, checking duplicates, charging and discharging of records as well as cataloguing jobs are saved in an automated library environment.

d) **Facilitates wider dissemination of information products and services:** it gives room for users even from remote areas to access the library resources and enables easy and timely provision of such services as Current Awareness (CA) and Selective Dissemination of Information (SDI).

e) **Resource-sharing among libraries (Union Catalogues):** Automated cataloging standards, such as MARC (Machine Readable Cataloging), allow for quicker cataloging of library items and makes the sharing of materials among libraries much easier and much more affordable. It enables consortium formulation and makes library collaboration very easy.

f) **Control and management:** Automation enables library staff to circulate materials with ease, accurately track individual users' transactions, and enables users to do self-charging and discharging. Automation also facilitates periodic stock inventories without having to suspend library operations. It gives room for improvement in the variety, amount and quality of materials that are available in the library's collection. It also helps make weeding out outdated and irrelevant books and materials from the collection, which helps keep the library's collection more streamlined and easier to find the right item.

2. Application of Open-source Content Management Software in libraries

The library is one of the main center points to develop a content management system to do it in a perfect manner OSS are very helpful such as DRUPAL and JOOMLA.

- **Wordpress**

Wordpress started out as a quick, free, open-source solution blogging solution just a few years ago; today it is a perfect alternative to building a web site from scratch. In addition to being free to use (and easy to install), the Wordpress community has exploded, with thousands of users and programmers creating custom themes and plug-ins to completely change the way the software looks and operates. The most important aspect of the software is its easy-to-use interface and content management system. With its visual rich editor, anyone can publish text and photos to the web site. Other options include multiple authors (with separate log-ins), built in RSS (Real Simple Syndication) technology to keep subscribers updated, and a comment system that allows readers to interact with the content of the site (Randhawa, 2018).

- **Drupal**

Drupal is another open-source web publishing option that allows an individual or a community of users to easily publish, manage and organize a wide variety of content on a website. Tens of thousands of people and organizations have used Drupal to power scores of different web sites, including Community web portals, Discussion sites, Corporate web sites, Intranet applications, Personal web sites or blogs, E-commerce applications, Resource directories, Social Networking sites (Njoku, 2017).

3. Application of Open-source Digital Library Software

Nowadays, digital libraries provide an integrated set of services for capturing, cataloguing, storing, searching, protecting, and retrieving information, which provide a coherent organization and convenient access to typically large amounts of digital information. The implementation of Digital library Software helps the user

mainly in the retrieval of needed information such as faculty publication, Question papers, Newspaper clippings, Video Lecture and so on, this all together called an Institutional Repository (Satheesh, 2012).

2.2.2 Open-Source Software for Libraries

- **NewGenLib**

NewGenLib (New Generation Library) is an Integrated Library Automation and Networking Solution Developed by Verus Solutions Pvt Ltd and The Kesavan Institute of Information and Knowledge Management, India. NewGenLib is a fully web based integrated library management software that runs on distributed computers through a network or server. It can also run on local area networks without access to the Internet, although some of the advantages of using it via the web will be lost. It uses a number of well supported and widely-used, reliable and well tested open-source components like PostgreSQL, Apache Tomcat, and Solr Lucene. . NewGenLib is entirely Java-based, platform neutral, and uses the following related software technologies in its presentation, web server and database layers: Java.6.0, PostgreSQL 8.X Database server, Apache Tomcat, Spring Framework, XML and JSON etc.

- **Evergreen**

Evergreen “ILS is another option when researching open-source ILS options. Developed by Equinox Software, Evergreen is a robust, enterprise-level ILS solution developed to be capable of support in the workload of large libraries in a fault-tolerant system. It too is standards compliant and uses the OPAC interface, and offers many features including flexible administration, workflow customization, adaptable programming interfaces, and

because its open-source, cannot be locked away and can benefit from any community contributions (Satheesh, 2012).

- **Greenstone Digital Library Software**

The Greenstone digital library software is an open-source system for the construction and presentation of information collections. It builds collections with effective full-text searching and metadata-based browsing facilities that are attractive and easy to use. Moreover, they are easily maintained and can be augmented and rebuilt entirely automatically. The system is extensible: software "plugins" accommodate different document and metadata types. The aim of the Greenstone software is to empower users, particularly in universities, libraries, and other public service institutions, to build their own digital libraries (Satheesh, 2012)

- **DSpace**

DuraSpace (DSpace) is a groundbreaking digital institutional repository software package that captures, stores, indexes, preserves, and redistributes the intellectual output of a university's research faculty in digital formats. It manages and distributes digital items, made up of digital files and allows for the creation, indexing, and searching of associated metadata to locate and retrieve the items. DSpace design and developed by Massachusetts Institute of Technology (MIT) Libraries and Hewlett-Packard (HP). DSpace was designed as an open-source application that institutions and organizations could run with relatively few resources. It is to support the long-term preservation of the digital material stored in the repository. It is also designed to make submission easy. DSpace supports submission, management, and access to digital content (Satheesh, 2012).

- **Koha**

Koha is the "world's first free and open-source Integrated Library System (ILS). It has features suitable for the library management system of various types and sizes. Koha is a browser-based using an Online public access catalog interface. There is no cost for the license, and users have the freedom to modify the product to adapt it to your library needs. Development is sponsored by libraries of varying types and sizes, volunteers, and support companies from around the world. The strength of Koha lies with its strong community of users, libraries, and businesses that contribute to its development. Koha runs on Linux, Web, and Server (Njoku, 2017).

- **Fedora**

Fedora open-source software gives organizations a flexible service-oriented architecture for managing and delivering their digital content. At its core is a powerful digital object model that supports multiple views of each digital object and the relationships among digital objects. Digital objects can encapsulate locally managed content or make reference to remote content. Dynamic views are possible by associating web services with objects. Digital objects exist within a repository architecture that supports a variety of management functions.

All functions of Fedora, both at the object and repository level, are exposed as web services. These functions can be protected with fine-grained access control policies. This unique combination of features makes Fedora an attractive solution in a variety of domains. Some examples of applications that are built upon Fedora include library collections management, multimedia authoring systems, archival repositories, institutional repositories, and digital libraries for education" (Randhawa, 2018)

- **EPrints**

Eprints is an open-source software package for building open access repositories that are compliant with the Open Archives Initiative Protocol for Metadata Harvesting. It shares many of the features commonly seen in Document Management systems but is primarily used for institutional repositories and scientific journals. EPrints has been developed at the University of Southampton School of Electronics and Computer Science and released under a GPL license (Randhawa, 2018).

2.3 Application Open-Source Software in Academic Libraries

The cooperative community environment allows the users to use, change, improve, and redistribute the modified or unmodified form of software to the wider community. In many open-source projects, copyright is retained by the original author(s). In the initial stages, the product may be free or discounted, but over a period of time, may end up being a costly affair entailing overhead expenses, resources, or expertise for customization and add-ons to incorporate the new programming. This section captures the use and advantage of open-source software in academic libraries.

2.6.1 The use of Open-source Software in Academic Libraries

Open-source software such as Koha is a promising full-featured open-source ILS (integrated library system) currently being used by libraries all over the world. For those of you out there unfamiliar of what an ILS is, well, it is a system of keeping track of the operations of a library - payroll, expenses, purchases, and most importantly, keeping track of the various media being checked out by the librarians' patrons. Many smaller libraries cannot afford to purchase, install, and maintain an ILS, and Koha is a perfect alternative. Koha is built using library ILS standards and uses the OPAC (open public

access catalog) interface. In addition, Koha has no vendor-lock in, so libraries can receive tech support from any party they choose (Randhawa, 2018).

RajKumar & Krishnan (2011) explored the effectiveness open-source software in which flexibility and freedom were emphasized as a critical advantage of the open-source software for libraries: This software is flexibility as it gives users opportunity to be able to choose solutions suitable for their needs. Open-source software offers its users greater freedom to purchase other products, avoiding lock-in to particular manufacturers. Freedom from a single vendor and the freedom to modify your software. These findings support the works of (Morgan, 2015, Upasani, 2016). Quality software as an advantage was revealed in the study of Randhawa (2007). Evidence and research indicate that open-source software is good stuff. The peer review process and community standards, plus the fact that source code is out there for the world to see, tend to drive excellence in design and efficiency in coding.

Randhawa (2018) investigated the role played by open-source software in academic libraries. The study found that the integrated sources such as Koha can handle almost every functions of the library and no wonder majority of libraries have adopted it.

2.7 Advantages of Open-Source Software

Hanumappa et al., (2014) explored the OSS that used in the libraries of India and review the existing library automation i.e. Integrated Library Management System (ILMS) and Digital Library (DL) software. The authors brought to bear that, the use of open-source software is coupled with several advantages and one of the topmost is the ease of availability and access. The OSS system can be installed in libraries as live media

without extensive installation barriers. It democratizes the use of software applications irrespective of the type, size, or area of the library.

The OSS LMS is ubiquitously available and can be implemented irrespective of type or size of the library, with complete open documentation and source code. Similar findings were found in the works Oyelude et. al., (2016). In the same vein, Ray (2017) postulated that the implementation of OSS provides many advantages and opportunities to all sectors including libraries. OSS can be the right solution for long term use with several significant benefits but still, there are some possible limitations. Researchers and software experts have identified several advantages and disadvantages of OSS. Cost effective: The base product on which OSS LMS is developed is free or without major.

Randhawa (2017) also uncovered that; simplified license management is one of the cardinal advantages of the use of open-source software for libraries management. The Author added to obtain the software once and install it as many times and in as many locations as you need. There's no need to count, track, or monitor for license compliance."

