

**BIG DATA ANALYTICS AND ELECTRONIC RESOURCE USAGE IN  
ACADEMIC LIBRARIES**

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INFORMATION SCIENCE**

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## DECLARATION

The research project is my original work and has not been submitted for examination in any other university for academic credit.

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## **DEDICATION**

I dedicate this work to my late beloved dad, Paul Wakahia Kairigo. His encouragement to pursue greater educational heights brought me thus far.

## **ACKNOWLEDGEMENTS**

I hereby wish to express sincere gratitude to these people for the assistance accorded as I worked towards completing this study, this research would not have been complete without their support. At first is to glorify the Almighty God who gave me the idea that brought about this research work. To my beloved wife Gladys, thanks for the patience, support and continued motivation as I was working on this research, to my supervisors, Dr. Makori, Dr. Irura and at some point Dr. Oredo, thanks for the continued guidance towards the production of this research, to my employer, Pac University, thanks for allowing me the time study and finally to my Mum, my brothers and sisters, thanks a lot for the support as well.

God bless you all

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## ABSTRACT

The purpose of the study was to investigate the application of big data analytics as a tool for analyzing electronic resources usage in the academic library setup in Kenya with reference to the library of Pan Africa Christian University. The objectives were: to examine the application of big data analytics as a tool for investigating electronic resources seeking and usage trends and patterns within academic libraries, to distinguish the appropriate technologies applicable to data mining and analytics from e-resources usage in academic libraries, and to ascertain the determinants of user interaction with the various websites and e-resources platforms accessible to the library users. The study adopted a descriptive research design. A stratified sample of 79 postgraduate students pursuing various master's and PhD programs was used. A structured questionnaire was used to collect data directly from respondents while their log files were mined from the server. Data analysis was performed using Statistical Package for Social Sciences software. In terms of usage intensity, the total URL count was 2,352, the highest user made 283 downloads and the mean URL count of 49 downloads. Although no respondent utilized more than 4 databases over the one year period under review, results revealed the most popular databases were e-book central and ebscohost collectively. Usage intensity was significantly correlated to behavioral control factors such as knowledge, confidence and ability to use e-resources as well as possession and control over e-resource devices such as laptops. Respondents trained or orientated on e-resource usage was above average at 69.0 while those not trained was below average at 29.8. Big data analytics is a necessary and powerful tool for investigating electronic resources seeking and usage trends and patterns within academic libraries. The overall efficiency of the academic library's e-resources should be improved by removing redundant databases from the platform after a cost-benefit analysis. An integrated data analytics model for investigating academic library's e-resources usage is a necessary requirement in the internet of things set up. How such a model can be developed into a software tool with commercial value should be the subject of further research.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Introduction**

Data analytics as a concept majorly is used in the business world where organizations have realized the potential of big data and have begun leveraging it. In the library world, with the invention and adoption of social computing systems as a way of accessing resources available to the library for research, most users no longer just sit within the ordinary library set up. The library users and in particular, the student researchers' ability to connect and to interact with the Internet is normally augmented by the advancement of an ever growing conglomeration of Internet-capacitated computing devices, the extension of networks to sustain connectivity and the web developers' ever-increasing attention to provide internet access through these computing devices. However, such a shift, even with the benefits that are alongside poses a challenge in that it becomes difficult to understand what resources users interact with most and how they utilize them since the gadgets being used are not within a centralized locality, hence the need for data mining. Adopting data analytics concept related services enables libraries and information centres to remain ahead of the curve when it comes to offering relevant and top notch resources for research work and to remain relevant in their role of providing timely and reliable resources to the clientele that benefit from the resources on offer. However, it also becomes important for the library set up to understand how the information obtained from any data mining can be of benefit. This chapter presents a background to the study, statement of the problem and research objectives. The scope, significance and definition of terms are also some of the aspects contained in this chapter.

#### **1.2 Background to the Study**

With the growth of online business, there has been an upsurge of analytics to provide insights about the business environment that inform business managers on what decisions they should make concerning the products of their business entities (Marr, 2016). Analytics are therefore as old as online business. Big data analytics however is a fairly new concept especially to the library world (Teets & Goldner, 2013). Websites or web portals have since been developed which have a definite impact on the approach

taken by libraries to organize, offer and facilitate the access to information resources and services. More and more digital content continues to be published on online platforms which make modern libraries and information centers different from what they were in the past. Technology then advances so rapidly, bringing along new developments in the research world within very short spans. Such technological advancements prompt the library institutions to move their resources and services online, hence making websites a vital component of library services, in their role of linking the various online resources and databases to enhance easier access among the patrons who intend to utilize them. “To enhance user friendliness upon library websites, the navigational outline of such websites should imitate or support the behavior of the users depending on the navigational trails that such users opt to pursue and stick to (Vecchione et al, 2016; 1)

“Librarians spend lots of hours and money in millions enhancing access to online database resources that form part of the library collection (Imler & Eichelberger, 2011:446). In order to justify the importance of these resources and to ensure that they are being spent well, they conduct user studies in order to obtain usage statistics. The studies may be in form of focus groups, surveys through the use of a black book, direct observation and questionnaire which are sent out and issued to the users in search for their responses and feedback. In most cases the statistics are in form of a tally sheet in paper form used to generate a report meant for the management who need a constant update of how the library users interact with the database resources at their disposal (Farney & McHale, 2014). However, the above methods do not bring out the best picture of how these online resources and databases are used. Imler & Eichelberger (2011) have stated that these methods may not bring out the exact impression on how these database resources are used by the library institutions’ patrons. For instance, direct observation affects the behaviors of the patrons, since their physical presence brings out the psychological notion that they are being monitored. The focus groups, surveys and questionnaires just provide statistics but never bring out exact interactive picture between the patrons and the resources available.

While such methods are continually considered as noteworthy sources of data collection, they have notable limitations on their success levels in bringing out the unbiased impact of utilization of library e-collection on any academic undertaking of an information institution. The only way to bring out the exact impression as well as unbiased results on

how resources are utilized, especially the electronic resources and to help the information provider to fully dissect the needs of his information seekers is through data mining from big data collection. Renaud et al, (2015) opines that data mining normally will entail the application of numerous data sets or even one sizable data set coupled with analytical techniques that will reveal trends or patterns.

This research therefore seeks to analyze and bring out the applicability of big data analytics as tools for understanding electronic resources seeking and usage behavior within one Kenyan university. The research will look at six main areas of study such as (systems like ezproxy which provide access to offsite access to electronic resources, social media platforms and their roles when merged to web pages, web analytics to help analyze page views and visits, cookies and users history, usability testing e.g. through screen capture, pre and post questionnaires and page tagging through the use of web beacons such as web bugs or tracking bugs

It would be an addition to the body of knowledge when websites provide analytical information about library user studies to help the librarians understand the user needs through usage behavior. “The best way through which librarians can satisfy the patrons who come to the library without failing then is through understanding what they need (Al-Suqri, Lillard & Al-Saleem, 2014).

### **1.3 Statement of the Research Problem**

Big data analytics is an aspect that has been practiced for as long as online business has been in existence. Research in this area has been conducted in fundamental areas such as the business world, with an intention to understand the consumers and their ever growing needs, the political world, with an intention to understand the thoughts of the political electorate and the mobile phone industry where the main objective is to crack down on insecurity related issues. Within the library world, both globally and locally within Kenya, there is minimal and in some cases no attempt whatsoever to directly investigate how library users interact with the e-resources at hand through the application of big data.

With the library and research institutions spending money in millions enhancing access to the online resources that form part of the library collection, there is need to engage a tool that will present such details more accurately; Statistics show that in the United

States, even with a varied nature of publisher prices being pushed down to vendors for specific periodicals, university libraries on average have to spend \$172, \$572 and \$1,636 on single humanity journals, single social sciences and single pure science journals respectively in terms of annual subscriptions (Rose-Wiles, 2011). In Kenya, Strathmore University spends over one million Kenya shillings on journal subscriptions annually (Chibini, 2011) and Pan Africa Christian University spends Kshs 500,000 annually on the same. Such institutions have to justify the importance of these resources by ensuring that they are being spent well. Engaging data usage analytics for available databases and websites by studying the interaction patterns between the users and these resources will provide valuable insight into the effectiveness, relevance and the impact these resources have towards fulfilling the constant needs of the users. Such valuable insights will provide the management with concrete data meant for them to make informed decisions about issues like the subscription costs incurred annually paying for the e-resource databases. The same data will influence policy making among the top management in regards to enhancement, retention and weeding of databases from the collection, intensified information literacy training and development and training of staff to acquire the skills needed to conduct the analytics. Skilled on board staff who can conduct the analytics would translate to timely data for quick decision making and presentation of data to the management in the required formats.

#### **1.4 Aim of the Study**

The purpose was to investigate big data analytics as a tool for analyzing electronic resources usage in academic libraries in Kenya with reference to Pan Africa Christian University library.

##### **1.4.1 Research Objectives**

The objectives of the study are to:

1. Examine the application of big data analytics as a tool for investigating electronic resources seeking and usage trends and patterns in academic libraries.
2. Determine the appropriate technologies applicable to data mining and analytics for electronic resource usage in academic libraries.
3. Establish the nature of user interaction with the various websites and e-resource platforms accessible in academic libraries.

4. Propose appropriate big data analytics model to guide analysis of e-resources usage within academic libraries.

### **1.5 Research Questions**

1. How applicable is big data analytics when investigating electronic resources seeking and usage trends in academic libraries?
2. What appropriate technologies are applicable for conducting data mining and analytics from e-resources usage in academic libraries?
3. What is the nature of user interaction with the various websites and e-resources platforms accessible in academic libraries?
4. What analytics model is appropriate for use to guide the assessment of e-resource usage in academic libraries?

### **1.6 Assumptions of the Study**

This research was based on the following research assumptions

1. Every respondent who participates in this research was enrolled into their respective program one year before the research was conducted.
2. Every respondent who participates in this research had been in session within the last one year period

### **1.7 Scope of the Study**

The study focused on Pan Africa Christian University library in Kenya. It covered the electronic database resource usage and web interaction patterns by the library users of this university. The choice of the university, besides largely being based on the availability of electronic resources within the library was also influenced by the fact that the post graduate students within the university embraced the usage of various technologies to access the electronic resources available to them on campus as well as remotely. In as much as the university has provided a state of the art electronic resource lab, the students don't always frequent the lab and in some cases rely on smart phones, I-pads, personal laptops and kindle gadgets to access the library resources. The researcher also has established that individual subscription to a database in order to access electronic resources is not financially viable. Fortunately, Pan Africa Christian University, where this study was conducted – subscribes and avails the e-resources to the research community comprising of students and faculty using the library through the Kenya Library and Information Services Consortium. The databases are linked at the Library's website for users to connect and access them within

campus range and also through a proxy for the users that need to access the resources remotely.

### **1.8 Limitations of the Study**

At first data analytics aspect may not be new but is a relatively new concept to the library and information world. The information that had been released to the research world about this area and inventions to bench mark from is very minimal. The researcher focused the research entirely on Pan Africa Christian University. As of the time of the study, Pan Africa Christian University had slightly above 5,000 students. These students were spread across two campuses and several units, located in different parts of Nairobi City and also out of the Kenyan Capital. The research targeted web and electronic resources users from across all the students of the postgraduate programs. The researcher also limited his focus mainly on specific big data analytics areas which were: web analytics, browser histories, cookies, mining virtual private network logs and also social media.

### **1.9 Significance of Study**

The study would be beneficial to research all over the world since additional methods of studying electronic resources usage patterns was help build into the Kenya universities practice of librarianship. By the presentation of this research idea in its entirety, information is extended into the body of knowledge on the application of big data analytics and electronic resource usage in academic libraries.

Librarians and information professionals in charge of libraries could use the study findings to identify what use data analytics have as platforms for studying and understanding electronic resource usage behaviors within the libraries. Most academic library authorities, not only in Kenya but within the third world countries would have an evaluation of their existing methods of information presentation upon their websites based on the insights provided by this research. They would therefore seek to improve their services from the insights provided in order to enhance users' experiences.

The Government of Kenya, specifically, the Ministry of Education could find this study very useful in understanding the role data analytics can play as determinants of effective and successful users' study. Vision 2030 has earmarked the education sector as an

important flagship project which will enhance the competitiveness of Kenya. The government can adopt this research and use the insights from this research to enhance the quality of information presentation on the various government funded university and research institution websites.

Private universities, parastatals and NGOs would find the study findings useful in an effort to understand emerging trends and consumer queries in their quest for information if they are to meet the expected needs of their clientele. For business firms that aren't already conducting data analytics, they could use trainings firms who can have a field day to expose opportunities associated with using data analytics as platforms for studying and understanding the behaviors of users in the various information institutions. In the end, the researcher obtained practical familiarity on aspects of web log analysis, mining virtual private network logs and also profound understanding into the electronic resource seeking patterns, usage information behaviour and information retrieval trends through data analytics.

## **1.10 Operational Terms and Concepts**

### **Big Data**

Big Data can be conceptualized as a situation in which data sets have grown to such massive levels that ordinary information technologies cannot successfully handle the size or the scale and growth of the data in order to obtain value of it.

### **Data Analytics**

Data analytics is an assessment of statistical data generated in order to obtain a clearer understanding of the statistical data itself and the organizational entity that owns this data. Data analytics may involve discovering pertinent information from the data and drawing suggestive conclusions necessary to support the decision making processes.

### **Data Mining**

Data mining is the process of extracting hidden patterns from data for profiling practices such as surveillance, marketing, scientific discovery or fraud detection.

### **Google Analytics**

This concept can be conceptualized as a web analytics platform provided by Google that prepares anonymous and statistical reports about website visits through the collection of ordinary Internet log data and visitor's conduct and information seeking behavior in an anonymous form.

### **Information Seeking Behavior**

This concept mainly focuses on the interactions between any given information user and computer-based information systems



## **Internet of Things**

Internet of things can be defined as “a system where physical objects can be discovered, monitored, controlled or interacted with by electronic devices which communicate over various networking interfaces.” Internet of thing is a network of gadgets, facilities, systems and anything that can be linked into any form of a network.

## **University Library**

Research set up within a university tasked with the responsibility for selecting, acquiring, processing, storing and disseminating needed information, to meet the mandates of the university

## **Virtual Private Network**

This is a user-to-Local Area Network connection normally used by an organization that has users who may require authentication in order to connect to the private network from various off-site and remote localities.

## **Web Analytics**

This can be conceptualized as the collection, measuring, investigating and reporting of Internet statistics generated through observing the number of visits and page views by website users for the purposes of understanding and optimizing web usage.

## **Web Behavior Tracking**

constant operation of tracking or trailing users of the web (and users of mobile web apps users) on the internet through tracking, collecting and storing browsing histories, website interaction details and website visitors' behaviors with an intention to analyze their usage trends.

## **Web Users**

Someone who actively or passively visits a specific web site or web page with an intention of obtaining some needed information is a web user.

## **1.11 Chapter Summary**

This introductory chapter has provided an overview and background to the subject of data analytics as a tool for investigation in the modern world. Subsequently, the problem of the study has been stated, along with the purpose of the study and research objectives. In addition, the scope, significance and limitations of the study have been discussed. The definition of key terms has also been provided. The next chapter reviews literature pertinent to the research.