Also, Upasani (2016) investigated the advantages and Limitations of Open-source Software for Library Management System Functions of Libraries in India and revealed the use of open-source software is cost effective. The author further added that the base product on which OSS LMS is developed is free or without major licensing costs. However, the enhancements and customizations of the OSS system are reflected in the consulting cost of tailoring the product to the library's need." Similar findings were found in the works of Hanumappa et al., (2014) and Ray (2017) was cost-effective emerged as

the most advantage of the open-source software and Satheesh (2012) who investigated Open-source Software in Libraries in Hindustan University. In confirmation to the above findings, Randhawa (2017) explore Open-source Software and Libraries and discovered that there are "lower software costs: Open-source solutions generally require no licensing fees.

The logical extension is no maintenance fees. The only expenditures are for media, documentation, and support if required. Randhawa (2018) investigated open-source software and libraries and revealed that one of the critical advantages of open software is there is an escape of vendor lock-in: Frustration with vendor lock-in is a reality for all IT managers. In addition to ongoing license fees, there is a lack of portability and the inability to customize the software to meet specific needs. Open-source exists as a declaration of freedom of choice. Further, Reddy and Kumar (2013) undertook a study on the open-source software's and their impact on library and information center. It was found that two cardinal benefits of open-source software it is easy to maintain. The author elucidated that the OSS LMS are often web-based software with free desktop clients or thin client access, thus freeing up the libraries from server maintenance requirements. Outside vendors or information technology (IT) experts can manage all the upgrades, backups, and general system maintenance while local library IT staff focus on other projects in the library.

In the same study, it was revealed that the open-source software is characterized as ease of operations for both staff and users. It was further explained that the community of support in the form of wikis, forums, and listservs helps address user issues more economically. OSS development is based on open standards around communication and

therefore is more adaptive and interoperable. This provides for ease in operations and management, intuitive navigation, and extensive permissions for both users and staff accounts. Similar findings were evidenced in the works of Morgan (2015) and Asay (2007).

Additionally, Morgan (2015) explored the impact of Open-source Software in Libraries, and it was found that the use of open-source software leads to give and take. Libraries with an OSS system can develop an effective set of interacting applications and share their enhancements with the open-source community. Libraries are able to collaborate and share code for the functionality and fixes they commonly require. In sharing, both parties' benefit. These solutions can be available free of cost or with marginal cost compared to proprietary systems. The analogous study was found in the study of (Upasani, 2016).

Raj and Sangeeta (2012) also found networking and internet support as one of the advantages of open-sources software for libraries. Libraries in consortia or libraries with sister concerns sharing the same network can benefit by sharing library materials and services as well as systems. This not only benefits the library but also the patrons who now have access to a wider variety of resources.

Satheesh (2012) investigated the Open-source Software in Libraries focusing on its pro and cons. The author revealed the following advantages; Easy Evaluation, thusly, it is easier to evaluate open-source software than proprietary software. Since open-source software is typically freely available to download, Libraries and systems Administrator can install complete production-ready versions of software and can evaluate the competing packages.

Open-source software usually has its versions for all popular operating systems - Linux, Windows or Mac. Again, it ensures Flexibility in Choosing Support. Open-source Software is backed by online forums and support groups. Established open-source software is even backed by paid support services and training programs." Similar findings were found in the works of Ukachi, (2014) in which Library automation and open-source software were used to maximize library productivity.

2.4 Extent of use of open-source software in academic libraries

Upasani (2016) states that modern libraries need to stay technologically active to provide different value-added services to their research community. Libraries need to hold library management systems and digital technologies as a smart tool for providing advanced services to their users. According to the author, libraries should collaborate with computer experts to become technologically sounder in using OSS. Here the author also provides an overview of the benefits, limitations, and availability of different open-source library management systems in the Indian context.

Vijayakumar et. al., (2016) stated that now libraries are completely dependent on ICT (Information and Communications Technology) for providing various services to the users. The extent of the use of Open-source software was encouraging due to its perceived benefits. In support of what Vijayakumar et. al., (2016) revealed, Baeza-Yates and Ribeiro (2011) mentioned that Asian governments are considered "open-source as a boost for their economies and a way to increase technological innovation in the region. The findings brought to bear that; majority of the library staff were found using the open-source software.

However, Amekuedee (2005) sought to find out which library processes have been automated in Ghana's pioneer university libraries and recognized that the extent of use of the open-source software for library activities was below average.

2.5 ICT skills and competencies of library staff

Wijaya and Sunrendro (2017) described that the literacy comprises of two different terms i.e. ICT and literacy. ICT is considered as the fusion of computer technology and telecommunication technology, while literacy is considered an ability to learn and improve an individual's capability. In broad-spectrum ICT literacy is considered as the necessary skill are required to use the ICT to perform the "day-to-day professional work. ICT literacy enables library professionals to use digital information resources effectively in their place of work. This includes the use of ICT to perform routine professional tasks most efficiently and effectively including word processing, using spreadsheets, creating databases and presentations, manage networks, using the Internet, performing automated activities, providing ICT based services, managing social and ethical issues in the library (Abdullahi, 2011).

A comparative study of strategic management of IT applications in some selected university libraries of Ghana and United Kingdom found that the status of IT applications was very low in all the university libraries in Ghana with slightly varying degrees in individual institutions (Mirza, 2014). In the United Kingdom, a very significant level of IT applications was found in the university libraries (Badu, 2004).

In reflection to that Singh (2004) posited that acquisition, processing, organization, storage, preservation, and dissemination of information in the library will continue to

revolve around ICT tools. This is because physical location and collection of a library are not as important as the accessibility of the information resources in the library's repository (Faboyinde, 2006; Devchoudhary, 2007; Ezeani, 2010; Adelokun, 2011).

In congruence to that, Igun and Adogbeji (2007) rightly observed that librarian competency is very crucial to the successful implementation and application of ICT to library operations. Even where there is a fund for acquiring ICT tools for the library, library staff competency is still very important to the success of ICT incorporation for information handling and management.

Csapo (2002) notes some basic IT competencies required for success in the workplace. These include using the computer and managing file, word processing, spreadsheet, databases, presentation, internet, and E-mail. The knowledge of them is described as computer competency

Salaam (2000) maintain that such knowledge is needed by librarians to enhance their performance in the variety of library functions such as, maintaining and providing access to catalogue of items in the collection; the acquisition of new items for collection; controlling of serial publication, retrieving of information from local files, searching external online information (database), sourcing literature and accessing full-text document for reference. Oni (2004) summarizes these competencies as house-keeping functions and advice that library staff should be competent in the use of basic computer tools for efficiency and relevance in the library profession.

Bansode and Viswe (2017) investigated ICT Literacy among Library Professionals Working in the University Libraries in Maharashtra, India. The study revealed that

majority of library professionals have acquired the basic ICT literacy skills which are required to handle day to day library operations, but still few library professionals need to enhance their literacy level in the area of open-source library automation software, digital library software and institutional repository software, etc.

Ekoja (2007) asserts that ICT competency library staff in Nigerian universities are still below average. According to him, many librarians and library staff working in the Nigerian university libraries are unable to use ICTs even when they are available. Only very few library staff who have made effort to acquire competencies in the use of ICTs have put them into practice. Library professionals work in the midst of knowledge repositories which give them abundant opportunities to learn and develop themselves.

On the contrary, Chisenga (1995) acknowledges that ICT applications improve service delivery in libraries and allied institutions responsible for information provision. Most library functions such as Acquisition, Cataloguing, and Classification, Reference services, previously handled manually are now performed electronically using ICTs. This has helped to reduce the time spent on doing the jobs and with fewer mistakes. It was further elucidated that, their level of ICT competency was high."

2.9 Limitations of open-source software for library work

Taking a comprehensive and critical view of open-source should raise some questions as well, regarding drawbacks. There have been several criticisms of open-source software. Satheesh (2012) indicated three critical limitations of open-source software and they are as follows. "No or less personal support, thusly, less customer-friendly i.e. All the features expected by the user may not be available. Similar findings were found in the

works of Maltikarjun (2011) who explored Open-Source software. Moreover, lack of training, due to lack of training and expertise on Open-Source software may lead to ineffective utilization of the software and Maintenance and troubleshooting of a particular OSS needs specialized skills and knowledge about that software. It supports the research by Anjaneya and Aswath (2014) in which it was indicated that adequate training is a prerequisite for the success of open-source software movement among working professionals. It is also one of the risk factors that how to train the library staff on operational modules of open-source software. It includes updating of new versions too. Continuous training support is required to cope-up with the new versions and technology. This finding was in congruence with the works of RajKumar and Krishnan (2011). Need for technological sophistication such as higher labor costs, Lack of scalability fewer advanced features; nobody is really responsible (by contract) also in agreement with RajKumar and Krishnan (2011).

Further, Anjaneya and Aswath (2014) researched on the Open-source Software in Libraries where Threats and Challenges were the focus. The study revealed insecure data security as a major limitation of the open-source software for libraries. In further elucidation, the author postulated that, protecting data from unauthorized access or manipulation of data in the database. The open-source software is available free to all those who want to use. It is highly difficult to have control over the data and unauthorized persons may hack the data easily in the open-source software scenario. The code of open-source software is created and uploaded on the internet by the program developers and chances are open to modify or corrupt the code by unauthorized persons. For instance, many libraries are using 'Koha', library automation software for its routine

operations and the same is being hosted on cloud computing'. The cloud computing might have helped to take away the problem of setting up their own hardware and managing it, but it could also take away your data, with so many free online office suites and online storage service providers out on the cloud, it's very easy to take out data under the guise of accessing it from anywhere (RajKumar & Krishnan, 2011).

Muller (2011) investigated how to choose a free and open-source integrated library system; it was found that lack of skills on the part of the user was indicated. Skilled persons are required to execute and implement open-source software in a proper manner. Lack of software technology skills among library professionals is another major risk to implement open-source software in the library environment. Dependence on IT experts or skilled persons enhances the library expenditure and defeats the purpose of OSS movements.

Anjaneya and Aswath (2014) also identified some critical limitations to open-source software such as Up-gradation issue. The author further explained that to upgrade to the new version with the existing source is quite difficult. The risk of data migration and compatibility are matter in this level. Example; 'Koha' improved new versions are being released frequently and it is difficult to replace with the existing version provided librarian is proficient in it.

Asay (2007) explained that installation and customization is a big challenge to Library professionals who may not have IT skills sufficient for installation and customization of software which makes implementation more a complex process. The basic knowledge of IT may not help in customizing open-source software and it requires programming and IT expert involvement in the process.

Satheesh (2012) indicated another major risk in open-source software environment is, support from the developers or vendors for solving problems at the installation level, implementation level and thereafter. Some of the commercial developers and vendor are there to support but the charges are too high. This finding is in support of the works of Ayres (2015) where it was revealed that the open-source software does not come with extensive support.

Furthermore, inadequate technological infrastructure to support the integration of ICTs in the curricula (Manda, 2006). This refers to issues as poor or lack of national ICT policy, low internet connectivity, inadequate supply of electricity, inadequate number of PCs, etc. The author posits that there is a need for policies that deregulate satellite communication and other telecommunication links, regulate ISPs, regulate government and cross-border data flow, etc. ICT policies can help address stringent tax regimes that still treat computers, communication equipment, and other peripherals as luxury items, thus imposing heavy import duties on them and subsequently rendering these items very expensive. Internet access is now widely available, but the efficiency is poor as many LIS schools experience downtime, several times a week. The telecommunication services are the root cause of these downtimes in terms of either low bandwidth, technical faults or other network configuration problems.

As Jensen (2005) puts it, there are also "many external system factors such as electricity, transport networks, import duties etc., which impact on internet service delivery on the Indian sub-continent. In some institutions, access is limited, not only by the number of internet service point but also by the time that access is available or permitted, leave alone the difficulty of bandwidth. "Yet for research purposes, access to the internet is no

longer a luxury or privilege for only a few people because, in academic circles, access to the internet and hence to the world's stores of knowledge is a necessity. LIS departments still need to lobby to gain greater access to internet resources for academic staff and/or research. Thus, there is an urgent need for improved ICT policies and infrastructure in institutions and countries. In the same vein, Kamila (2008) revealed that lack of infrastructure has been a big hindrance to use of open-source software.

That notwithstanding, funding/sustainability of the technology is the major non-technical constraint in most libraries (Minishi-Majanja, 2004). Most universities libraries decry the issue of under-funding in most of its functions. Besides, the unprecedented, phenomenal and multifaceted growth and development of the ICTs themselves pose another challenge. This rapid pace and transient nature of technological development require sustained funding. While the centralization of ICT services, hence funding, has been found to be the most affordable system for institution-wide development and use of ICTs, it only works well where there exists a policy that has explicitly incorporated the goals and needs of all sectors. Similar findings were found in the works of (Kamila, 2008).

2.6 Summary

It is generally acceptable that the role played by open-source software in the administration of academic libraries cannot be underestimated. The discussions above provide a candid overview of how open-source software systems can effectively be used to improve the work processes of academic libraries, most importantly in higher learning institutions. The types of licensing, applications and the technical skills needed to fully implement such systems are duly covered.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the approach (design and methodology) used to conduct the study. It discusses the set of tools, techniques, and procedures that are used to collect, analyze and present data (Acheampong, 2016).

3.2 Research Design

A research design provides comprehensive and complete guidance or guidelines for collecting data. It entails the general approach to the study, the sampling plan and the design of the questionnaire (Panneerselvam, 2011). This study adopted the survey research methodology. Although there are other research designs employed by researchers such as; action research design, grounded theory, case study, ethnographic study, experiment, archival research and survey research (Cooper & Schindler, 2008). Surveys are the most widely used data-gathering techniques in the social sciences and in related applied fields according to Neuman (2006). A survey methodology is a procedure whereby information is gathered from the population that responds to questions.

Bernacle (2001) states that survey research involves a problem definition, data collection, careful analysis and reporting of findings. McMillan and Schumacher (2001) described a survey research method as a descriptive research methodology that interprets what exists, the conditions and relationships of that which exists. This implies that survey research concerns itself with present events but also considers past events and influences in relation to current conditions. The survey research method is mainly concerned with the discovery of the relative incidence distribution and interrelations of variables using either

large and small population or items (Renkly, 2004). Tronchim (2002) opines that survey research is a research method in which a group of people or items are considered to be representative of the entire group.

Surveys elicit information from a defined population about their "knowledge, feelings, opinions, attitudes and self-reported behavior. In the view of Creswell (2007) survey research provides a quantitative or numerical data of descriptions of trends, attitudes, opinions of a population by studying a sample of that population from which the researcher can generalize and make inferences from results of a sample to a population by using questionnaires or structured interviews for data collection. Questionnaires are seen to be the most common and standard data collection instruments in survey research (Acheampong, 2016).

The choice of this research method was based on the nature of the research problem to be investigated. In line with the factors mentioned, a survey research method was deemed an appropriate type of inquiry in the assessment of the use of open-source software in academic libraries in Ghana.

3.3 Selection of Case

This study was conducted at the Academic libraries of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED), Christian Service University and Kwame Nkrumah University of Science and Technology (KNUST). These are some of the few libraries that have adopted the open-source software for its activities.

3.4 Population

A research population can be described generally as a large collection of individuals or objects that form the main focus of a study. According to (Creswell, 2007), a research population is a well-defined collection of individuals who share similar characteristics based on what a researcher is interested in and therefore qualify to be included in the study. However, due to the large sizes of the populations, researchers often cannot test every individual in the population because it is too expensive and time-consuming. This is the reason why researchers rely on sampling techniques. It is also known as a well-defined collection of individuals or objects known to have similar characteristics. All individuals or objects within a certain population usually have a common, binding characteristic or trait. Usually, the description of the population and the common binding characteristic of its members are the same.

The target Population for this study was the academic library staff of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED), Kwame Nkrumah University of Science and Technology (KNUST) and Christian Service University. The rationale for choosing such a population is the fact that these libraries have adopted open-source software for managing their resources. The library staff from these institutions culminates to a population 68 participants. The professional and para-professionals forms the population for this study. Outlined below are the details of staff in each institution.

Table 1: Library staff in the Selected Universities

No.	Institution	No. of Library Staff
1.	KNUST	35
2.	AAMUSTED	19
3.	CSU	16
	Total	**70**

3.5 Sampling and Sampling Procedure

Sampling is the process of selecting a subset of a population for a study of which inferences will be drawn about the population. Obtaining a sample size is a daunting task as there are different views held by various scholars. According to Creswell (2007) researchers often choose a sample size based on selecting a fraction of the population (10% or more), or the sample size should be based on the margin of error the researcher is willing to accept.

However, the researcher with the use of the stratified and purposive sampling techniques selected 50% of staff from each institution to comprise the sample of this study (0.5*N). Thus, the sampling size of the study culminated to 35 participants. The sample comprised 18 staff from KNUST, nine (9) staff from AMMUSTED and eight (8) staff from CSU.

3.6 Instrumentation

According to Burns and Grove (1999), data collection is the precise systematic gathering of information relevant to the research purpose or specific objectives, questions, or hypotheses of a study. The researcher used the questionnaire as an instrument for the collection of data for the study because they enabled the researcher to gather the

responses in a standardized way. Besides, questionnaires are certainly more objective than interviews, and relatively quicker in collecting (Acheampong, 2016).

According to Panneerselvam (2011), the questionnaire consists of a set of well-formulated questions to probe and obtain responses from respondents. Questionnaires for the study consists of closed-ended questions and open-ended questions. In closed-ended questions, responses are structured and sometimes coding is provided beside responses to ease the interpretation of data. Survey questionnaires, apart from addressing numerous issues at the same time, are administered to a large group with the same set of questions (Fraenkel & Wallen, 2003).

The questionnaire for this study was partly structured and partly unstructured. The questionnaire was divided into five (5) sections. Section one comprised the Socio-demographic characteristics and professional background of respondents. The second section, Section B gathered respondents' data on the Application of Open-source software, Section C collected data on the ICT skills and competencies of library staff, Section D focused on the extent of use of Open-source software with the last section concentrating on the limitations of Open-source software for library work processes. Each section indicated the purpose and had instructions that aided the respondents to respond to each question without or fewer difficulty and provided spaces where necessary.

To avoid ambiguity and unclear choices of questions and words, the questionnaire was subjected to rigorous review, corrections were affected and deletion of redundant questions for final approval by the researcher's supervisor.

3.7 Data Collection Procedure

The researcher obtained an introductory letter from the Graduate Studies Department of AAMUSTED, to seek the formal consent of the head of Library at AAMUSTED and Christian University College to give the assurance that the data collected for the research will purely be for an academic purpose. This was to give the researcher access to the population. The researcher explained to the respondents the purpose of the study and assured them of confidentiality and anonymity. The questionnaires were then distributed to the subjects by the research at the appropriate time that was convenient for them. The researcher later went for the questionnaire from those who couldn't complete it at the time of distributing the questionnaires.

3.8 Data Reliability and Validity

The reliability of the instrument refers to the stability and consistency of the instrument developed (Creswell, 2007). The reliability level of the instrument is represented by Alpha Cronbach (Creswell, 2007). To measure the reliability of the questionnaire items, the researcher conducted a pilot study with 60 participants. The responses were coded into an SPSS v20 application. The researcher then calculated the Alpha Cronbach's value of the coded questionnaire items, attaining a value of 0.63. According to Pallant (2001), an Alpha Cronbach's of 0.6 is considered a highly reliability and acceptable index. Based on the Alpha Cronbach's value, the researcher accepted the data collection instruments as being reliable.