## **CHAPTER TWO**

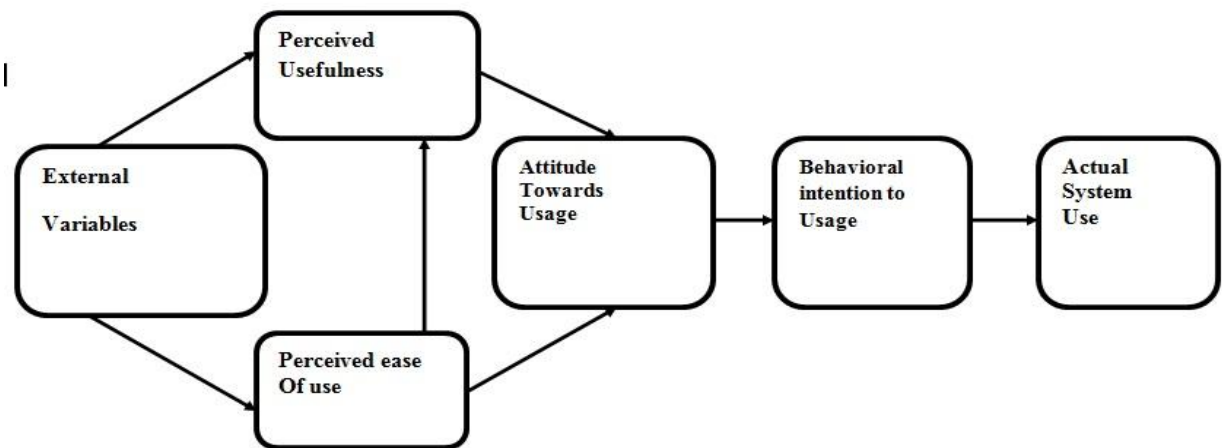
### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter critically examines the available literature and studies that have been previously carried out and are relevant to this research. The chapter will create a better understanding of the issues pertinent to information seeking and user behavior and the impact data mining, data analysis, web analytics and social media have towards influencing opinions about the users of e-resource databases. The literature review contains four parts. The first is an overview of information seeking and user behavior. The second contains descriptions and characterized opinions of various aspects about how e-resource databases and websites are accessible through personal and smart gadget technology. The literature review brings out both the optimistic as well as the pessimistic opinions as explained by the various authors in their own right. The third subsection contains a summary that brings the applicability of big data analytics within the library set up as analytical tool that can be used by the information professional to understand information seeking and user behavior, while the last part is an image of the conceptual framework of the research.

#### **2.2 Theoretical Framework**

The research was based on the Technology Acceptance Model (TAM) as the theoretical framework. The model's past deployment for other researches has proved that it is an appropriate model for predicting and explaining acceptance and usage of information technology and information systems by different users (Surendran, 2012). Technology Acceptance Model usually dictates that the seeming usefulness of a system and its seeming ease of use are normally the most crucial determinants explaining the usage of the particular system. This is illustrated in Figure 1. The model is useful in the current study because it demarcates the antecedents to systems use that were revealed by big data analytics tools.



**Figure 1 Technology Acceptance Model**

The figure above which is an image of the Technology Acceptance model is a representation of the theoretical framework adopted for this research. It relates to the conceptual framework in Figure 1 below in that the external variables depicted in the model above, which are perceived usefulness, behavioral intention to usage and perceived ease of use are all conditional variables as depicted in the conceptual framework of this research. Actual system use relates to the outcome obtained through the process of data mining. The results of such an outcome as depicted in the conceptual framework are database count, URL count, size of log files, database preference and electronic resource platform preference, all which informed electronic resource usage patterns and trends after this research was conducted. The end result is the recommendations that were given following the conclusions drawn from conduct of the research

### **2.3 Big Data Analytics, User Needs and Information Seeking Trends in Academic Libraries**

Data is an essential component in all operations in the modern world since it appears as a representation of something that is occurring or that has already occurred in this modern world. Meaning may not necessarily be drawn at an instance when looking at data sets but human beings have a great capacity to create meaning and therefore build knowledge out of obtained data sets though processing, studying and eventually analyzing such data

sets. Frederick (2016) opines that Libraries, as with all other human activities, have an interest in data since it is a requirement for making the technologies within the library setup to work. The main strategic reasons that compel libraries to conduct analytics are to enhance the experiences of library patrons, to demonstrate value for finances allocated and to bring out excellence in research (Showers, (2014; 140). Library patrons also require data in order to find or locate the information needed when they have an information gap to fill. Frederick further states that research and academic libraries often should make accessible statistical and other important forms of data which would frequently be used for learning, teaching, supporting decision making as well as fulfilling research centered purposes. According to Intezari and Gressel (2017) in as much as the data sets generated from the big data, that is available to organizations may vary marginally, such volumes of data usually present more robust and valid results when organizations are faced with queries. The most important thing is to understand what type of analytics to apply where in order to obtain a desired range of results.

The library as a result, in its role as an information resourcing institution not only gets exposed to so much information but also generates a lot of data in the process. Such large amount of data is what is referred to as big data. The exposure to big amounts of data which may either be structured or unstructured results in the emergence of a state of disorganization within the libraries where there is so much information at the library's disposal, some of which may result in an information overload and not be of assistance to the users. In some cases, the users give their feedback through available platforms and they don't get an actual audience at the library because the libraries don't have staff, such as data librarians who are specialized in mining data sets that could reflect the queries or the unspoken concerns emanating from the users. This necessitates the need of constantly conducting big data analytics within the library set up to get timely and reliable data that shows how well e-resource data bases are utilized. According to Vecchione et al, (2016) librarians and other researchers can therefore gain insights into user behavior through assessing their research patterns in order to establish what resources in particular are the most popular and to a greater extent the unpopular resources, this in turn so as to decide on whether to improve their visibility on the website for quick navigation, access and retrieval by the users or to remove them altogether from the collection.

With the continued advancement in technology, and the introduction of different modes of study in institutions of learning, there has an increasing need to ensure that the library resources are not only accessible from the ordinary desktop computers but also through other gadgets which library patrons and users can connect to either from within the library or remotely. Most users will opt to use their personal gadgets to access the available resources and for this reason, the library has no option but to adjust to this trend accordingly. Tidal; (2013; 2) concurs with this statement by saying that technological trends have enabled gadgets such as Wi-Fi-enabled e-readers, computer tablets and smart phones to connect library users to the available online resources and the information institutions have had to adjust accordingly in order to meet the arising needs of such gadget or smart device users. In order to analyze information seeking behavior or e-resource database usage trends, libraries can adopt web analytics processes, such as Google analytics, web log analysis through analysing cookies and browser history files, mining virtual private network logs, the use of social media and also independent query platforms such as contact forms.

Farney & McHale, (2014; 4) conceptualize web analytics as a method of gathering and trying to construct meaning out of the virtual usage of a website by its users in order to understand how these users interact with this website. In library and information science, it is seen as a process of tracking the significance of web and online information material available to an information institution. The process is done under the umbrella of webometrics. Gooding, (2016; 235) offers that in library and information science, deeper research about the web users can be done through web log analysis which is a branch of webometrics and web servers keep track and record all data about a user activity, in regards to the dates of access, times of access and content the particular user viewed” This data can be manipulated to suit the interests of the researcher intending to study the web users. “Data collected in this case will include the serial occurrences of visited websites, pages viewed by a user, and the amount time spent on each page visited” (Castelluccia, 2012; 23). The most appropriate point to conduct web analytics when trying to analyze library users are on the library web portals since such portals act as library gateways or library openings that lead the users to the research databases available to that library either through timely subscriptions or through open access. Vecchione et al, (2016; 1) argues that such portals and gateways are created with an

intention of saving the users a lot of navigation and time thus enhancing quicker and more efficient research and task completion through consolidating all the resources onto a single web platform. Farney & McHale (2014; 4) also point out that “web analytics capacitates libraries to look further than just data collection but to use the facts presented out of conducting the analytics for tangible action.” Google analytics and altmetric systems can be attached to this web portal, to establish web page visits, counts of visitations and download counts based on every individual. Such information would come in handy to inform the library management how the e-resources databases available have being utilized by providing accurate and timely statistics on who newly visits the website, who’s a constant visitor, countable searches and also session lengths which the users spend on particular databases. Bashinsky (2015) informs clearly that poor visits to the various sites could be as a result of outdated designs, reading and navigation difficulty of outdated plugins or slowness when it comes to loading. All these aspects can be insightful to prompt library management to take necessary action.

Libraries can also mine virtual private network logs to obtain usage data statistics. Virtual private networks provide access to local area network connectivity for people who are accessing such a network remotely. Libraries use virtual private network platforms such as ezproxy to provide off campus access to resources subscribed to the parent institution under a certain IP address. Magnuson and Davis (2014) state that “in as much as mining log data from a system such as ezproxy may look like an overwhelming task, it can be extremely revealing to show the top databases visited by the users, what connections are done within a location or remotely, which users between the students and faculty are using what particular resources and even reveal the busiest days as well as when there is minimal activity.” This means that through collecting of log data obtained through from the Virtual Private Network (VPN) platform, the library is able to understand the information seeking patterns from the users through studying and analyzing the user logs. The VPN systems have a log format that reveals the actual details through initials that represent the actual information needed. The statistics collected become very useful for conducting database cross comparisons and therefore inform on which particular databases are used the most compared to the ones that are minimally or hardly used. Such statistics will give a detailed account of the intensity in usage therefore informing which databases are most valuable to the users.

Apart from direct data mining on proxy servers, in order to clearly understand how users utilize the databases at their disposal; the libraries consider avenues that enhance the building of rapport with the users. This helps the libraries to get feedback about the services on offer and even insights from the consumers about what they need most in order to reap utmost benefit. Such avenues include social media platforms created for the library set up with an intention to constantly communicate with the users and also get user feedback. Zhai and Wang (2016) state that “libraries make the effort to acclimatize to the habits of their library patrons through building relationships with the patrons whom they serve, which is usually done through avenues such as Facebook.” McCallum, (2015) supports this statement by further arguing that libraries can exploit the potential benefits of social media to build intact relationships with their patrons regardless of their location and the modes that they adopt for learning and accessing the library resources and services at their disposal. Zhai and Wang further argue that as much as the usage of social media platforms within library communities generally remains experimental and ad hoc, the consumption of these platforms is accelerating gradually to play a critical role in future outreach of users and service provision within the library setup.

Commentary on published works done by scholars has expanded into the online world in the form of blogs, e-mails, tweets, web pages, and a host of social media opportunities for communication. Social media platforms would not only be used as a way of marketing information resources available, through recommendations and tags but commentaries and recommendations in this case go on to inform about the strength of the resource base within the library (Xie and Stevenson, 2014). When rapport is created through these social media platforms, the users can make comments about a poor service or applaud the library for a good service through the comments made through the same platforms. This comes in handy when the library is trying to gauge the satisfaction rate of the users in response to the services offered. Other rapport avenues are contact forms where users can also make requests through filling a contact form. Curreri (2015) opines that contact forms are a great way of encouraging consumers, both current and potential to take appropriate action when faced with a situation. He however argues that they should be kept easy and short to encourage potential clients to complete. Contact forms differ with social media platforms since the same way a user will write a long comment

requesting for something is handled differently on a contact form since the contact forms will require information filled in brief.

## **2.4 Big Data Analytics and Data Mining**

Top research institutions and business organizations have invested heavily in technologies that best utilize the continually increasing opportunities for new data collection, as well as merging data from both internal and external sources and eventually bringing into application data analytics concepts to surpass the competitors' levels of production. (Marshall et al, 2015). This new data normally regarded as Big data when managed effectively in its huge volumes provides opportunity for organizations to conduct a real time analysis based on what is depicted from this huge data volumes and also for the organizations to react accordingly at an appropriate time frame and within suitable deadlines. (Hurwitz et al, 2013).

Big data is characterized by huge sets of data whose size surpasses the typical databases or ordinary computers' processing capability. Through Big data, organizations realize a synthesized progression achievable when they obtain, analyze and leverage the information for the effective running of their daily operations. Big data therefore results in the evolution of the business organizations since through the obtaining, analyzing and leveraging the information gathered, the organizations are compelled to revise what they consider as initial business traditions. Through the re-evaluation of data that is available from without and within the confines of an organization, valuable insights are provided from such information since it highlights pertinent issues at a broader scope which when well utilized will lead to enhanced decision making processes (Runciman and Gordon, 2014). Cheng et al, (2016) opine that the more data is obtained; the structure of a problem becomes more illuminated and therefore can be observed more clearly. This will in turn lead to an accurate analysis drawn from the data to put in place a solution to the problem. Cheng further argues that data sets needed for the conduct of big data analytics cannot be handled by a typical relational or object-oriented database, ordinary computers, or the ordinary desktop application software since they are too huge. The need for huge parallel processing power of computer clusters becomes necessary therefore to be able to handle the massive data. Big Data Analytics, despite being a common practice within information and communication technology (ICT) circles, is



new and at an infancy stage when it comes to library management application (McAfee and Brynjolfsson, 2012).

Big data has majorly been forerun by the emergence of internet of things. Internet of things enhances the integration of systems or gadgets that operate solely into interconnected systems, gadgets or devices to form a network. Kache, and Seuring (2017) support this statement by saying that the emergence of the long proposed “internet of things” marked the beginning of the big data analytics development in the sense that it offers a platform for integrating technologies and communication solutions from unconnected gadgets within a network into an intelligent gadget network within which both virtual and physical set ups get to interact. According to Guinard & Trifa (2016: 4) Internet of Things has in the recent past become one of the most potential displaying and thrilling development in all technological and commerce industries. Computers that possess sensors are implanted objects such as cars, sensor doors, transaction cards and even clothes, hence an aspect that intends to revolutionize the way business in all daily operations is conducted. Gadgets become accessible to other applications through an existing infrastructural connection. “The gadgets in question that get linked to the internet don’t necessarily have to be computers, tablets, or mobile phones but any plain object, such as an umbrella, clock or air freshener which releases scent at the sensing of movement within a room ( McEwen & Cassimally, 2013: 9). “The original interpretation of internet of things meant an identified capability to recognize and identify applications with the help of radio tags or barcodes implanted in these gadgets” (Nolin & Olson, 2016: 362). This has however changed with Guinard & Trifa (2016: 6) adding that QR codes, RFID and NFC tags are also included among the automatic identification methods which are attached to gadgets to make them more trackable. “For the internet of things to work, there must be a physical object, controllers or sensors and there must be an internet on which the communication between objects takes place” (McEwen & Cassimally, 2013: 11)

Big Data Analytics emerges therefore to provide an applicable standard, which enables effective exploitation of the rapidly increasing amounts of data generated within these “internet of things” gadgets or systems. A conglomeration of networked gadgets or systems will usually include information from all available sources, information that is structured or unstructured and originating from within or without the business

environment. According to Dubey and Gunasekaran (2015) big data analytics works through the integration of large amounts of data and technology. He further argues that big data analytics obtains, integrates, analyses and reports all data that is available through sorting, correlating, and exposing insights not attainable through the use of past data technologies. Uden and He (2017) support the above statement by saying that the main objective of the internet of things is to capacitate items to connect within them at anytime and in any place with anyone through a network path. This is such that objects within the internet of things recognize one another hence acquiring intelligence to enhance or capacitate the making of decisions that relate to a particular context. Gadgets connected through the Internet of things easily exchange information between and about themselves, and in turn obtain information emitted or produced through other gadgets within a shared network. Such data emitted from the internetworked gadgets may be collected through inter-organizational information systems to eventually avail solutions in response to predefined problems relating through the process of data analytics (Pauleen and Wang, 2017: 3).