The validity of an instrument is the degree to which an instrument measures what it is intended to measure (Polit and Hungler, 1993). All questionnaires were distributed by the

researcher personally. The questions was formulated in simple language for clarity and ease of understanding. Clear instructions were given to respondents on the requirements of each category of questions to be answered. The questionnaires were validated by professionals in the field and the study's supervisor.

3.9 Data Analysis

Data collected will be analyzed and findings presented in a meaningful form to give better insight and understanding of the research problem. This will be done using appropriate tools and techniques (Panneerselvam, 2011). The Statistical Package for Social Sciences (SPSS) 23.0 computer program will be used to analyze the data that was collected. The SPSS by far is seen as the most widely used computer package for statistical analysis throughout the world, most especially in colleges and universities for data analysis (Howitt & Cramer, 2008). Analysis and presentation of data will be done under the major themes expressed in the research questions. Also, tables, pie chart and column chart will be used to represent data that was gathered for a better explanation.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter discusses the findings of the data collected from AAMUSTED, KNUST and CSU based on the objectives of the study. The study obtained a total of 70 questionnaires out of the 70 questionnaire that were distributed to the subject of the study representing a response rate of 100%.

The chapter has been organized under the following major sub-headings:

1. Socio-demographic characteristics and professional background
2. The use and Advantages of open source software in academic libraries
3. The extent of the use of open source software in academic libraries.
4. ICT skills and competencies of library staff.
5. Limitations of Open Source Software for library work.

4.1 Socio-Demographic Characteristics

Socio-demographics refer to the characteristics of a population. Generally, characteristics such as age, gender, education level, etc. considered as the major socio-demographic characteristics discussed in most studies. This section includes the age, gender and educational level of respondents.

4.1.1 Gender

According to Davis (2000), gender has a critical influence on the use of new technology. On this backdrop, the respondents were asked to indicate their gender as shown in Figure 1.

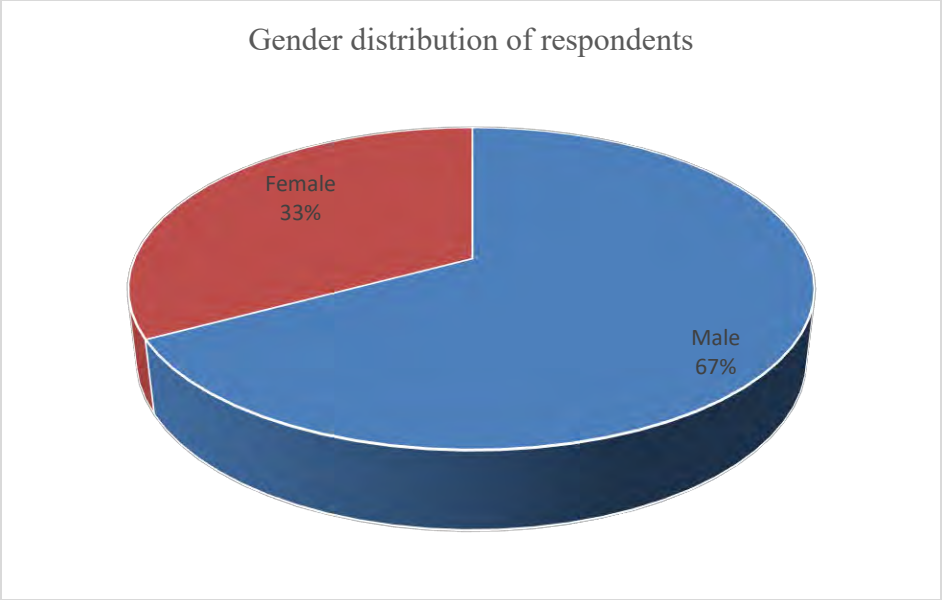

Figure 1: Gender distribution of respondents (Source: Field Survey)

As shown in the figure 1 above, 47 respondents representing 67% were male with the remaining 23 representing33% being female. This indicates that majority of the staff who worked in the three sampled libraries (KNUST, AAMUSTED and CSU) were male and that there were more male respondents using Open-Source Software than female.

4.1.2 Age of Respondents

In the view of Aramide, Ladipo, and Adebayo (2015), age is an integral demographic characteristic to be considered in learning new technologies. At this point, respondents were asked to indicate their age ranges as shown in Table 2.

Table 2: Age of Respondents

Age Ranges	Frequency	Percentage
Less than 24	9	13%
25-30	27	39%
31-35	19	27%
36-40	12	17%
41 and above	13	19%
Total	**70**	**100%**

(Source: Field Survey)

From table 2 out of 70 respondents, 27 representing 39% were within the 25-30 age range, 19 representing 27% were within the 31-35 age range, 13 representing 19% were 41 years or above, 12 representing 17%were within the 36-40 age range with nine respondents representing 13% being less than 24 years of age.

The responses give an indication that most of the staff in the academic libraries considered fall within the ages of 31-35. This finding is in support of the works of Erdamar and Demirel (2014) in which it was found that the age of 18-35 are considered the technological age and therefore they are often exposed to the use of ICT than the older people who are normally described as emigrants. It can, therefore, be deduced that there is the tendency of the library staffs being able to use the open-source software with ease for the activities of the library staff will be high.

4.1.3 Educational Level of Respondents

Respondents were requested to show their level of education by choosing from the group they belong as depicted in Figure 2.

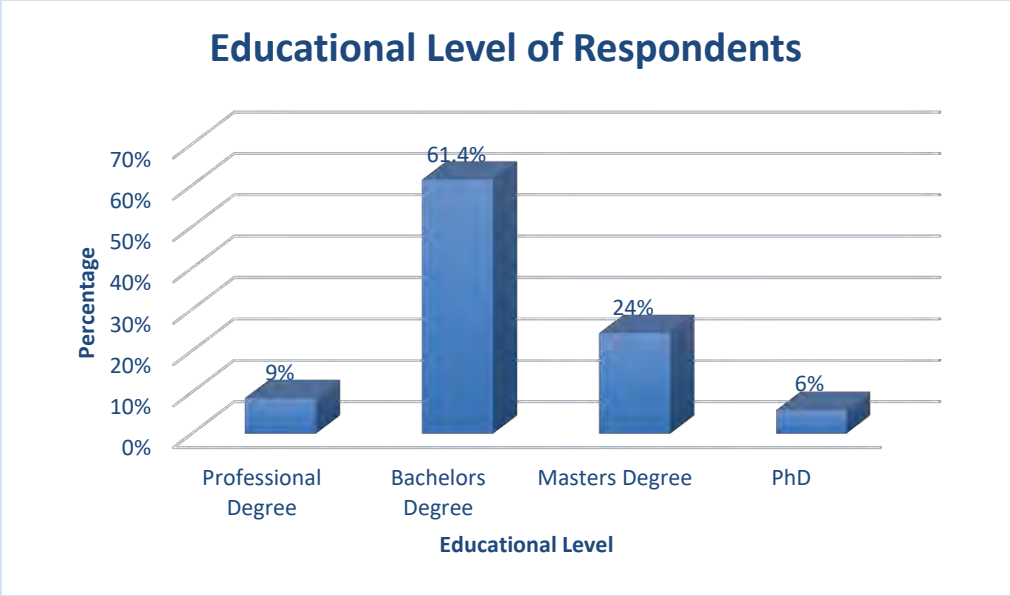

Figure 2: Educational level of respondents (Source: Field Survey)

It can clearly be seen from Figure 2 that majority of the respondents, 61.4% held a Bachelor degree, 24% of the respondents had obtained Masters Degree, 9% of the respondents had Professional Degrees with 6% holding PhDs respectively. The response is an indication that most of the library staff hold at least a Bachelors degree.

4.2 Available Open-Source software in the University Libraries

According to PriYal, Prabu, and Poongodi (2012), the persistence of low budgetary allocations for the use of Proprietary software in Academic Libraries led to the implementation of Open-Source software in most Academic Libraries with their roles being hugely emphasized.

4.2.1 Number of Open-Source Software used by Academic Libraries

Respondents were asked to indicate the number of open-source software used in the library. The responses are shown in Table 2.

Table 3: Number of Open-Source software used by Academic Libraries

Item	Frequency	Percentage
One	32	46%
Two	36	51%
More than two	2	3%
Total	70	100%

(Source: Field Survey)

It is evident in Table 3 that more than half of the respondents, 51% indicated that they use two open-source software adopted by the respective libraries, 32 representing 46% indicated that they use only one of the open-source software adopted by the libraries with only two respondents representing 3% indicating they use more than two software. The two widely used open-source software are Dspace which is used to manage institution's repository and Koha which is used for the processing of library materials such as cataloging, classification, ordering of materials, circulation, and many more.

4.2.2 User-Friendliness of Open-Source Software

The friendliness of a software or program is a key contributor to determine the extent of its use. In relation to the Technology Acceptance Model (TAM) as described by Davis (1958), if a system is easy to use it means, there is the propensity that users will use it the more. Likewise, if the open-source software employed by the library management is user-friendly, then there is the likelihood that, the extent of its use will increase. As shown in Figure 3, respondents were asked to indicate the extent to which they consider open software employed by the library as user-friendly.

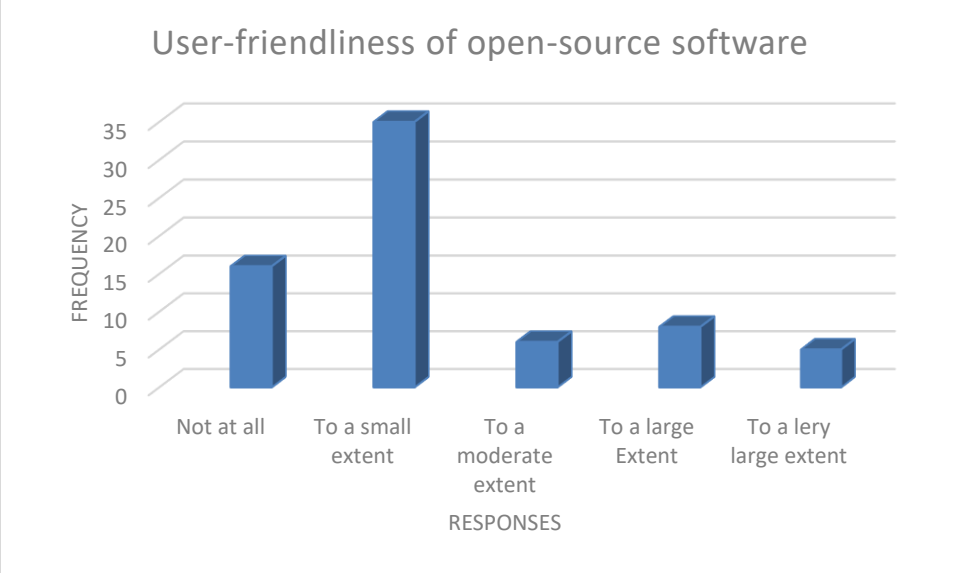

Figure 3: User-friendliness of Open-source software (Source: Field Survey)

As shown in Figure 3 that, exactly half of the respondents, 35 representing 50% asserted to a small extent that the open-source software adopted by the library is user-friendly. Moreover, 16 respondents representing 23% affirmed not at all to the fact that the open-source software used at the libraries is user-friendly, eight representing 11.4% indicating to a large extent, six representing 8.6% indicated to a moderate extent with only five representing 7.1% indicating to a very large extent that the open-source software is user-friendly. These findings are inconsistent with the works of RajKumar & Krishnan (2011) who explored the effectiveness of open-source software in which flexibility and freedom were emphasized as a critical advantage of the open source software for libraries.

4.2.3 Staff Ability to use Open-Source Software

Respondents were asked to confirm whether the open-source software adopted by the respective libraries can handle all the functions and processes of the library. The responses are illustrated in figure 4.

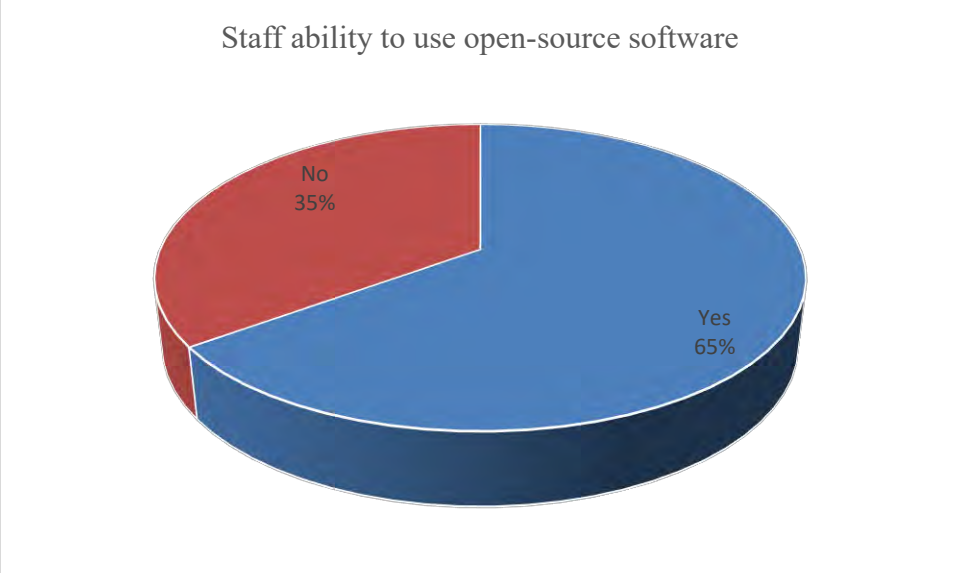

Figure 4: Staff ability use to the Open-Source Software (Source: Field Survey)

It can be observed from Figure 4 that, a greater percentage of the respondents 65% affirmed that the open-source software adopted by the library can handle all the functions and processes of the library. However, 35% responded otherwise by indicating no. It can be inferred from this finding that the open-source software can handle almost all the functions and process of the library. These findings support the works of Randhawa (2018) who investigated the open-source software and libraries, the study found that the integrated sources such as Koha can handle almost every functions of the library and no wonder majority of libraries have adopted it.

4.3 Advantages of Open-Source Software in Academic Libraries

According to Venkatesh et al., (2003), Performance Expectancy (PE) is the degree at which an individual believes that using a particular system or technology will improve work performance then they will continue to use it. Considering this background, respondents were asked to indicate whether the open-source software adopted by the

libraries is advantageous using the five-point likert scale. The responses are shown in Table 4 below.

Table 4: Advantages of Open-Source Software

Statement	N	Min.	Max.	Mean	Std. Deviation
1. Lower software costs	70	1	5	4.27	1.065
2. Simplified license management:	70	1	5	3.92	1.246
3. Lower hardware costs	70	1	5	3.81	1.152
4. Scaling/consolidation potential	70	1	5	3.67	1.234
5. Support is available for open source	70	1	5	3.88	1.348
6. Escape vendor lock-in	70	1	5	3.42	1.190
7. Ease of availability and access	70	1	5	3.65	1.015
8. Cost effective	70	1	5	3.42	1.206
9. Server/software maintenance: web-based software with free desktop clients or thin client access, thus freeing up the libraries from server maintenance requirements	70	1	5	3.71	1.142
10. Ease of operations for both staff and users	70	1	5	3.37	1.214
11. Libraries can use a number of open source software applications together to effectively build a customized solution from among the best-of-breed OSS for their patrons.	70	1	5	3.48	1.148
12. Consortia approach: Libraries using OSS systems can discuss the problems with existing users and software experts, and this consortia approach will benefit all.	70	1	5	3.63	1.034
Valid N (listwise)	70				

(Source: Field Survey) *Strongly Disagree **(SD)**, Disagree **(D)**, Neutral **(N)**, Agree **(A)**, Strongly Agree **(SA)***

Table 4 shows the descriptive statistics of respondents' assertions on the advantages of the use of open-source software in academic libraries.

As shown in the table, majority of the respondents agreed to the following advantages of the use of open-source software by libraries; lower software costs (M=4.27, SD=1.065), simplified license management (M=3.92, SD=1.246), lower hardware costs (M=3.81, SD=1.152), scaling/consolidation potential (M=3.67, SD=1.234), availability of support

(M=3.88, SD=1.348), escape vendor lock-in (M=3.42, SD=1.190), ease of availability and access (M=3.65, SD=1.015) and cost effectiveness (M=3.42, SD=1.206).

Moreover, most of the respondents agreed that open-source software offers Server/software maintenance: web-based software with free desktop clients or thin client access, thus freeing up the libraries from server maintenance requirements (M=3.71, SD=1.142), provides ease of operations for both staff and users (M=3.37, SD=1.214), ability of libraries to use a number of open source software applications together to effectively build a customized solution from among the best-of-breed OSS for their patrons (M=3.48, SD=1.148).

Finally, most respondents agreed that open-source software offers the advantage of a Consortia approach where Libraries using OSS systems can discuss the problems with existing users and software experts, and this consortia approach will benefit all (M=3.63, SD=1.034).

In summary, it can be realized that most of the respondents showed a positive view on the advantages of open-source software adopted by the sampled academic libraries.

This finding is an indication that the use of open-source software for the running of the activities of the library is very advantageous. Other remarks from the respondents were as follows; the open-source software is easy to update, it is flexible, easy to modify, easy accessibility and reliability. This finding supports the works of Hanumappa et al., (2014) in which it was found that the use of open-source software is coupled with several advantages and one of the topmost is the ease of availability and access. It is also consistent with the works of Ray (2017 whereby it was revealed the open-source software

adopted for the running of the activities of the library performed phenomenal roles, for instance, open-source software is considered as cost-effective and can be customized to suit the interest of the adopter. Similar findings were found in the works of (Upasani, 2016; Satheesh, 2012; Morgan, 2015, Raj and Sangeeta, 2012, Satheesh, 2012)."

4.4 Extent of Use of Open-Source Software

The extent of use of any program or software is determinant on some factors such as perceived usefulness and perceived ease of use which is considered the critical factors. Respondents were requested to show their extent of use of the open-source software as shown in" Figure 5

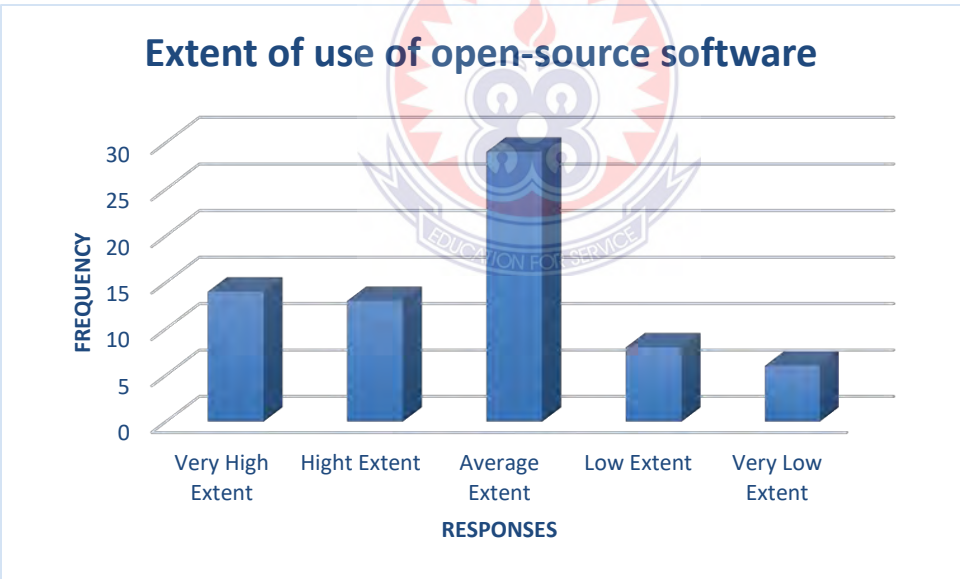

Figure 5: Extent of use of Open-Source Software in Academic Libraries (Source: Field Survey)

It is clearly shown in the figure 5 above that most of the respondents, 29 representing 41.4% remarked the extent of use of open-source software as average extent, 14 representing 20% indicated very high extent, 13 representing 18.6% indicated high

extent, eight representing 11.4% asserted low extent with the remaining six representing 8.6% indicating very low extent.