Information managers or librarians can use big data analytics applications to obtain valuable information about areas concerning service provision within the library and information centers to investigate information seeking trends when they interact with the e-resource databases and understanding what users utilize most. The investigation can also point out what areas are points of concern because they probably are not working for the library users. Insightful and valuable information from all the big data sources that a library is exposed to and that can be used for timely decision making can be obtained through the data mining process. According to Segura et al (2011) Data mining in education and e-learning set up can be used in to obtain information concerning multiple problems. The process may come in handy when establishing problem relating to students' learning assessment, materials used for learning and evaluation of courses. It can also be used to guide on course adaptation based on learning behavior of the students. Simple distributed algorithms can be applied for mining and harvesting data not only from server platforms but also from the text sources such as e-mails as well as the internet.

Some authors have felt that the data mining concept may be an intrusion into people's lives. This data mining concept may be a breach of ethical issues such as privacy

invasion application that restricts people's freedom, it may also cause misinformation, false alarms and eventually lead to chaos" (Fortuna and Grobelnik, 2010), (Banse, Herrmann, & Federrath, 2012; 1). Farney & McHale (2014; 12) further argue that analytics tools through the data mining process have the ability to track a computer's IP address, which is not only a sensitive issue when such an address is used to spot the network, Internet service provider (ISP), and estimated geographic location of the computer that uses a website, but it is also very invasive. Another aspect that can be looked at as a short coming for data mining through the use of logs is that such logs never reveal the actual motivation behind information searches conducted or even the step by step actions that the users engage in during the search. According to Chen et al (2015) projected statistics based on log analysis alone can lead to people drawing very basic conclusions about information seeking behavior with no appreciation of the context under which the information search is being conducted or even the preferences of the particular users. Nevertheless Banse et al, (2012; 1) are quick to opine that tracking cookies, are a crucial aspect that allow web content providers to link multiple sessions of a frequent visitor to a website and are used on many popular websites today. Organizations mainly do this when trying to understand their users in order to create profiles for them depending on their preferences (DaCosta, 2013). Bollier, (2010) adds that it generally becomes safer and more appropriate to look at data sets from multiple big data sources.

## **2.5 Information Seeking and Usage Behavior**

"Information seeking behaviour as a concept mainly focuses on the interactions between any given information user and computer-based information systems" (Timmers & Glas, 2010: 47), (Kadli & Kumbar, 2013: 12). "The concept of information seeking behaviour may also be described as human information behaviour" (Kadli & Kumbar, 2013: 17). Michael et al. (2014: 10) had opined that information seeking behavior can be described as any person's method and approach of collecting and obtaining information for advancement, personal use and updating their knowledge. The concept largely describes modalities through which information is needed, sought after, managed, provided and used in all the various contexts to fill an information gap (Kadli & Kumbar, 2013). Information seeking behaviour may involve the way users navigate and find their way in an information institution or an information space such as within a library. This normally

is depicted in the way the information seekers utilize the available varieties of informational media, information systems and people and familiarize themselves with these resources” (Mandel, 2016: 12).

The driving aspect to the idea of information seeking is the idea of a user need or information need. Any information need can be seen as the motivation an information seeker may have when seeking for information. Users with certain information needs behave in a certain ways as they interact with the available people, information resources and systems. The information seeker sees a gap between what he has, what he has experienced, and what he wants, or even wishes to experience. Users will be prompted to visit a certain site depending on the information needs they may have. The queries raised through the information seeking process inform an information provider about the user information needs. “User behaviors lead to user groups since users behave in different ways depending on their information literacy or information skills.” (Timmers & Glas, 2010: 47) “These user groups may not necessarily form around issues related to specific professions and the job functions involved in such professions but the groups broaden further and form constellations based on the diversity of user issues” (Connaway, 2015, 9). In order for any information provider to successfully meet the needs of the information seekers, it becomes paramount for them to be aware of the user information needs as well as their information seeking behavior. Halder, Roy and Chakraborty, (2010, 42) agree and offer that at such competitive and information obesity times, it follows that the information professionals have a crucial task of knowing the users whom they serve innately if they are to provide help or impart any instruction so that such a user can obtain optimum support. “The social, economic, and technological environments require employees to understand what is going on in the field and to arm themselves with up-to date expertise and insights to transition smoothly and meet changing and ever-expanding user needs.” (Williams, Golden & Sweeney, 2015) “Such insights are valuable for researchers and practitioners (such as teachers and information professionals) who are interested in understanding user behavior” (Halder, Roy and Chakraborty, 2010: 43).

“For any information organization therefore, understanding how their users approach information sources and make sense of what they find plays a key role in trying to

analyze their information seeking behavior.” (Case & Given, 2016: 5); (Tella, 2016: 2). Information seekers are normally exposed to the availability of too much information. This availability of too much information leads to an information overload which doesn't necessarily translate into an informed user. “The available information may also possess all dynamisms in that it may be old, it may be new and may also be incomprehensible to the information seeker” (Case & Given, 2016: 5). “The information organization will therefore help the users interpret and understand the information through user education programs such as information and literacy training” (Case & Given, 2016: 5)

“Aspects such as the environment form an essential framework for information seeking behavior, together in the way through which immediate environments such as information grounds are formed, and also through the wider social frameworks that influence and forms information seeking behavior” (Spink & Heinstrom, 2011: 4). For instance, a digital services environment, where the information available is just digital publications gathered by people and services that support arrangement and distribution of digital resources will influence the way information is distributed; hence the needs arising from such an environment will define the needs of the users. This will be different from the needs stemming from those who restrict themselves to the print collection in a library set up. Information behavior may also be dictated by the institutions, available sources and even organizational culture. Mungai, (2011:1) has opined that Kenya government institutions may not avail information to the information seekers when they need it because of factors such as poor internet connectivity in the offices, lack of infrastructure to publish the information and lack of initiative by the people at the ground”. “Organizational culture may discourage some form of information sharing owing to the levels of trust within the organization. Some people may look at information seekers as people with an intention to seek dominance through the use of the information they share hence leading to lack of sharing” (Case & Given, 2016: 5).

The way the information seeker behaves constantly when interacting with all aspects meant to provide information for him, leads to the information provider to presume the user behavior with the information seeker as a user of the available facilities within the information institution. “The information provider therefore conducts a user study whose main intention is to gather information that is useful in design and provision and/or

evaluation of specific information products or services geared to meet the needs of these information seekers. He will deduce the various user needs that can form his users groups based from the analysis drawn from the behavior of all these users (Prabha, 2013: 309). Spink & Heinstrom, (2011: 4) agree to the above view and continue to opine that “by linking information behavior to other instinctive genetic dispositions, such as personality differences and language, information providers can further increase the understanding of information behavior patterns and styles”. The inner traits and personality dimensions of the information seekers interacts with the contextual factors to formulate the impact in the form of motivation for information, information habits, patterns of information seeking and the nature of cognitive, affective and social utilization of information (Halder, Roy & Chakraborty, 2010, 43). These user motivations, information habits, patterns of information seeking, social utilization methodologies are the ones that information professionals peg on to form user groups. The categories of users will vary from one information institution to another depending on the services offered. The user needs and requirements of each user group will also be divergent (Prabha, 2013: 310).

User needs arising from information seeking patterns are not constant but usually keep changing from time to time (Connaway, 2015, 9; Tella, 2016: 2; Harbo & Hansen, 2012). Such changing needs are usually affected by factors such as changes of academic curricula, new services in the market, switched user preferences or changes in physical facilities. Gibbons (2012; 10) concurs to this opinion by offering that the swiftly changing education scene mainly caused by the dynamisms of technology bring along different challenges and the administration has no option but to embrace this dynamism and the challenges that come along and realign the information institution is a way that seeks to meet these challenges. Any information institution or information provider that wishes to extend the way they satisfy all their users’ needs, have to portray innovation in the services they offer, innovation on their facilities also on the courses on offer by capitalizing on the ‘user logic’ aspect as opposed to the traditional ‘library logic’ aspect. ‘User logic’ means being user centric and this involves shifting the focus on what is significant for the user as opposed to “library logic” which is what is traditionally significant to the information institution (Harbo & Hansen, 2012; 368). In order to understand information seeking patterns among various users especially concerning the information availed by the institutions on websites and e-resource databases, the

information institution has to study the patterns of interaction between the information seekers and these available e-resource databases and websites. When the information seekers and e-resources available to information institutions are linked together, it becomes easier to monitor users and mine their data from a central point, build informative statistics from the data that can be useful to the management of any given information organization to demonstrate the user needs, user preferences and even portray the benefits aligned to what is already available.

## **2.6 Electronic Resources Accessibility on Social Computing Systems**

Access of electronic resources through social computing systems is not a new concept. With continued advancements in technology, smart gadgets like phones, iPads, Kindle gadgets and even pagers have had their magnitude within the information landscape building and escalating to very diverse dimensions. However, according to Jensen (2010; 6) the magnitude has scarcely been acknowledged by many librarians when compared to the other business professions. Jensen (2010) further opines that the library institution cannot still be seen as to depend entirely on the desktop computers that are placed within the e-resources section of the library if a concrete decision concerning e-resource utilization is to be arrived at. Patrons come to the library with a conglomeration of gadgets which they connect to in order to access the resources available. While some may have on site access to the resources at their disposal, other users have off site access. Dukic , Chiu & Lo, (2015) add that libraries provide extensive mobile services to their patrons. The services provided through the mobile enable their patrons to search the library catalogues, online databases resources, managing their circulation accounts, book to use facilities such as study spaces available computers and find documented information about the library facility in question. Such services are available to library patrons regardless of their locality since most modern library institutions have enhanced access to their resources and services even to users in remote locations. Paterson & Low (2011; 11) corroborate by saying that “students in the library world are embracing the utilization of mobile internet in through so many ways”

Mobile and smart gadget interactions are context driven such that people will use mobile and social computing systems services for specific purposes and not for others. For instance according to Dukic et al (2015; 9) Information seekers rarely download journal

articles or access e-books to read on their smart phones. When they do it usually is to save in their emails and access later on. They also avoid typing or editing papers because the mobile phone is too small for typing. Nowlan, (2013;143) further argues that library users prefer to use their mobile phones to bookmark or save articles when they do access them from electronic resource databases, rather than reading them in their totality. The reason being, that the size of the mobile phone screens is too small to be able to provide comfortable reading of an article to its entirety. Yet in as much as the readers may not go through an article entirely when downloaded through a phone or a social computing system, they still can access them. The challenge therefore lies with the library ensuring that a user who may wish to access the online resource databases available through social computing systems can have a user friendly experience accessing what they need. Paterson & Low (2011) opine that the challenge academic libraries face is to form persuasive information services and digital resources available in a way that the information seekers will not only embrace, but also like because they are services that guarantee satisfaction to what the information seekers desire. Boudreaux (2012) offers that as more gadgets within the universe are transformed and placed into the record of digitally connected internet devices, the roles and responsibilities of web developers and technology managers will need to evolve in keeping pace with the ever expanding list of appliances and gadgets that require a web interface.” This in turn means that the professionals such as the systems librarians in any library set up will have to build on their capacities if they are to keep abreast to such emerging technological developments. Nowlan, (2013;144) concurs and further argues that every library should own up the responsibility or the goal of designing and constructing a library site that is mobile phone compatibility in order to offer excellent services and information to all its patrons, including the ever-growing population of mobile enthusiasts.

In order to justify the importance of available library e-resources and to ensure that they are being spent well, the librarians conduct user studies in order to obtain usage statistics that will corroborate the need to have such resources in the library environment (Imler & Eichelberger, 2011). Research libraries interested in analysing how people make use of the internet facility and online resources to address their information needs normally make use of several options. This depends also on the available information access options to the given library environment. The best method for bringing out an analysis of



the how the resources are utilized, and even for the management to establish whether or not the needs of the online resource users are being met is through introducing web tracking and data mining methodologies which are aspects of data analytics. Such methodologies may involve the use of tools such as google analytics, incite, altmetrics, computer /server log analytics which bring out the usage patterns and trends of electronic database resources. It is only natural to observe usage or utilization on any library's digital resources presence. This includes the main website, online catalog, online electronic resources, library blogs, and other virtually available services (Farney & McHale, 2014; 3). Any library adopting the data analytics concept will make considerable discoveries and more revealing usage details about the patrons since it is evident that access to information resources can be done through many platforms such as through smart gadgets and phones, through kindle gadgets, personal laptops and iPads.

Marek (2011) observes that there's been an aggressive growth in big data analytics and adoption of the same within business institutions. Big data analytics therefore if adopted or given utmost attention within libraries, as is the case in the business environments, would help library management to know what measures to take concerning their resources depending on the analysis produced from web user visitation data. Román et al (2012; 5) concur by saying "through this process of big data analytics, web usage routines can be used to draw an analysis on preferences for the various categories of web users. "In many instances, libraries and information centres will have minimal face to face time with remotely located users, therefore mining for such data statistics concerning web usage becomes the crucial most method to comprehend their conduct when on the various research content bearing websites" (Vecchione et al, (2016; 3). Well projected usage statistics will help the library institution to make resolute decisions regarding the resources they have at hand. They will conclude on which resources they'll need to enhance maybe through obtaining full licenses if they only have access to them partially if they have a great impact on the patrons. The institutions can also decide on which ones they'll need to weed off from the collection by halting payment of subscription if the resource in question is of minimal importance to the users that the library serves. A holistic and unbiased analysis can be drawn through investigating not only the desktop computers that are located within the e-resources section of the library

but all the social computing and personalized systems that these clients make use of to access the e-resource databases at their disposal.

## **2.7 Tracking Usage and Web Resource Interactions**

If any library is to make headway when it comes to satisfying the needs of its users, it has to align its services according to the user preferences. “All decision makers have to take into account these preferences as they are expressing not only user needs but also trends” (Meletiou, 2010; 289). These user preferences are not just determined based on the traditional library services but also through web resources. “Library services have since undergone evolution from the time of closed library stacks, through library shelf browsing procedures, searches upon the punched cards of a card catalogue to open access databases and institutional repositories concept” (Gakibayo et al 2013: 1). According to Vecchione et al (2016, 1) this means that librarians and other researchers can get to understand user behaviour through tracking users pathways as they interact with such open access databases, websites, institutional repositories, social media platforms and analysing the same in order to determine what content is most popular with the users, hence seek to improve ease of navigation to that content in a bid to reach out to this users and guarantee them satisfaction.