It can be observed from these responses that most of the users of open-source software do not really use open-source software as envisioned by the library management. It can, therefore, be attributed to the limitations plagued in the use of the open-source software for the running of the day-to-day activities of the library. This finding did not support the study of Baeza-Yates and Ribeiro (2011) who found that the extent of use of the open-source software by the library staffs was found high.

4.4.1 Reasons for use of Open-Source Software in Academic Libraries

Table 5: Reasons for use of Open-Source Software

Statement	N	Min.	Max.	Mean	Std. Deviation
1. Openness	70	1	5	1.86	1.065
2. Flexibility	70	1	5	1.62	1.246
3. Speed	70	1	5	1.51	1.152
4. Compatibility	70	1	5	1.47	1.234
5. Easily extensible to support other languages	70	1	5	1.78	1.348
6. Ease of availability and access	70	1	5	1.52	1.190
7. Cost-effective	70	1	5	1.89	1.065
8. Ease of operations for both staff and users:	70	1	5	1.52	1.246
9. New open additions	70	1	5	1.61	1.152
10. Consortia approaches	70	1	5	1.57	1.234
Valid N (listwise)	70	1	5	1.46	1.348

(Source: Field Survey) (yes, no)

Table 5 shows the descriptive statistics of respondents' view on the reasons for the use of open-source software in the academic libraries.

As shown in the table, majority of the respondents asserted yes to the following reasons; openness of the open-source software (M=1.86, SD=1.065), flexibility (M=1.62, SD=1.246), speed (M=1.51, SD=1.152), compatibility (M=1.47, SD=1.234) and easy extensibility to support other languages (M=1.78, SD=1.348).

Moreover, most of the respondents said yes to ease of availability and access (M=1.52, SD=1.190), cost-effectiveness (M=1.89, SD=1.065), ease of operations for both staff and users (M=1.52, SD=1.246), new open additions (M=1.57, SD=1.234) and consortia approaches to solving problems with software (M=1.46, SD=1.348).

Generally, it can be observed from the above findings that, factors such as openness and cost-effective are most critical reasons for the use of open-source software as indicated by the majority of the participants of the study. This finding can be extrapolated that, most libraries use open-source software because of its cost-effectiveness and openness as compared to proprietary software. This finding is in agreement with the works of Upasani (2016) in which it was found that the cardinal reasons for the use of open-source software are because of its cost-effectiveness for instances open-source software is developed for free or without major licensing costs. Also consistent with the works of Hanumappa et al., (2014) and Ray (2017) in which was cost-effective, and openness emerged as the most advantageous factors of the open-source software.

4.5 ICT Skills and Competencies of Library Staff.

According to Eshet-Alkalai (2004) computer literacy comprises a variety of complex skills (which include: booting a computer, how to use a keyboard, edit work, retrieve information from computers, send and receive e-mails, etc.) which users need to function

effectively in digital environments. In this regard, it can be deduced that the ICT skills and competencies of library staff determine the perception of the open-source software."

4.5.1 Knowledge and skills to use a computer and other related technologies

Knowledge and skills are very critical in the use of open-source software for library activities. Respondents were asked to indicate if they have knowledge and skills to use a computer and other related technology as shown in Figure 6.

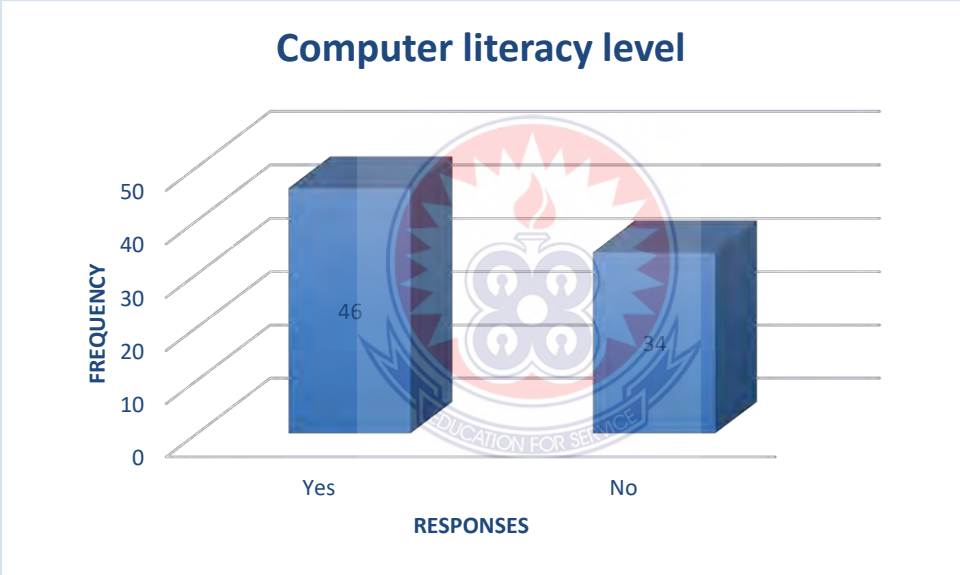

Figure 6: Respondents' Knowledge and skills to use a computer and other related technology

It can be observed from Figure 6 that majority of the respondents 46 (65%) affirmed that they possess knowledge and skills to use a computer and other related technology while 34 representing 35% asserted no. This finding can be explained that at least almost every libraries' staff possesses some level of knowledge and skills to use the open-source software for the running of the activities of the library. This finding corroborates with the

study of Bansode and Viswe (2017). The study revealed that the majority of libraries' professionals have acquired the basic ICT literacy skills which are required to handle day to day library operations

4.5.2 Level of knowledge and ICT skills of library staff

The level of computer literacy is the stage at which one may be classified as far as knowledge and skills to use a computer is concerned. It is critical to know the different levels of computer experience of users in order to holistically determine the ease of use and extent of use of the e-learning platform (Fusilier & Durlabhji, 2005). It is obvious that the level of ICT skills is a determinant of the use of open-source software for day to day running of libraries. Respondents were asked to indicate their level of ICT skills as reported in Figure.7

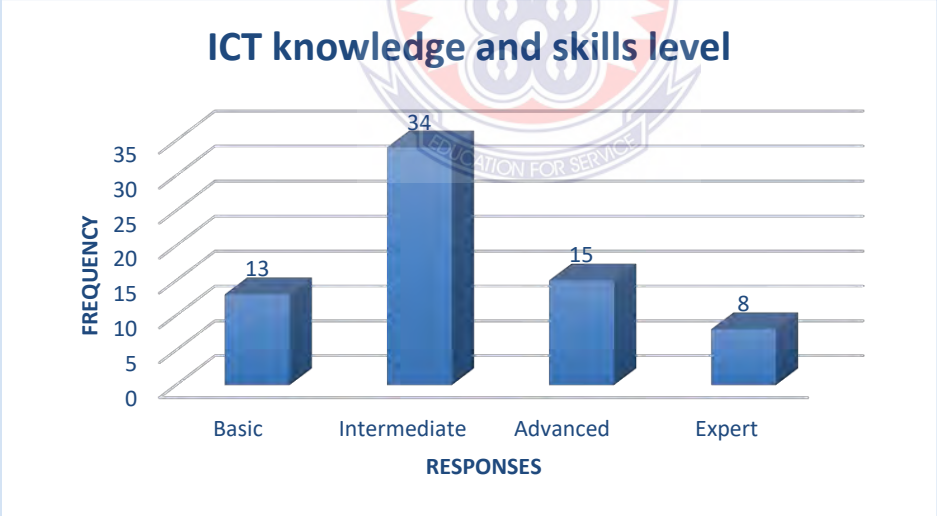

Figure 7: Respondents' level of knowledge and ICT skills (Source: Field Survey)

As shown in Figure 7 majority of the respondents, 34 representing 48.6% classified their knowledge level as intermediate as far as level of knowledge and ICT skills are

concerned, 15 representing 21.4% indicated advanced, 13 representing 18% asserted basic with only eight representing 11.4% asserting expert.

These responses are an indication that the libraries' staff possesses basic knowledge skills to use the open-source software for running of the day-to-day activities of the library. As observed by Igun and Adogbeji (2007) librarian competency is very crucial to the successful implementation and application of ICT to library operations. In this regard, it can be extrapolated from the findings that the library staff possess knowledge and skills that will fuel them to use the open source software for the day to day activities of the library. This finding agrees with the works of Bansode and Viswe (2017) who investigated ICT Literacy among Library Professionals. The study revealed that many library professionals have acquired the basic ICT literacy skills which are required to handle day to day library operations.