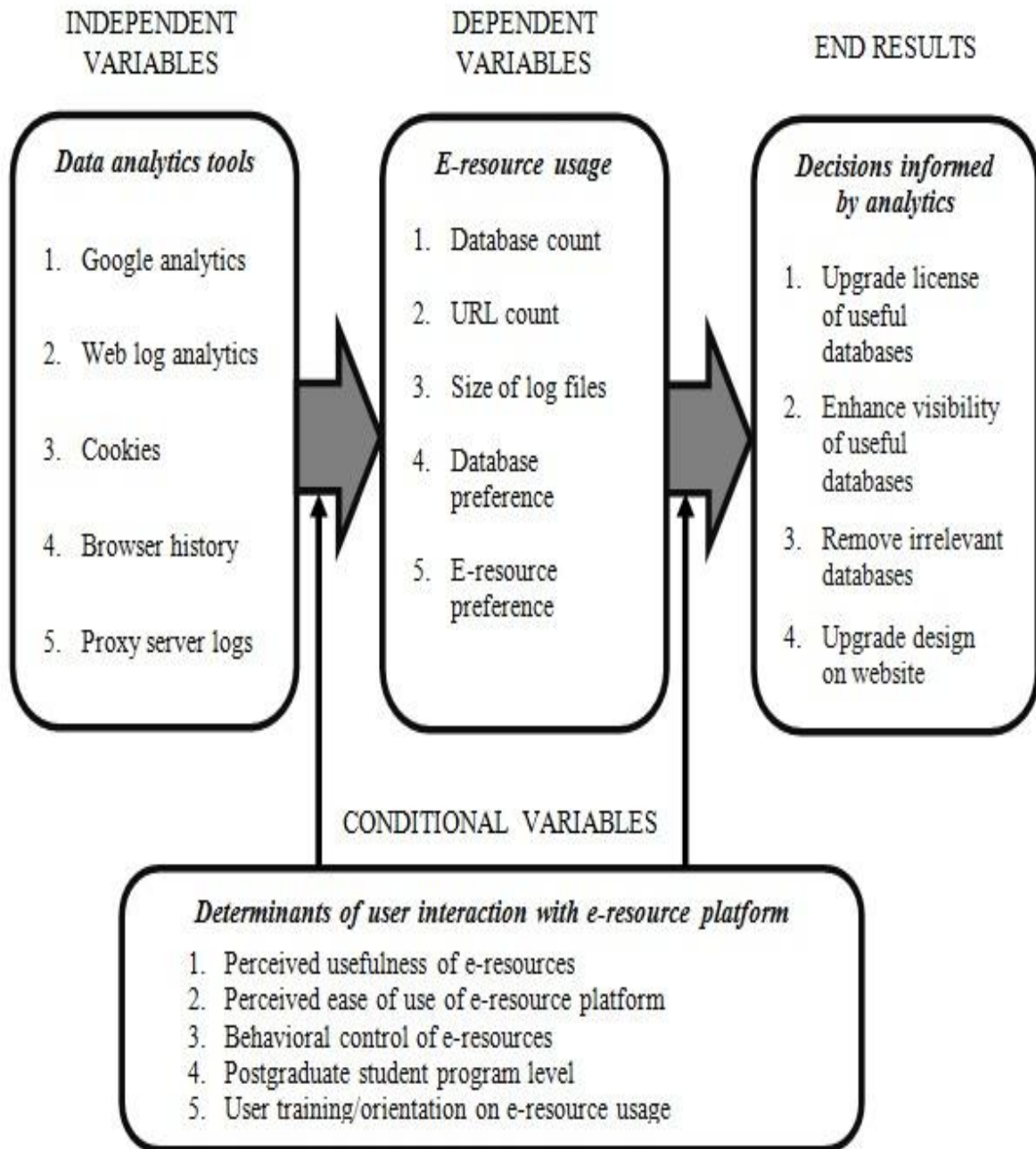
“Libraries have to create websites that are compatible to smart phone technologies by factoring aspects such as small screen, poor network connectivity, apps compatibility and poor screen resolution” (Tidal, 2013; 2). Just like the name “mobile user” or “social computing system user” the idea will be to enhance quick access to the available varieties of library resources. Apart from the catalogue which most libraries develop mobile apps for, there is need to develop services for other apps as well. Washburn (2011; 2) states that “services such as check out, fine payment, access to electronic resources, access to audio content, access to video content and even booking a room are of paramount interest to the users just as checking the availability of resources on the library catalog”. Yoo-Lee, Heon Lee, & Velez, (2013) offer that the library should also consider this especially in its effort to provide the resources to the physically challenged users since through the social computing systems the library resources are accessible to such users at minimal mobility when they are at whichever locality. “It would therefore be essential for the library to scrutinize the usage levels of such resources on the smart

platforms, in this case, by tracking the usage of these mobile apps like any other traditional or desktop tool” (Farney & McHale, 2014; 115)

## **2.8 Conceptual Framework Explanation**

In order to determine electronic resource usage trends and patterns, data analytic tools are crucial since they are the main aspects to be assessed. Web log files, cookies, browser history and proxy server logs will contain log data that show the patterns of usage in terms of what particular websites and databases specific students visit. Google analytics will show what particular sites any user accesses. This applies when such users access the internet when are going through the Google chrome browser. After an analysis is done, results such as database counts, URL counts, size of log files, database preference and electronic resource platform preference are determined. A comparative analysis can be drawn based on the particular databases and electronic resource platforms an institution has availed to the users to utilize for research. Once the electronic usage patterns and trends are established, the results obtained from the analysis will inform the decisions made by the management of the academic libraries. They may opt to upgrade the licenses of useful databases, such that they now obtain full access licenses for databases that initially were only accessible through partial licenses, they may decide to enhance visibility of useful databases, probably by placing them on a quickly accessible link on the library website, the management may also decide to remove irrelevant databases by stopping subscription to such databases as a cost cutting measure or they may decide the design on the website should be upgraded so as to create new themes that are user friendly to the electronic databases and resource users. There are conditional variables that determine the way the users interact with the resources they have access to. The users may have an already formed opinion on whether these databases are useful to them or not depending on the impressions they’ve had initially, they may also have perceptions on whether the databases are easy to navigate or not, users’ information literacy levels may vary depending on the orientation or usage education they have received from the library staff, the post graduate level may also be a variable since there are those who are at their course work stage while others would be writing their theses. The intensity of usage at both levels would vary from one student to another.

## 2.9 Conceptual Framework



**Figure 2 Conceptual Framework**

**Source: Researcher; 2017**

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter will look at the data collection method, definition and justification of the variables under study and the methodology used to undertake this study. The latter part of this study will look at the results and further evaluate the results.

#### **3.2 Research Design**

The study adopts a descriptive research design. In this research approach, the purpose was to describe usage trends and patterns and explore the potential underlying factors behind the trends and patterns in usage of e-resources. This was helpful in delineating the areas for improvements to be made and the appropriate model for big data analytics useful to the academic library context.

#### **3.3 Area of Study**

The study was conducted in Pan Africa Christian University in Nairobi, Kenya. Specifically, the study targeted the users of the university's electronic library facilities. Every user who needs to access the electronic resources has to have authentication through the ezproxy access platform. The researcher mined the server where the offsite access platform (ezproxy) is installed in order to obtain individual user log files that register once a user logs into the ezproxy platform to access the electronic resource databases. The researcher sought to look at files for a period not exceeding and not less than the past one academic year. This was used as the evidence on e-resources usage trends and patterns for the researcher.

#### **3.4 Target Population**

The target population was 225 postgraduate students who were on session during the September 2017 semester and who had completed at least one year of study. The main reason why the researcher zeroed in on the Post-graduate students was because the intensity of their usage of the electronic resources was potentially higher compared to those in the undergraduate programs. Such students had a higher need for library

resources because of the intensity of research expected at postgraduate level. The post graduate programs that were in progress were MBA, MAMFT, MAL, MPCS, MBT, PMFT and POLD.

### 3.5 Sample and Sampling Techniques

Sampling usually involves picking out a particular group of people that are representative of the given target population. “Sampling is usually done to save on the time and cost aspects. The necessity to pick a sample population to represent a target population is mostly encountered when a quantitative research is being undertaken. There may be factors that need to be considered separately when sampling either for qualitative research or quantitative research. However, the ideologies and techniques of picking samples are the similar in both types of research (Bryman, 2016).”

#### 3.5.1 Sample Size

The initial rule for sampling according to Mugenda and Mugenda (2003) suggests that sample sizes of between 10% to 30% are representative of population. However, in any research, the rule for determining an adequate sample size is that the higher the sample size, the more it is representative of the population (Rasinger, 2013). Therefore, in this study, a sample size of 79 respondents, representing 35% of the target population was used. Table 1 shows the distribution of the sample.

**Table 1: Population and Sample Size Distribution by Program Level**

<b>Strata</b>	<b>Population</b>	<b>Percent</b>	<b>Sample</b>
PhD students	59	26%	21
Master’s students	166	74%	58
<b>Total</b>	<b>225</b>	<b>100%</b>	<b>79</b>

Source: Registrar’s office PAC University (2017).

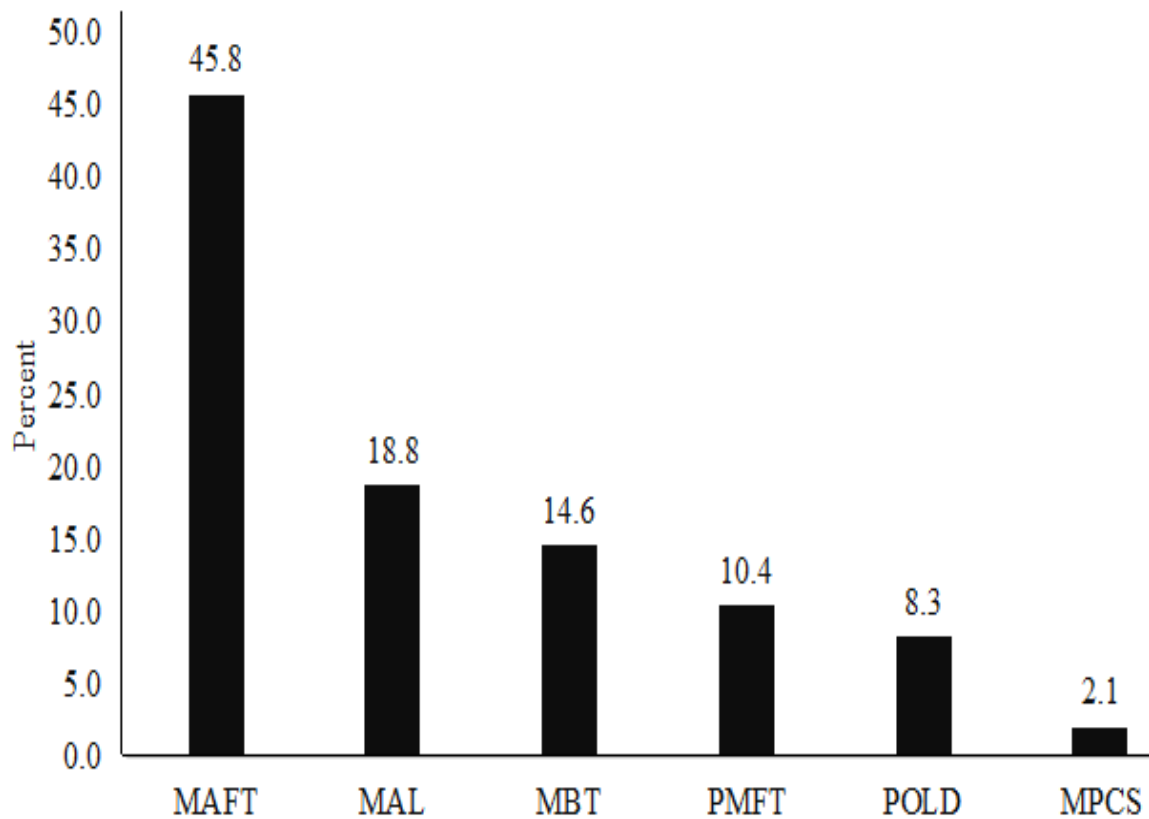
Table 2 below further classifies the population and sample by discipline. The table indicates that School of Humanities and Social Sciences was the highest at 44, followed by School of Leadership, Business and Technology at 21 while School of Theology was 14.

**Table 2: Population and Sample Size Distribution by Discipline**

<b>Discipline</b>	<b>Population</b>	<b>Sample</b>
School of Humanities and Social Sciences	127	44
School of Leadership, Business and Technology	61	21
School of Theology	38	14
<b>Total</b>	<b>225</b>	<b>79</b>

Source: Researcher; 2017

The distribution of the sample by program undertaken is also presented in Figure 3.



**Figure 3 Program Respondent Undertaking**

The figure shows that 45.8% (36) of the respondents were enrolled for Master of Arts in Marriage and Family Therapy (MAFT). This was followed by respondents undertaking Master of Arts in Leadership (MAL) at 18.8% (15), those enrolled in Master of Bible and

Theology (MBT) at 14.6% (12) and those pursuing PhD in Marriage and Family Therapy (PMFT) at 10.4% (8). The figure further shows that respondents pursuing PhD in Leadership and Organizational Development (POLD) accounted for 8.3% (6) of the respondents while those undertaking Master of Pentecostal and Charismatic Studies were 2.1% (2). The results suggest that most of the respondents were students undertaking the Marriage and Family Therapy program at master's level.

### **3.5.2 Sampling Techniques**

There are quite a number of sampling procedures e.g. probability sampling, random sampling, stratified sampling, cluster sampling, non-probability sampling etc. The researcher used probability sampling and applied stratified random sampling specifically to pick the respondents. The log files identified the particular users based on the IP address and the student numbers. Within each stratum, the researcher opted for systematic random sampling because the method accorded every student or participant an equal chance of being selected to participate in filling the questionnaires. The researcher obtained a list of all the students pursuing postgraduate degree programs from the institution.

## **3.6 Data Collection Methods**

In a quantitative research, random sampling techniques are singled as the main ways of picking a sample size. Instruments that are well structured, such as questionnaires, are the most appropriate tools for data collection, depending on the diversity of the research. These two aspects simplify the capability to compare various issues arising, make a general interpretation and draw a summarized conclusion based on the results obtained in the research.

### **3.6.1 Questionnaire**

A structured interviewer-administered questionnaire designed to obtain information from every interviewee on their opinions about websites and e-resource databases was used. The questionnaire comprised of two major sections. The first section contained questions with dichotomous and multichotomous questions seeking respondents' demographic information such as program enrolled in, year of study, computer and internet skills. The second section also contained several multichotomous questions exploring usage



behavior as reported by respondents. This was followed by a seven-item likert scale statements measuring perceived usefulness of e-resources. Afterwards, another set of eight-item likert scale statements measuring perceived ease of use of e-resources. The last part of the questionnaire was also a set of five-item likert scale statement measuring behavioural control factors with respect to e-resource use.

### **3.6.2 Document Review**

The researcher, with the help of an ICT technician, also mined the server where the offsite access platform (ezproxy) was installed in order to obtain individual user log files that register once a user logs into the ezproxy platform to access the electronic resource databases. This exercise was performed to obtain user intensity data such as URL count, database count, databases accessed and log file size in kilobytes.

## **3.7 Research Instruments**

Instruments of research are mainly categorized into two, instruments which are researcher-completed and instruments that are subject-completed. “Subject collected instruments are normally filled by the researcher who basically is the primary data collector while instruments which are subject completed are distributed to a group of respondents who act as the main source of data collection. They help to collect quantitative research data on a particular subject that is responsive to a given research query (Blankenship, 2010).” This research mainly made use of a subject-completed research instrument in the form of a questionnaire that was filled by a sampled group of respondents.

### **3.7.1 Pilot Study**

The researcher administered the questionnaire with intent to carry out a pilot testing at University of Nairobi among the Masters of library and information science students. The purpose of this pilot study was for him to obtain results which formed the basis of establishing and eventually justifying how reliable his research instrument was. Through this pilot test, the researcher was able to mark out the potential problems or errors that were related to the research design and in particular, the research instruments.

### **3.7.2 Reliability of the Research Instrument**

Reliability is defined as the consistency with which an instrument yields the same results for similar populations (Kraska-Miller, 2013). For the purpose of this study, reliability of the instrument was analyzed using split-half technique whereby scores on one half of the items were correlated with scores on the other half of the items. Stangor (2014) explains that a reliable instrument yields a high correlation between the two halves, with an instrument usually considered reliable when the correlation coefficient is at least 0.7 or higher. In this study, a correlation coefficient of 0.894 was obtained, suggesting that the instrument was reliable.

### **3.7.3 Validity of the Research Instruments**

According to Kraska-Miller (2013), reliability can be conceptualized as uniformity or consistency at which an instrument yields the same results for similar populations. Reliability puts into consideration the representativeness, the relevance and the appearances of items in the instruments. Validity was established by relying on expert opinion from the researcher's supervisor who scrutinized the instrument in order to ensure there was no mistake made during questionnaire construction. The researcher also engaged his peers through the process of scrutinizing the questionnaire scripts so that they could critic the data collection instruments and bring out the face validity if the instruments.

## **3.8 Ethical Considerations**

Ethics of research and the client was adhered to. In planning and conducting research, as well as in reporting research findings, a researcher has to fulfill several obligations in order to meet the ethical standards. First, the research project must be planned so that the chances of presenting misleading results are minimized. Participation was voluntary. The researcher informed the interviewees on the purpose of the study in advance and they had the right to and not to answer any question that they were not comfortable to answer. The information given was treated as confidential in order to protect and ensure the dignity and welfare of all participants, and after the study, was destroyed. The respondent was not supposed to indicate their names anywhere. The respondent was also given an opportunity to ask any question before the interview took place. The researcher strove for

honesty in all communications. This was ensured through reporting data, results, methods and procedures, and publication status in a manner as honest as possible.

### **3.9 Data Collection Procedures**

The researcher interview/administered the questionnaire to the selected respondents. The researcher begun by undertaking a pilot-test of the instrument. After the review of the instrument, the researcher identified the respondents in the sample, sought for an audience with the respondent. The researcher then created rapport with the respondents in question and undertook the interview. Each questionnaire was then matched with their respective log files in order to determine usage patterns from data obtained from the server. The log files were extracted to facilitate correlation between the study variables.

### **3.10 Data analysis**

The Data collected was analyzed using Statistical Package for Social Sciences (SPSS) software and presented in percentage and frequency form and thereafter illustrated in figures and tables in order to represent e-resource usage trends and tables to represent the refined data. The data analysis process entailed first entering the data into computer software for analysis. The use of the Statistical Package for the Social Sciences (SPSS, Version 20) was made for this particular purpose. The data was coded and entered into this software where the data was analyzed for results in relation to the research questions posed. Karl Pearson correlation technique was used to draw inferences.

### **3.11 Chapter Summary**

This chapter has detailed the methodology that was applied to undertake the study. It has discussed the research design, area of study, target population and sampling process. It has also discussed the data collection methods, research instruments and ethical considerations. It has further discussed data collection procedures and provided the data analysis plan. In the next chapter, the study findings are analyzed and presented.

## CHAPTER FOUR

### DATA PRESENTATION, ANALYSIS AND INTERPRETATION

#### 4.0 Introduction

This chapter presents the analysis of findings as well as interpretation and discussion of the results. The findings are discussed and presented in line with the specific objectives and research questions. The chapter is divided into four sections. The first section presents a descriptive analysis of demographic data of the respondents. The succeeding findings are presented and discussed in line with the specific objectives. Section two concerns the application of big data analytics in the investigation of electronic library resource usage trends and patterns. Section three analyzes the determinants of user interaction with various websites and e-resources platforms accessible to the library users. A summary of the key findings is presented at the end of the chapter.

#### 4.1 Response Rate

Out of the 79 questionnaires administered, a total of 48 were successfully filled. The response rate is presented in Table 2. The table shows that Master's students accounted for 51% (40) of the respondents while PhD students were 10% (8). This placed the total response rate at 61%. Rubin and Babbie (2010) suggest that a response rate of at least 60% is good enough. Therefore, the response rate obtained was considered adequate for analysis. The respective log-files for the actual participants were mined from the servers using their registration numbers to aid in the analysis of their e-resource usage behavior.

**Table 3: Response Rate**

<b>Respondents</b>	<b>Distributed</b>	<b>Returned</b>	<b>Percent (%)</b>
PhD students	21	8	10
Master's students	58	40	51
<b>Total</b>	<b>79</b>	<b>48</b>	<b>61.0</b>

## 4.2 Demographic Profile of Respondents

This section presents a descriptive analysis of respondents' demographic data with regards to level of study, school enrolled in and year of enrollment. The study sought to establish whether the respondent was pursuing the course at master's level or PhD. Table 4 shows the results. The table reveals that in the overall, students pursuing master's degree were the majority at 83.3% while PhD students were represented by 16.7% of the respondents.

**Table 4: Distribution of Respondents by Level of Study**

<b>Level of study</b>	<b>Population</b>	<b>Percent (%)</b>
PhD	8	16.7
Masters	40	83.3
<b>Total</b>	<b>48</b>	<b>100.0</b>

The distribution of the same respondents by school is presented in Table 5. The table reveals that in terms of schools at the university, 56.3% of the respondents represented the School of Humanities and Social Sciences, the School of Leadership, Business and Technology was represented by 27.1% of the respondents while respondents from the school of theology were 16.7%. Therefore, the School of Humanities and Social Sciences had the highest student representation.

**Table 5: Distribution of Respondents by School**

<b>School</b>	<b>Frequency</b>	<b>Percent (%)</b>
School of Humanities and Social Sciences	27	56.3
School of Leadership, Business and Technology	13	27.1
School of Theology	8	16.7
<b>Total</b>	<b>48</b>	<b>100.0</b>

The distribution of the same respondents by year of enrollment is presented in Table 6. The table shows that 16.7% of the respondents were enrolled in the year 2014, 33.3% were enrolled in the year 2015, 39.6% of the respondents were enrolled in the year 2016 and 10.4% joined the university in the year 2017. The results suggest that most of the

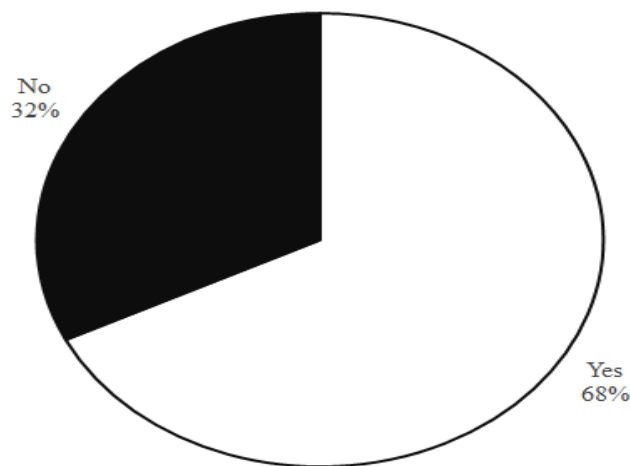
respondents had taken more than two years in the university. It can thus be deduced from the finding that most of the respondents were not new to the systems of operation at the university and hence, were perfectly within the one year threshold required for them to participate in this research.

**Table 6: Distribution of Respondents by Year of Enrolment**

<b>Year of enrollment</b>	<b>Population</b>	<b>Percent (%)</b>
2014	8	16.7
2015	16	33.3
2016	19	39.6
2017	5	10.4
Total	48	100.0

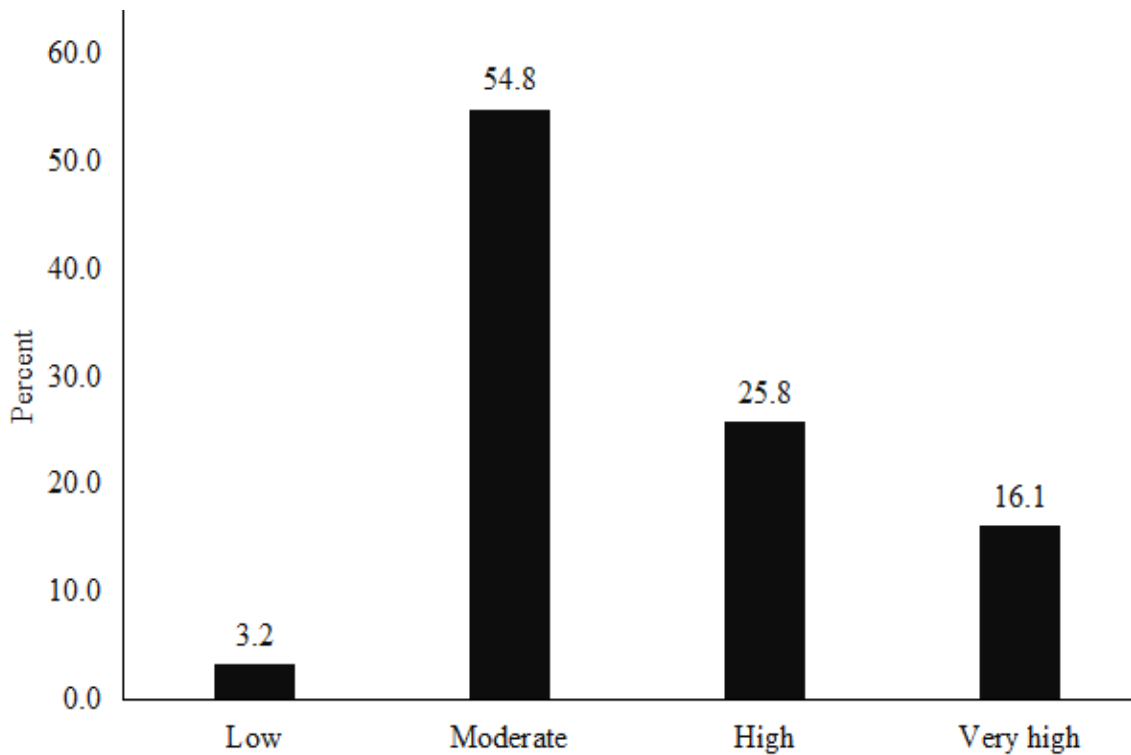
### **4.3 Orientation, Computer and Internet Self Efficacy Levels**

At this section, the study sought to establish whether respondents had ever received training/orientation on how to use the library’s e-resources, their level in terms of computer self efficacy as well as internet self efficacy. The distribution of respondents in terms of whether they had ever received training/orientation on how to use the library’s e-resources is presented in Figure 4 (pg. 38). The figure reveals that 68% of the respondents received training but 32% did not. This indicates that most participants in this study had already been trained and orientated on the usage of the library’s e-resources.



**Figure 4: Student Received Training/Orientation on Usage of Library’s E-Resources**

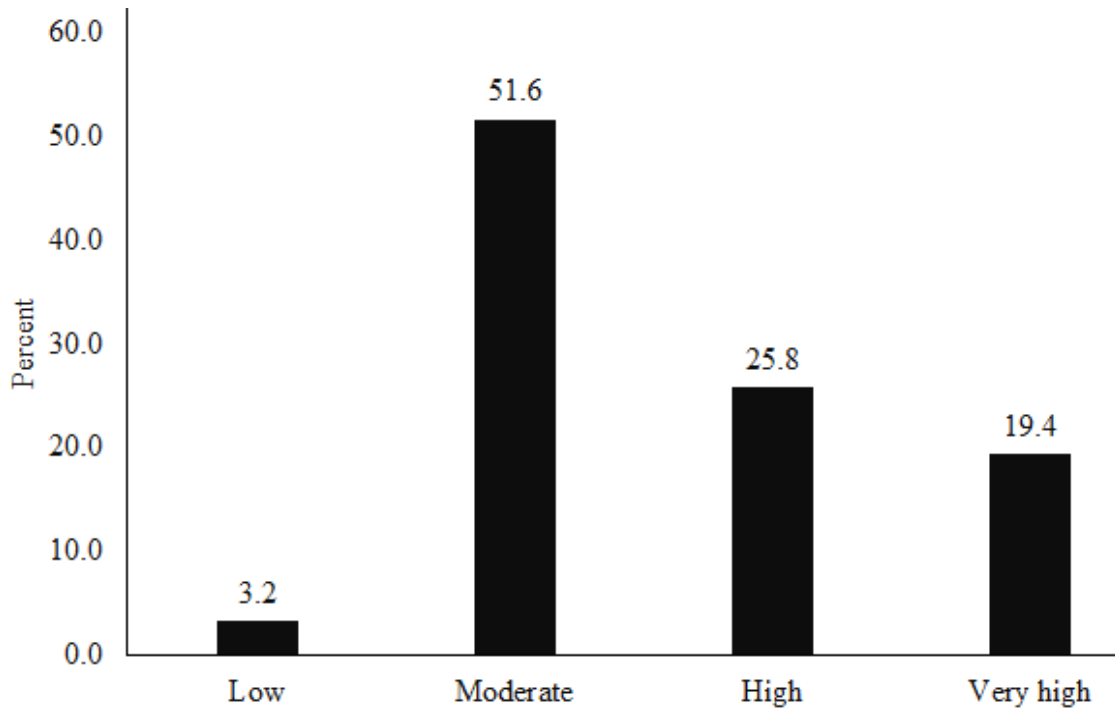
In terms of establishing computer self efficacy levels of the students, the Respondents were asked to rate their skills in operating a computer. The results are presented in Figure 5 below.



**Figure 5: Respondent's Computer Self-Efficacy**

The figure above reveals that majority of the respondents (54.8%) rated their computer self-efficacy as moderate, (25.8%) rated their computer skills as high and another 16.1% rated the same as very high. However, some 3.2% of the respondents rated their computer self-efficacy as low. This means that participants in the study had at least an average level of computer skills necessary to work effectively with computers. At another aspect of this section, respondents were also asked to rate their knowledge of using/navigating the internet with an intention to understand their internet self efficacy levels. Figure 6 (pg.39) displays the findings. The figure indicates that 51.6% of the respondents rated their internet skills as moderate, 25.8% rated their skills in navigating the internet as high and another 19.4% of the respondents said that they had very high internet skills. However, 3.2% of the respondents rated their internet skills as low. This

means that the research participants had minimum level of internet skills necessary to undertake research successfully via the internet.