4.5.3 Level of Training on the use of Open-source Software for Library Services

Sufficient training on the use of a system is a crucial factor to determine a user's perception and the level of usage. This implies that if users of the open-source software receive sufficient training on its use, they will find it easy to use it and which will eventually increase the extent of its use (Davis, 2018). Based on this background, the respondents were asked to indicate the extent of training they had received on the open-source software provided by the library management as shown in Figure 8

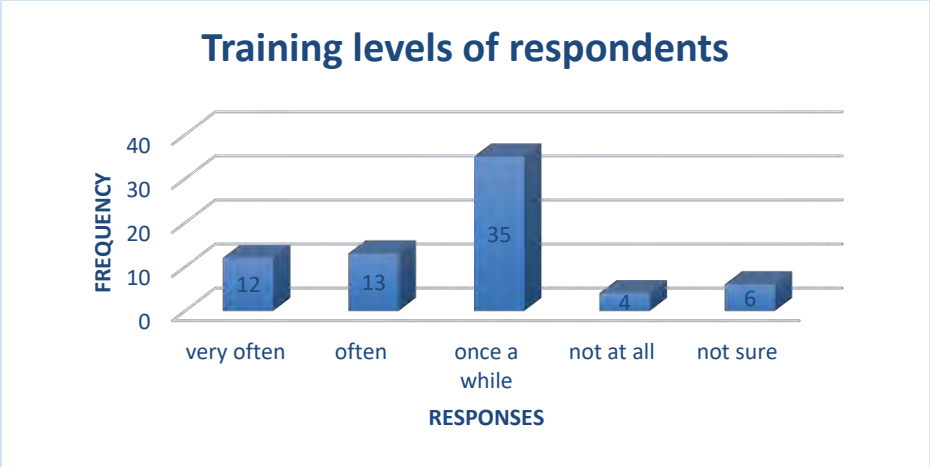

Figure 8: Respondents' level of training on the use of open-source software (Source: Field Survey)

From figure 8 exactly half of the respondents, 35 representing 50% affirmed that they once a while receive training on the use of the open source software for the running of the activities of the libraries, 13 representing 19% asserted often, 12 representing 17% asserted very often, six representing 8.6% asserted not at all with four representing 5.7% indicated not at all. It can be inferred from this finding that; the libraries' staff does not often receive training on the use of open-source software which is considered as a critical factor in the implementation of every program. It can also be explained that needed attention has not been given out to champion training on the use of open-source software in the libraries.

4.5.4 Knowledge in the use of Open-Source Software

Knowledge is the theoretical or practical understanding of a subject and skills are the proficiencies developed through training and experience (Lauby, 2013). Respondents were asked to rate their level of knowledge in the use of open-source software as depicted in Table 6.

Table 6: Knowledge in the use of Open-Source Software

Statement	Very Bad	Bad	Average	Good	Very Good
1. Your ability to download and uncompress the source code	9(12.857)	6(8.571)	21(30.000)	22(31.426)	12(17.143)
2. In the terminal, your ability to move into the extracted directory	12(17.143)	9(12.857)	19(27.143)	16(22.857)	14(20.000)
3. Your ability to Configure software	7(10.00)	10(14.286)	21(30.000)	20(28.571)	12(17.143)
4. Your ability to run "make" to compile the software	8(11.429)	6(8.571)	29(41.429)	12(17.143)	15(21.428)
5. Your ability to install the software.	3(4.286)	8(11.429)	26(37.143)	18(25.714)	15(21.428)
6. Your ability to Acknowledge that Windows is not a friend of open source software.	6(8.571)	5(7.143)	30(42.857)	15(21.428)	14(20.000)
7. Your ability to check for parts of the program	4(5.714)	8(11.426)	26(37.143)	21(30.000)	11(15.714)
8. Your ability to find a port for either Windows or your version of Windows	3(4.286)	9(12.857)	27(38.571)	18(25.714)	13(18.571)
9. Your ability to download and run the installer	2(2.857)	4(5.714)	24(34.286)	21(30.000)	19(27.143)
10. Your ability to detect errors in open-end software	9(12.857)	5(7.143)	26(37.143)	17(24.286)	13(18.571)
Valid N (listwise)					

(Source: Field Survey) Very Bad ***(VB),*** *Bad* ***(B),*** *Average* ***(A),*** *Good* ***(G),*** *Very Good* ***(VG).***

As shown in table 6, 22 respondents representing 31.4% asserted that their ability to download and uncompress source code was good, 12 representing 17.1% asserted very good, nine representing 12.8% asserted very bad whiles six representing 8.5% asserted bad.

Moreover, 30 respondents representing 52.8% asserted good to the assertion that they are able to move into extracted directories at the terminal, 21 representing 29% asserted bad with 19 representing 27% asserting neutral.

Further, 29 respondents representing 41.3% were neutral to their ability to compile software, 27 representing 40% asserted good with 14 representing 20% asserting bad. On staff ability to install software, 26 respondents representing 37.1% asserted neutral, 33

respondents representing 47% asserted good with 11 respondents representing 15% asserting bad.

On the assertion of staff ability to acknowledge that windows is not a friend of open-source software, 30 respondents representing 42.8% were neutral, 29 representing 41% asserted good whereas 11 respondents representing 14% asserted bad. That notwithstanding, 37% of the respondents were neutral on their ability to check for parts of programs, 45% said good with 18% asserting bad. Most of the respondents, 44% asserted good on their ability to find a port for windows versions, 38.6% asserted neutral with 17% affirming bad.

Furthermore, 40 respondents representing 57% affirmed that their ability to download and run the installer was good with only 8% asserting bad. Finally, 30 respondents representing 42% said their ability to detect errors and open-source software was good, 26 representing 37% asserted neutral with 14 representing 21% asserting bad.

In totality, it can be observed from Table 5 that most of the respondents rated themselves as average. This finding is an indication that the library management needs to frequently organized training library staff in the use of open-source software for the running of the activities of the library. This finding also confirmed the earlier objective whereby most of the respondents indicated that they do not often receive training on the open-source software. This finding is inconsistent with the works of Ekoja (2007) in which it was found that knowledge ICT competency library staff in Nigerian universities are still pertaining to open-source software is below average.

4.6 Limitations of use of Open-Source Software

It is obvious that every program or software has varying levels of limitations that need to be dealt with in order to ensure its efficiency and effectiveness. Respondents were asked to rate the level of limitation of the open-source software through the 5-Likert scale as shown in Table 7.

Table 7: Limitations to the use of Open-Source software

Statement	N	Min.	Max.	Mean	Std. Deviation
1. **Installation, customization, and maintenance support:** The current training of the library staff does not involve expertise in handling computers, networks, and open-source software	70	1	5	3.69	1.065
2. **Updates**: Commercial software vendors usually bundle in the cost of upgrades and support in the product price	70	1	5	2.72	1.076
3. **Accountability**: Often an OSS system is accessed using thin clients, so patrons often come to expect ubiquitous access to the system.	70	1	5	3.61	1.102
4. **Modules/components missing**: Every OSS system may not have all the modules or components required by the library,	70	1	5	3.57	1.009
5. **Breakdown:** Any breakdown would require some troubleshooting, which is often beyond the expertise of library staff.	70	1	5	3.52	1.160
Valid N (listwise)	70				

(Source: Field Survey) *Strongly Disagree **(SD)**, Disagree **(D)**, Neutral **(N)**, Agree **(A)**, Strongly Agree **(SA)***

Table 7 shows respondents' view on the limitations on the usage of open-source software in various libraries. The responses were gathered using the five-point likert scale of 1-strongly disagree, 2-disagree, 3-neutrarl, 4-agree and 5-strongly agree.

As shown in the table above, majority of the respondents agreed to the limitation of installation, customization, and maintenance (M=3.69, SD=1.065). in their view, the current training levels of staff are short of the expertise in handling these limitations. Most of the staff also agreed to the limitation of accountability (M=3.61, SD=1.102),

modules/components missing (M=3.57, SD=1.009) and component breakdown which sometimes require expertise beyond staff skills and knowledge (M3.52, SD=1.160). However, majority of the respondents disagreed to the limitations of updates of components (M=2.72, SD=1.076).

The limitations indicated by respondents' shows a consensus to the problems faced by most open-source software packages. Such shortfalls include Installation, customization, and maintenance support, missing components and breakdown of components. The challenges identified by the respondents were similar to the findings of Satheesh (2012) who indicated three (3) critical limitations of open source software; user-friendliness, support and unavailability of software features.

These views were buttressed by Maltikarjun (2011). Aswath (2015) identified the need for training of staff. Anjaneya and Aswath (2014) also data protection as a major issue to be addressed with the usage of open-source software for libraries. To resolve these issues Igun and Adogbeji (2007) posited that it is important that librarians are acquainted with the necessary skills to apply technologies to library operations (Igun and Adogbeji, 2007). Thus, library stuff competencies, skills and knowledge are integral to sufficient incorporation of ICTs for information handling and management. This view was buttressed by Salaam (2000) who stated that adequate knowledge is needed by librarians to enhance their performance in variety of library functions such as, maintaining and providing access to catalogue of items in the collection; the acquisition of new items for collection; controlling of serial publication, retrieving of information from local files, searching external online information (database), sourcing literature and accessing full-text document for reference.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter covers the summary of the major findings based on the objectives of the study as well as conclusion and recommendations from the major findings and then suggests areas for further research.

4.5 Summary of Findings

This study investigated the use of open-source software in academic libraries in the Kumasi Metropolis which focused on three Universities: Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED), Kwame Nkrumah University of Science and Technology (KNUST) and Christian Service University. The study was done based on the following objectives: to identify the available Open-Source Services in the University Libraries, determine the extent of use of Open-Source Services provided at the Libraries, evaluate the level of IT skills of library staff in the use of Open-source Software at various libraries and to identify the limitations of the use of Open-Source Software at the University Libraries.