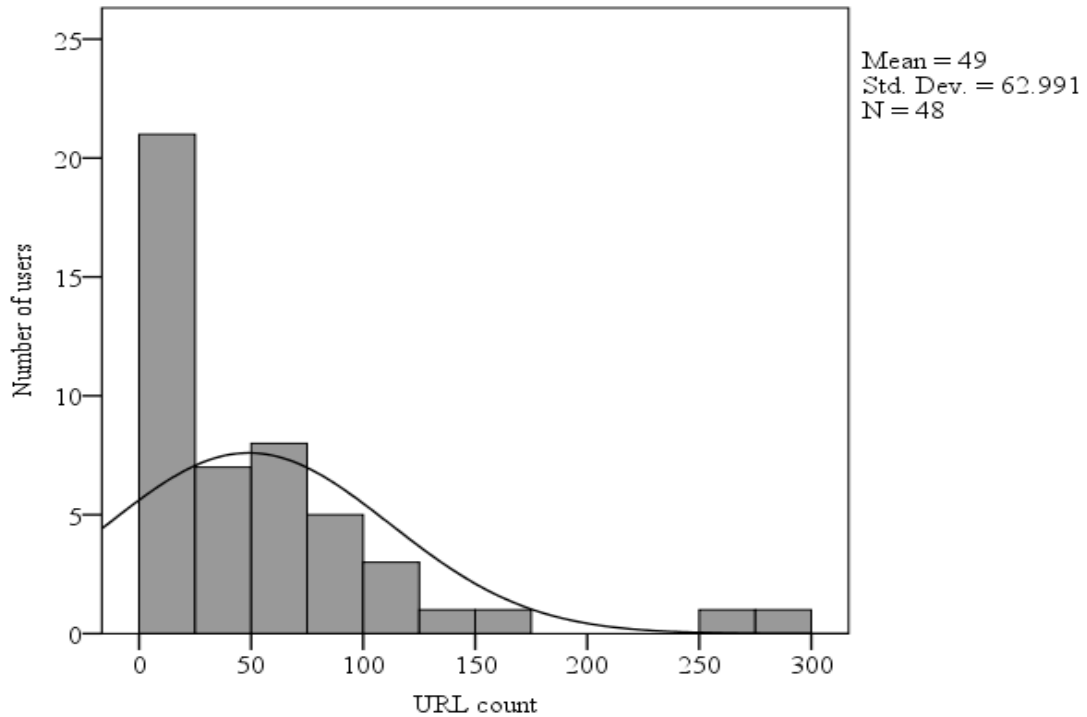
**Figure 6: Respondents' Rating of Internet Self-Efficacy**

#### **4.4 Big Data and Electronic Resource Usage Trends and Patterns**

This section uses big data analytics to analyze the resource usage trends and patterns in terms of usage intensity as measured by URL count, log file size in Kilobytes, level of program, database count, usage pattern for the electronic platforms and databases and the intention to use any other library resources. These are combined with self-reports on access and frequency of access to the library website and interactive platforms. The first aspect of this section sought to assess the Usage Intensity in terms of URL Count. Data mined from the library's server revealing URL count is presented in Figure 7. The figure shows that the mean URL count was 49, with individual counts per user deviating from this mean by about 63 URLs ( $M=49$ ,  $SD=62.991$ ). The results also revealed that the total URL count was 2,352 and the highest user made 283 downloads over the one year period. Out of the total URL count, the results showed that 50% of the users accounted for only 5.4% of the download volume. This is also reflected in the figure which depicts the skewness tailing to the right, suggesting that majority of the respondents were light users of the university library's e-resources. It was also established that the bottom third

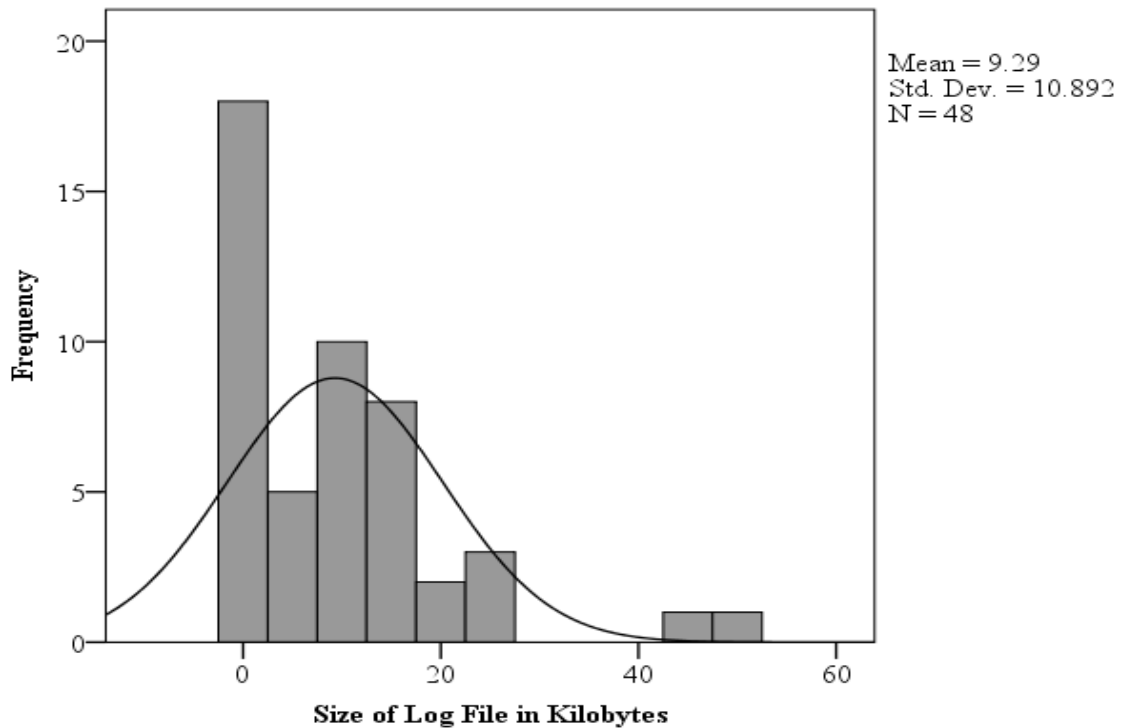


(33.3%) of the respondents had zero logs, meaning they never utilized electronic library resources over the one year period under review. In comparison, the top third (33.3%) of the users accounted for 78.9% (1855) of the volume of e-resources used as indicated by URL count while the remaining third (33.3%) of the users shared 21.1% of the volume. The results suggest that just a third of the students did make adequate use of the e-resource materials availed by the university library.



**Figure 7: Usage Intensity as Measured by URL Count**

In the second aspect of this section, usage intensity by size of user log files in Kilobytes was also used as a proxy for usage intensity. Figure 8 presents the results. The figure shows that the average Log File size was 9 kilobytes, with a variation of 11 kilobytes (M=9.29, SD=10.892). It was also found that the total size utilized by respondents over the one year period was only 446 kilobytes. The biggest log file size was 48kilobytes. Two-thirds (66.7%) of the users' log files collectively accounted for only 25% of the used capacity, of which some 31.3% (15) log files had zero kilobytes, implying no data on them. The results suggest that despite the intensity of research that characterizes studies at postgraduate level; about a third of the students never utilized the university library's e-resources at all.



**Figure 8: Usage Intensity as Measured by Size of Log files in Kilobytes**

Usage Intensity by Level of Program in terms of Masters and PhD was also sought. Table 7 (pg.42) compares the mean intensity of usage behavior between Master’s students and PhD students. The table indicates that PhD users recorded a higher mean log count at 68.5 than Masters level users with a mean log count of 45.10. The results suggest that the intensity of usage was higher among PhD students. By implication, this means that the usage level was lower among students pursuing Masters’ degree. It can be inferred from the finding that PhD students were above average usages while Master’s students were below average users. This suggests that interventions for enhancing utilization of the university library’s e-resources should target master’s level students.

**Table 7: Comparison of Usage Intensity by Level of Program Enrolled in**

	<b>Level of Program Enrolled</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Log Count	Masters	40	45.10	65.166
	PhD	8	68.50	49.598
	<b>Postgraduate average</b>	<b>48</b>	<b>49.00</b>	<b>62.991</b>

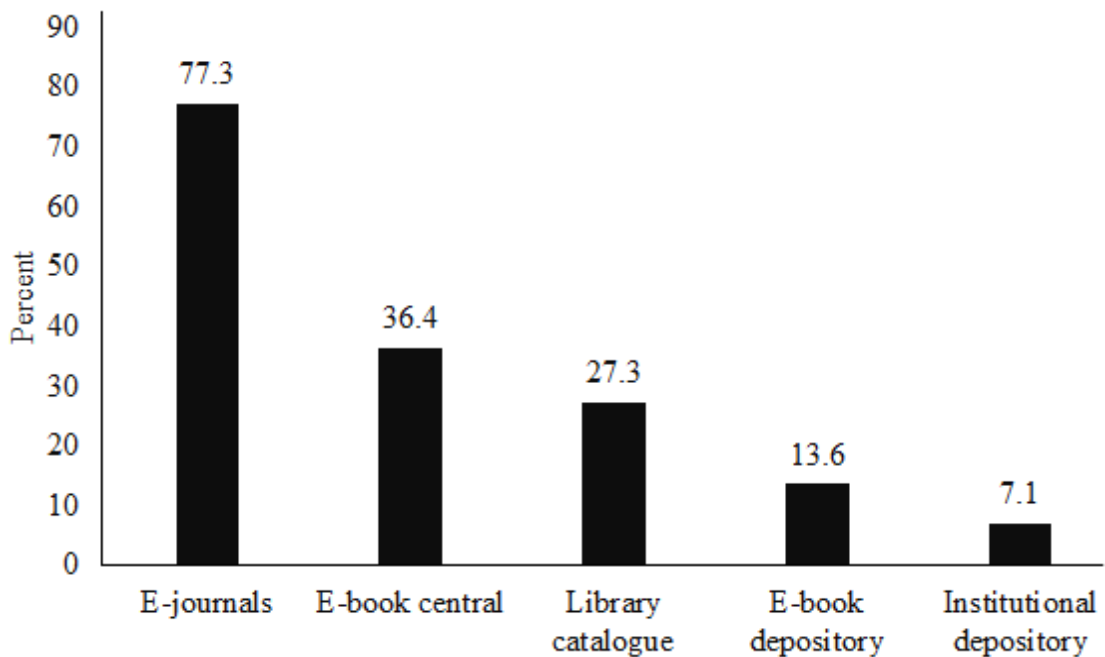
Source: Researcher; 2017

The user log files were analyzed to establish user intensity as measured by database count. Table 8 shows that 64.5% (20) of the users accessed only one database, 32.3% (10) of the users accessed two data bases and only 3.1%(1) of the users utilized 3 databases. No user utilized more than 3 databases over the one year period under review. The results suggest that participants in the study did not make adequate use of the variety of databases accessible through the university library’s e-resource portal.

**Table 8: Usage Intensity as Measured by Database Count**

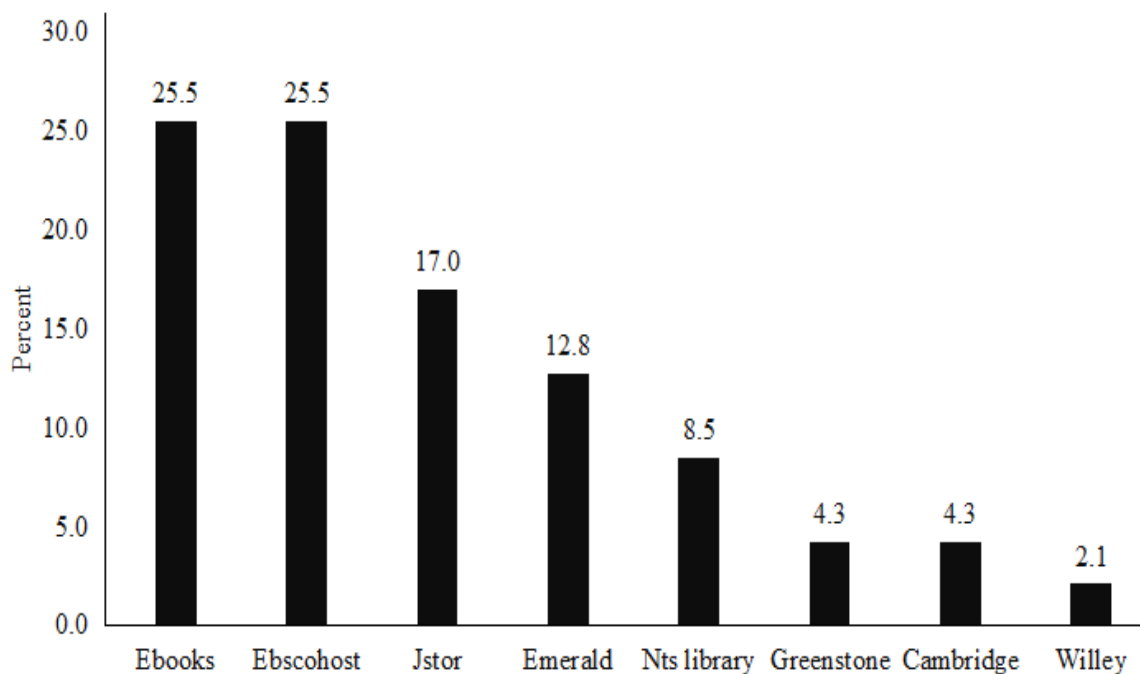
<b>Number of databases accessed</b>	<b>Frequency</b>	<b>Percent (%)</b>
1	20	64.5
2	10	32.3
3	1	3.2
<b>Total</b>	<b>31</b>	<b>100.0</b>

In another aspect of this section, respondents were asked to indicate the electronic resource platforms they most often used. Figure 9 shows that 77.3% of the respondents mostly used e-journals, 36.4% used e-book central, 27.3% used library catalogue, 13.6% used e-book depository and 7.1% visited institutional depository. Therefore, majority of the respondents used e-journals most often.



**Figure 9: Usage Patterns on Electronic Resource Platforms**

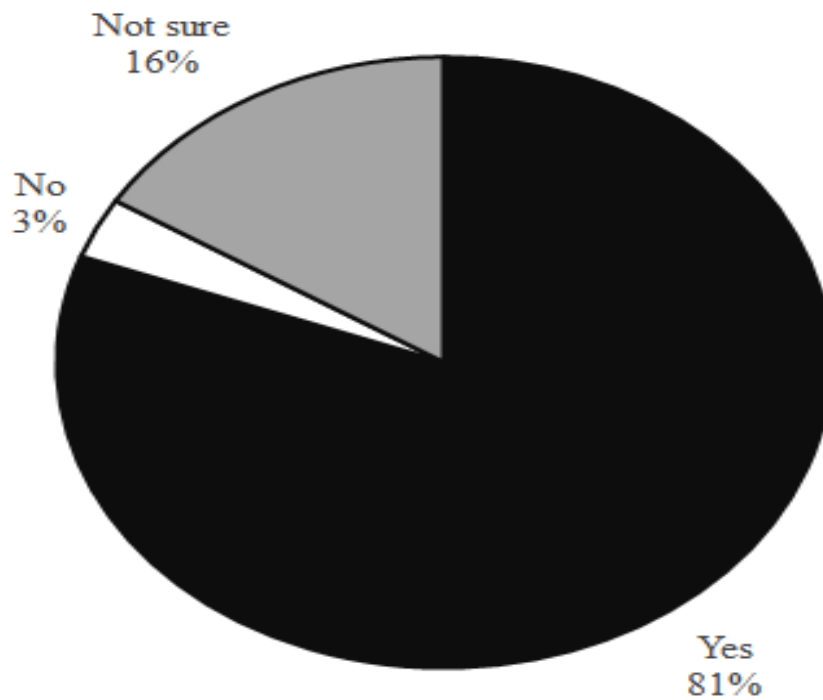
The user log files were also analyzed to reveal usage patterns for various databases at the users disposal comparatively. Figure 10 ranks the databases by order of popularity. The figure reveals that the most popular databases were e-books (25.5%) and ebscohost (25.5%) collectively accounting for 51% of the e-resources used. These were followed by Jstor at 17.0%, Emerald at 12.8% and NTS library at 8.5%. The figure indicates that the top five databases controlled 89.4% of the share of e-resources utilized. The figure also indicates that some 4.3% of the respondents frequented Greenstone and Cambridge, each. The least popular data base utilized was Wiley Inter-science at 2.1%. None of the remaining 10 other databases availed by the University library namely Hinari, University of Chicago Journals, Doaj, Springer, Taylor & Francis, Mary Ann Liebert, Intech, Eldis, World Cat and APS Journals were accessed in the one year period under review. This indicates that majority of the e-resource databases were redundant to this particular group of respondents.