5.2.1 The use and Advantages of open-source software in academic libraries

The first objective of the study sought to investigate the available open-source software used by academic libraries, their usage and the advantages of open-source software in academic libraries. The study found that the library uses two open-source software are such as Dspace which is used to manage institutional repository and Koha which is used for processing of library materials such as cataloging, classification, ordering of materials, circulation, borrowing of books, and lending of books.

On the usage of open-source software at the libraries considered for this study, the open-source software were not user-friendly as evident from the responses from most of the respondents. With respect to the ability of the adopted open-source software by the libraries, the study revealed that these software have the capability of handling all functions and work processes of the libraries. On the advantages of the usage of the open-source software by the libraries, it was revealed that the application of open-source software for the running of the activities of the library was very advantageous with some remarks such as its flexible, easy to modify, easy accessibility and reliability.

5.2.2 The extent of use of open-source software in academic libraries

Objective two of the study investigated the extent of the use of open-source software in academic libraries. It was revealed from the findings that the library staff do not really utilize the adopted open-source software as intended by the library management. The reasons given for the use of the open-source software sparingly were openness, flexibility, cost effectiveness and ease of availability and access.

5.2.3 ICT Skills and Competencies of Library Staff.

Objective three sought to find out the ICT Skills and Competencies of Library Staff of various libraries considered for the study**.** In terms of Knowledge and skills to use computers and other related technology, all respondents responded in affirmative that they possess knowledge and skills to use a computer and other related technology. Conversely, all the library staff who uses the open sources software possess basic knowledge and skills to use the open-source software. Also, in terms of the level of knowledge and ICT skills, the study found that most of the library staffs are found in the intermediate skills. Further, the study found that, once awhile the libraries organize

training for the study as far as the use of open-source software is concerned. Again, Knowledge in the use of open-source software was determined. The study found that knowledge in the use of the adopted open-source software was rated as average.

5.2.5 Limitations of Open-Source Software

The fourth objective of the study sought to find out the major limitations of the open-source software. From the findings, majority of the respondents acknowledged that the open-source software adopted by the libraries is plagued with limitations as the libraries deploy such software in their work processes and activity. Some of the limitations included the lack of expertise by libraries' staff in handling computers, networks, and open-source software. Moreover, some breakdown in the usage of these open-source software required some troubleshooting expertise which is often beyond the expertise of libraries' staff.

Other limitations listed by respondents included vulnerability of open-source software to malicious users, lack of expensive support for the open-source software and non-friendly nature of the software as compared to commercial versions.

5.3 Conclusion

Modern libraries are transforming from drab, ancient buildings housing precious print collections into modern service centers, hosting print and digital media, providing on-demand access to and management of their collections. In this transformation from mere curating to a central role as the information provider, libraries have been helped by open-source software which allows for the effective management of the wide variety of collections from physical to digital.

As evident in this study, the use of Koha and Dspace adopted by the libraries is very advantageous and as remarked by the participants as flexible, easy to modify, easy accessibility and reliability however, it is saddled with some limitation such as inadequate training, lack of expertise to train and manage the software, breakdown which requires special expertise, vulnerable to malicious users and not user-friendly as compared to the proprietary software. Therefore, the management of the libraries should put measures and policies to arrest the challenges faced using open-source software.

5.4 Recommendations

The following recommendation were based on the findings of the study

- **Orientation and Training**

Orientation and Training are the critical stages in the implementation of every system. It is the stage whereby users get to know and better learn how to effectively handle and use the system. In light of this, when library staff is taking though orientation and intensive training, it will pave way for them to handle the software adopted by the library management.

- **Infrastructure Support**

Infrastructure support is a compelling factor to ensure the effective use of a program. There should be the provision of constant power, computers, Help Desk for users to aid them in using the open-source software at the point of their need.

- **Provision of Technical Support**

There are many ways to influence the direction of an open-source project, from the testing code in different environments and adding to the code documentation, to funding the project or foundation and participating on the project board, or by using the code in

other open-source projects. The libraries can exert the greatest influence in open-source projects through the quality, quantity, and consistency of its code contributions. Its therefore in the best interest of libraries to provide the tools and processes that will help teams to develop high-quality, effective open-source code.

5.6 Suggestions for further Study

A further study should be conducted comparing the impact of open-source software and the proprietary software.

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APPENDIX

QUESTIONNAIRE FOR STAFF

PART A: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PROFESSIONAL BACKGROUND

Please tick [√] where appropriate.

1. Your age a. Less than 24 [ ] b. 25-30 [ ] c. 31-35 [ ] d. 36-40 [ ] e. 40 years and above [ ]

Your gender: Male [ ] Female [ ]

3. Educational Level: Bachelor's Degree [ ] Master's Degree [ ] Ph.D [ ] Professional Degree [ ] Others: please specify.....

PART B: APPLICATION/USE OF OPEN SOURCE SOFTWARE

1. What are the names of the open source software used in your library?

……

2. How many open source software do you use?

a. 1. [ ] b. 2. [ ] c. More than 2 [ ]

3. How user-friendly is the open source software?

a. Not at all [ ] b. To a small extent [ ] c. To a moderate extent [ ] d. To a large extent [ ], d. To a very large extent [ ]

4. Is the open source software an integrated software (able to handle all the functions and processes of the library? a. Yes [ ] b. [ ]

5. If no to the above, which sections or units of the library is it able to serve. ?

……

PART B1: ADVANTAGES OF OPEN SOURCE SOFTWARE IN ACADEMIC LIBRARIES

From the table below, tick (√) the extent to which you agree or disagree with the following statements.

*Strongly Disagree **(SD)**, Disagree **(D)**, Neutral **(N)**, Agree **(A)**, Strongly Agree **(SA)***

No.	Statement	SD	D	N	A	SA
1	Lower software costs:					
2	Simplified license management:					
3	Lower hardware costs					
4	Scaling/consolidation potential					
5	Support is available for open source					
6	Escape vendor lock-in					
7	The capability to integrate or consolidate server, service, application, and workstation management for powerful administration.					
8	Quality software: Evidence and research indicate that open source software is good stuff					
9	Ease of availability and access					
10	Cost effective					
11	Server/software maintenance: web-based software with free desktop clients or thin client access, thus freeing up the libraries from server maintenance requirements					
12	Ease of operations for both staff and users					

13	Libraries can use a number of open source software applications together to effectively build a customized solution from among the best-of-breed OSS for their patrons.					
14	Consortia approach: Libraries using OSS systems can discuss the problems with existing users and software experts, and this consortia approach will benefit all.					
15	Free to distribute modified versions of the software					

In your own opinion what do think are some of the advantages of open source software for your library work?

1.……

2.……

3.……

4.……

5.……

PART C: EXTENT OF USE OF OPEN SOURCE SERVICES PROVIDED.

Please rate the extent of use of open source software

Very High Extent [ ] High Extent [ ] Low Extent [ ] Very Low Extent [ ]

Please indicate the reasons for using the open source software and how frequently

Tick (√) all that applies

No.	Statement	Yes	No
1	Openness		
2	Flexibility		
3	Speed		
4	Compatibility		
5	Easily extensible to support other languages		
6	Ease of availability and access		
7	Cost-effective		
8	Ease of operations for both staff and users:		
9	New open additions		
10	Consortia approaches		

PART D: ICT SKILLS AND COMPETENCIES OF LIBRARY STAFF

1. **Do you have knowledge and skills to use a computer and other related technologies?**

(i) Yes [ ], (ii) No [ ]

2. If yes, which level will you belong to?

(i) Basic [ ] (ii) Intermediate [ ] (iii) Advanced [ ] (iv) Expert [ ]

3. How often does the university management provide training on the use of open source software for library services?

(i) Very often [ ], (ii) Often [ ], (iii) Once a while [ ], (iv) Not at all [ ], (v) Not sure [ ]

4. Please rate your knowledge in Open source software

Very Bad ***(VB),*** *Bad* ***(B),*** *Average* ***(A),*** *Good* ***(G),*** *Very Good* ***(VG).***

No.	Statements	VB	B	A	G	VG
1	Your ability to download and uncompress the source code					
2	In the terminal, your ability to move into the extracted directory					
3	Your ability to Configure software					
4	Your ability to run "make" to compile the software					
5	Your ability to install the software.					
6	Your ability to Acknowledge that Windows is not a friend of open source software.					
7	Your ability to check for parts of the program					
8	Your ability to find a port for either Windows or your version of Windows					
9	Your ability to download and run the installer					
10	Your ability to detect errors in open-end software					

PART E: LIMITATIONS OF OPEN SOURCE SOFTWARE FOR LIBRARY WORK

From the table below, tick (√) the extent to which you agree or disagree with the following statements.

*Strongly Disagree **(SD)**, Disagree **(D)**, Neutral **(N)**, Agree **(A)**, Strongly Agree **(SA)***

No.	Statement	SD	D	N	A	SA
	Installation, customization, and maintenance support: The current training of the library staff does not involve expertise in handling computers, networks, and open source software					
	Updates: Commercial software vendors usually bundle in the cost of upgrades and support in the product price					
	Accountability: Often an OSS system is accessed using thin clients, so patrons often come to expect ubiquitous access to the system.					
	Modules/components missing: Every OSS system may not have all the modules or components required by the library,					
	Accountability: Often an OSS system is accessed using thin clients, so patrons often come to expect ubiquitous access to the system.					
	Breakdown: Any breakdown would require some troubleshooting, which is often beyond the expertise of library staff.					
	Vulnerable to malicious users					
	Might not be as user-friendly as commercial versions.					
	Don't come with extensive support.					
	Limited funding					
	The open source development process may not be well defined and the stages in the development process, such as system testing					

	and documentation may be ignored.					
	Higher the lack of IT infrastructure.					
	Lower the technical knowledge of library professionals on					

RECOMMENDATIONS

In your own opinion, what do you think can be done to improve the effective use of open source software for library services?

……

……

……

……