**Figure 10: Usage Patterns of Specific Databases**

The final aspect in terms of usage patterns and trends sought to establish if the respondents had the intention of utilizing additional databases apart from those they preferred using. Respondents were asked whether they planned to use the other e-resources in the future. Figure 11 shows that 81% of the respondents intended to use the other e-resources in the future, 3% did not intend to, while 16% of the respondents were not sure. Therefore, majority of the respondents intended to make use of the library's

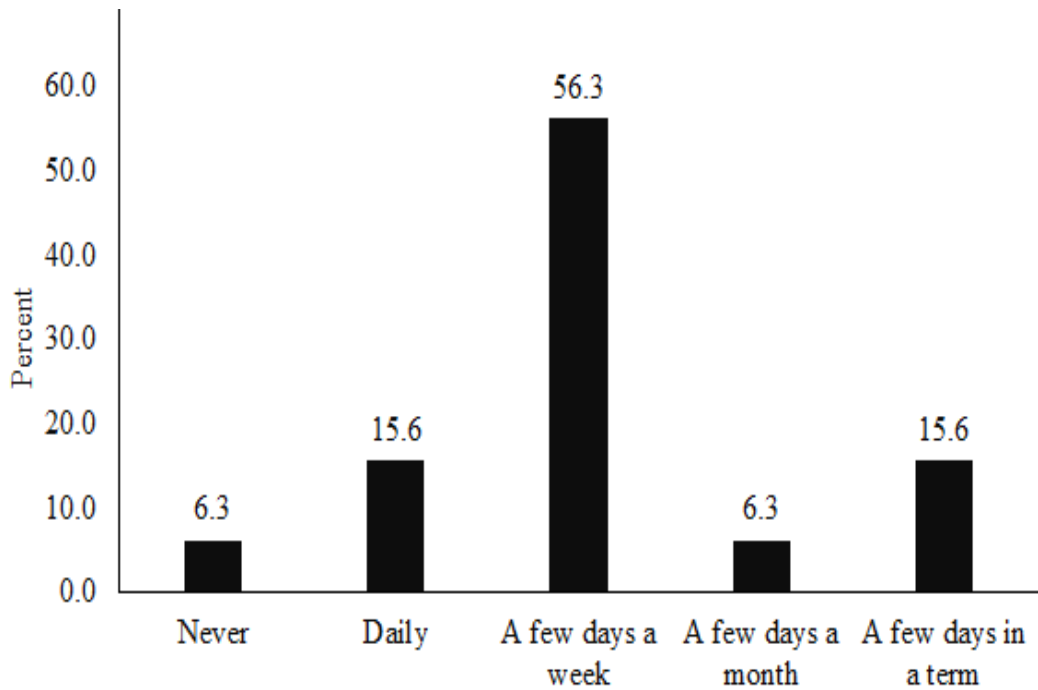
other e-resources in the future. This indicates that the e-resources not in use had a high future usage potential



**Figure 11: Intention to Use Library's Other E-Resources**

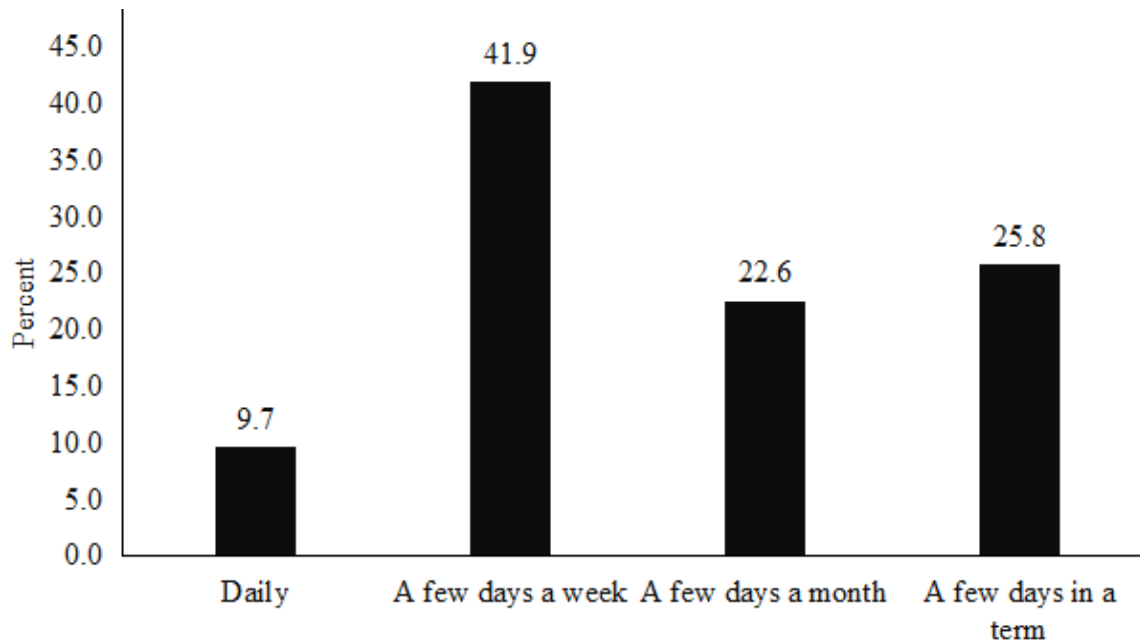
#### **4.5 Frequency of Library Website Access and E-Resources Usage**

This section of the study sought to establish the respondents' usage trends and patterns in terms of two main aspects i.e. Frequency of access to the library website and the electronic resources available. In terms of frequency of access to the library website, the respondents were asked to indicate how often they accessed the university library's website. Figure 12 shows that majority (56.3%) of the respondents accessed the website a few days a week, 15.6% did so a few days a term, and another 6.3% of the respondents accessed the site a few days a month. However, 15.6% of the respondents accessed the website daily but 6.3% never accessed it. The finding indicates that there was moderate access of the university's website.



**Figure 12: Frequency of Library Website Access**

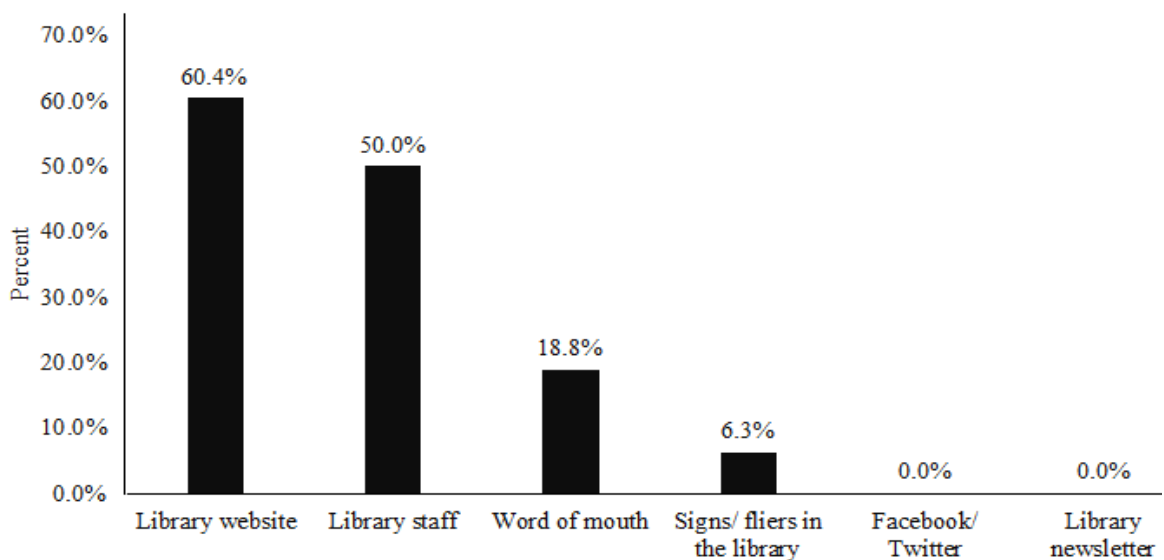
The second aspect in terms of frequency sought to establish the usage of electronic resources. The distribution of respondents by frequency of use of university library's e-resources is presented in figure 13 (pg.46). The figure reveals that 41.9% of the respondents used the resources a few days a week, 25.8% did so a few days in a term and 22.6% did so a few days a month. The results suggest that the university library's e-resources were moderately used.



**Figure 13: Frequency of Use of University Library's E-Resources**

#### **4.6 Knowledge Source For Additional Library Resources**

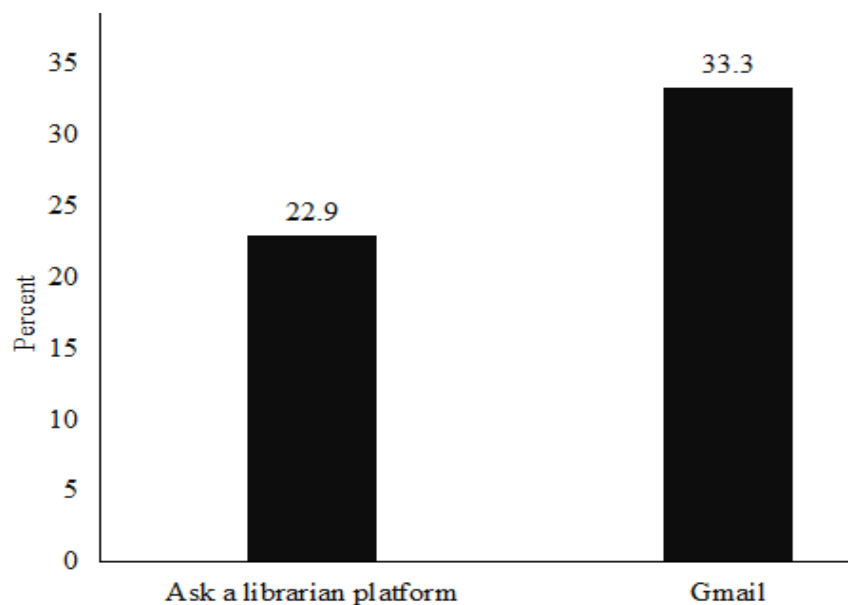
The study sought to establish how respondent found out about the university's additional library resources. Figure 14 presents the distribution of respondents by respective sources. The figure reveals that 60.4% of the respondents found out about additional library resources through the website, 50% obtained information from staff, 18.8% got information through word of mouth and 6.3% of the respondents got informed through signs or fliers in the library. No respondent utilized social media (Facebook or Twitter). Similarly, no respondent utilized library newsletter. This indicates that the website and library staffs were the main source of knowledge about additional library resources.



**Figure 14: Sources of Knowledge about Additional Library Resources**

#### 4.7 Awareness of Library's Interactive Platforms and E-resource Adequacy Perceptions

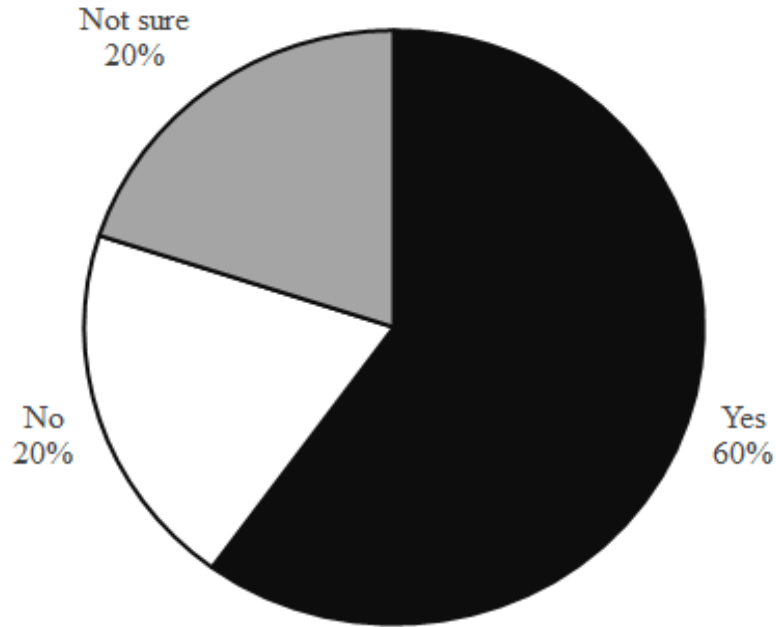
The study sought to establish respondents' awareness of the university library's interactive platforms as well as the perceptions on whether the electronic resources at their disposal are adequate to their research. The respondents' awareness of the interactive platforms was tested by asking them to identify from a list, the ones attached to the library's website. Figure 15 displays the percentage number of respondents who identified the interactive platforms used by the university. The figure reveals that 33.3% of the respondents were aware of the university's Gmail account and 22.9% were aware of the Ask-a-librarian platform. The results suggest that respondent's level of awareness about the university library's interactive platforms was low.



**Figure 15: Awareness of Library's Interactive Platforms**

In the second aspect that sought to establish the users' perception on adequacy of the university library's resources, the views of the respondents were sought as to whether the e-resources availed to them as links through the university library's website were adequate in aiding their research assignments. Figure 16 shows that 60% of the respondents said yes, 20% said no while another 20% weren't sure. This indicates that the library's e-resources were considered adequate.

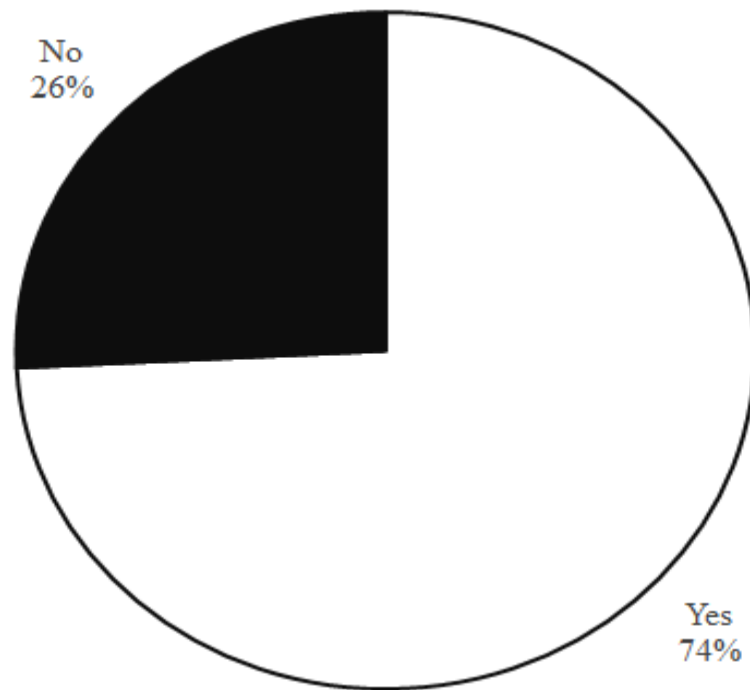




**Figure 16: Adequacy of Library's E-Resources in Aiding Research Assignments**

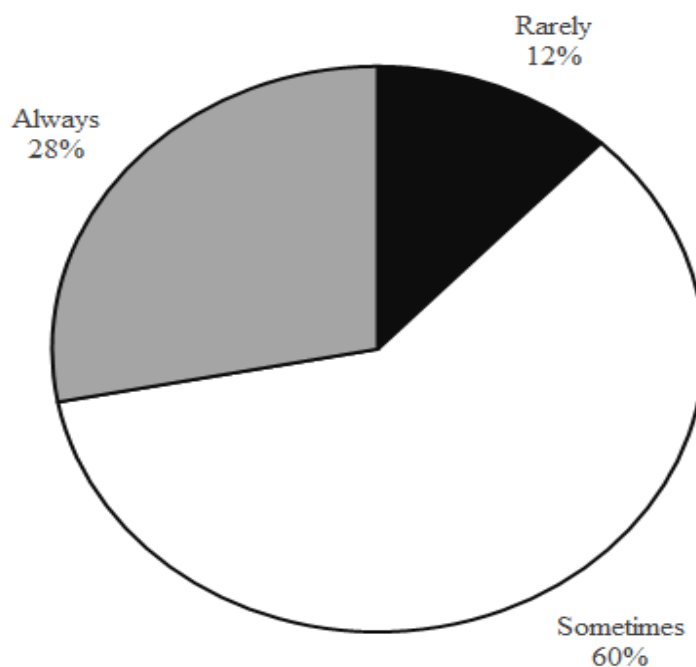
#### **4.8 Electronic Resource Access Challenges and Solutions**

In this section, respondents were asked whether they encountered any challenges, on what incidences such challenges occurred and their reaction to access challenges. Challenges are such as authentication/password requests when trying to access the university library's e-resources, need for information literacy training, access to wifi within campus as well as off campus access to resources. Figure 17 shows that 74% of the respondents encountered access challenges while 26% did not. Therefore, majority of the respondents encountered challenges while trying to access the e-resources. This indicates that for most of the students, the university electronic library platform was not easy to use.



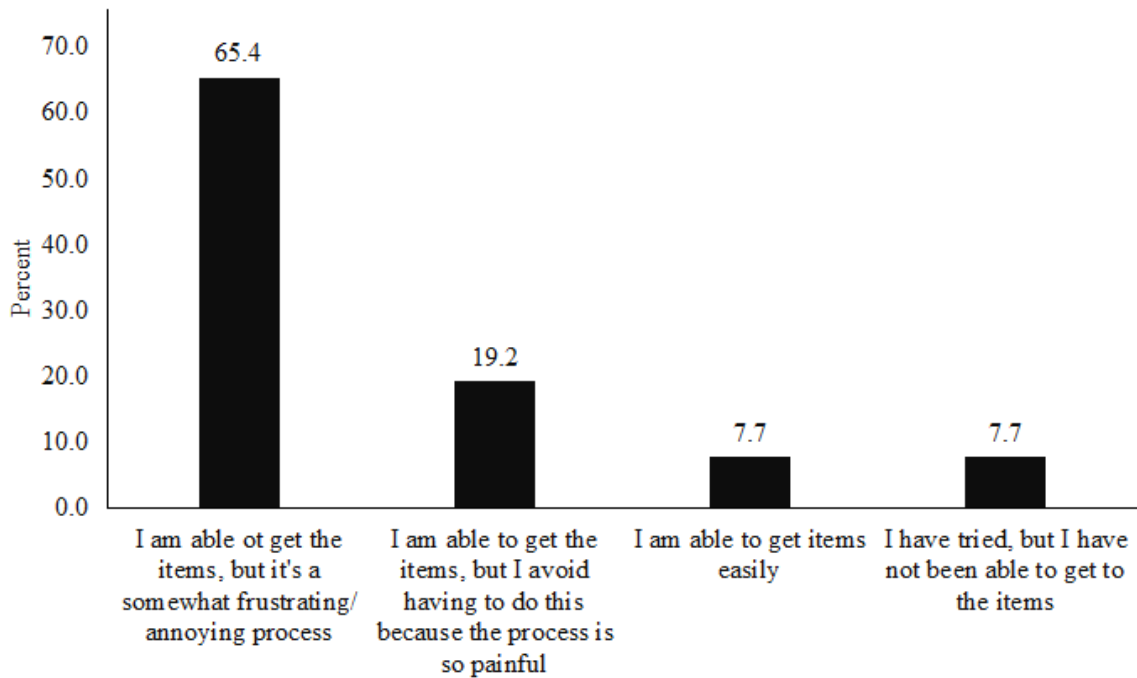
**Figure 17: Encountered E-Resource Access Challenges**

Respondents who experienced challenges when trying to access the university library's e-resources were further asked to indicate how often they experienced the challenges. Figure 18 displays the results. The figure shows that 60% of the respondents said they experienced access challenges sometimes while 28% of the respondents said they always experienced access challenges. However, 12% of the respondents said it rarely occurred. Therefore, majority of the respondents sometimes experienced challenges trying to access the university library's e-resources. This further reinforces the finding that the platform was difficult to use.



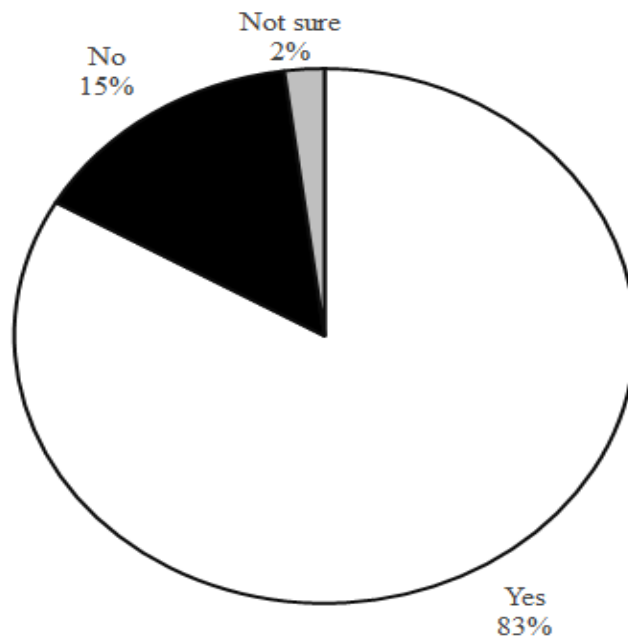
**Figure 18: Frequency of Occurrence of Access Challenges**

Respondents were asked to describe their experience with access to the university’s e-resources and express their reaction to the same. The findings are presented in Figure 19. The figure shows that 65.4% of the respondents were able to get to the items, but it was a somewhat frustrating/annoying process; 19.2% of the respondents were able to get to the items, but avoided having to do so because the process was so painful. Some 7.7% of the respondents tried but had not been able to get to the items. Only 7.7% of the respondents were able to get items easily. Therefore, most of the respondents were able to access the e-resources but described the process as frustrating, annoying and painful. This is why half the population (50%) will prefer obtaining information from the staff rather than going through the painful journey looking for resources that they have no guarantee of finding. Other databases are too hidden with two sets of authentication required in order to obtain access, which explains why ten databases have not been used for the past one year. “When users encounter databases that have poor navigation outlines, they will not adopt such databases rather they would opt for and stick to where they are guaranteed quick access to what they need (Vecchione et al, 2016; 1). With the creation of the Ask A librarian platform however, and the opening of a library’s Gmail account for the users to transact upon, it is clear that the library has portrayed innovation in the services it offers and tried to practice “user logic” through opening avenues for the users to raise any challenges or queries they might have .



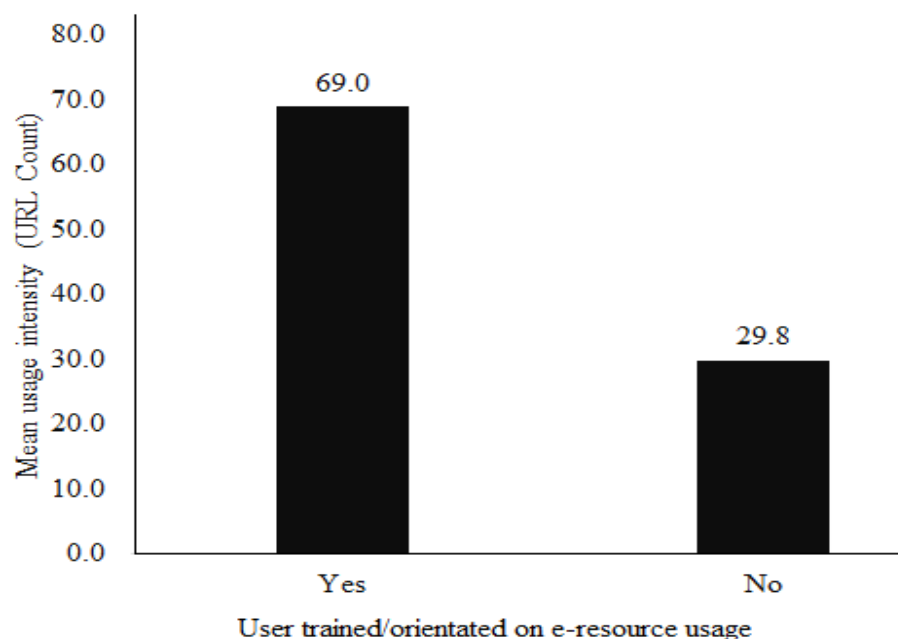
**Figure 19: Respondent’s Description of Access Challenges**

Respondents were asked whether they felt they needed more training to access e-resources. Figure 20 shows that 83% of the respondents said they needed more training on the university’s e-resources and 15% did not need training. Some 2% of the respondents were not sure. Therefore, majority of the respondents said they needed more training. This indicates that additional training was necessary to enhance user-efficacy.



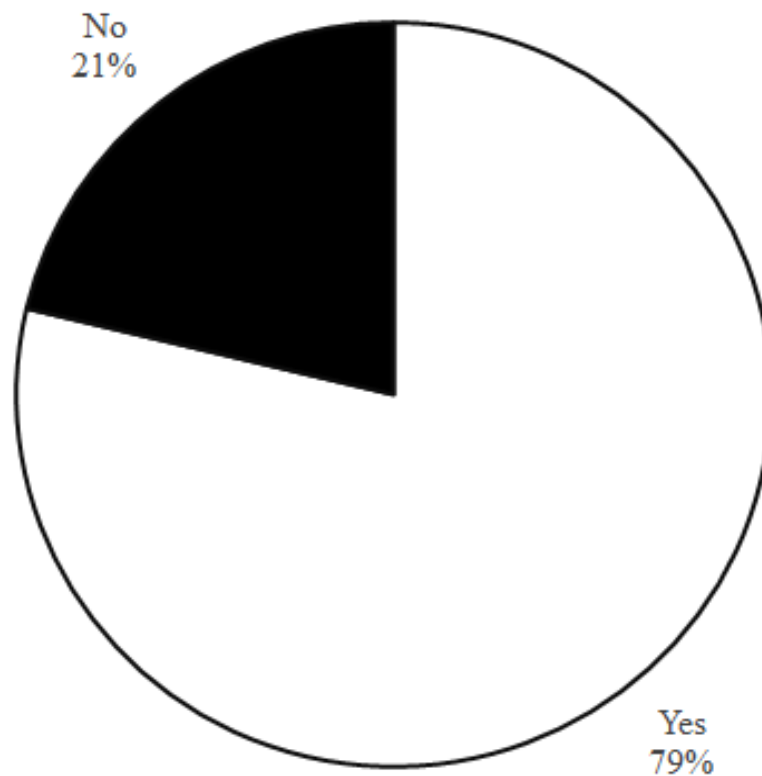
**Figure 20: Perceived Need for More Training on the Library’s E-Resources**

In another aspect of the same section, a comparison was made of the mean usage intensity between respondents who had received training and those who had not. This was done with an intention to establish whether usage intensity increases with the conduct of training. Figure 21 displays the results. The figure shows that the mean usage intensity score for respondents who were trained/orientated on e-resource usage was 69.0 while those who had not received training was 29.8, suggesting that usage intensity was more than twice as high for those who were trained as it was for those who had not been trained. The finding implies that training did influence higher usage of the university library's e-resources. Given that the postgraduate average usage intensity score was 49, it can be inferred that those who received training were above average users while those who did not were below average users. Judging from what was discussed in the literature review concerning user groups, and the fact that users behave in different ways depending on their information literacy or information skills (Timmers & Glas, 2010: 47), and the fact that user groups may not necessarily form around professions but the groups broaden further and form constellations based on the diversity of user issues. (OCLC, 2015, 9). This can be seen as to define the emergence of user groups, with user categories being created on the basis of the levels of information literacy training. These user groups will be different since the levels of literacy training differs with every individual user and those with similar information literacy levels can be grouped together.



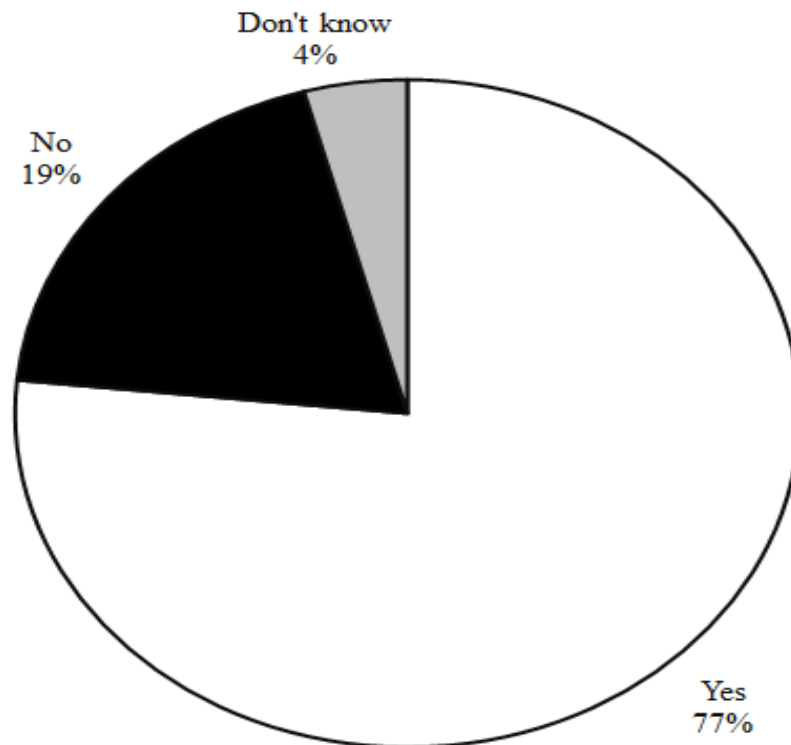
**Figure 21: Comparison of Usage Intensity by Training**

As part of ways of seeking solutions to any emergent access challenges, the study sought to establish whether respondents had accessible WiFi on campus. Figure 22 shows that 79% of the respondents had access to WiFi whereas 21% did not have access. Therefore, majority of the respondents were able to access on campus WiFi.



**Figure 22: Accessibility to On Campus WiFi**

In another aspect that is seen as a way of seeking solutions to emergent access challenges, the study sought to establish whether respondents had off campus access to the e-resources provided by the university library. Figure 23 shows that 77% of the respondents said yes, 19% said no and 4% did not know. Therefore, majority of the students were able to access the university library's e-resources off campus.



**Figure 23 Off-Campus Accessibility to the Library's E-Resources**

#### **4.9 Determinants of User Interaction with Academic Library's E-Resources**

This section presents inferential analysis of the determinants of user interaction with University Library's e-resources. Usage intensity (URL log count) was correlated with the composite mean scores for 7 perceived usefulness dimensions, 8 perceived ease of use dimensions and perceived 5 behavioral control dimensions using Pearson's product moment correlation coefficient at  $p < .05$ . The table below shows that usage intensity was significantly correlated to behavioral control factors. This means that usage intensity increased with increased behavioral control factors such as knowledge, confidence and ability to use e-resources as well as possession and control over e-resource devices such as laptops. Table 9 reveals that the correlation between usage intensity and perceived usefulness and perceived ease of use were not statistically significant. This means that there was no direct relationship between perceived ease of use of the library's e-resource platform, along with perceived usefulness of the e-resources, on the intensity of e-resource usage. The results in Table 9 however indicate that there was a strong positive correlation between behavioral control and perceived ease of use which in turn, significantly correlated to perceived usefulness. This implies that perceived behavioral control increased with rise in perceived ease of use. Further, perceived usefulness also

increased with increase in perceived ease of use. Thus, it can be inferred that users' perception of usefulness of e-resources increased with ease of use of the e-resource platform. Behavioral control also increased with ease of use of the platform. Finally, usage intensity increased with increase in behavioral control. The results summarized above confirm the applicability of the Technology Acceptance Model, as outlined in the literature review of this research. Aspects such as behavioral control, perceived usefulness of electronic resources and perceived ease of use all influence the intensity of electronic resource usage. The results are presented in Table 9 below.

**Table 9: Inferential Analysis of Determinants of E-Resource Usage**

<b>Determinants</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	
1. Usage intensity	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	48			
2. Perceived Usefulness	Pearson Correlation	.073	1		
	Sig. (2-tailed)	.620			
	N	48	48		
3. Perceived Ease of Use	Pearson Correlation	.159	.504**	1	
	Sig. (2-tailed)	.280	.000		
	N	48	48	48	
4. Behavioral Control	Pearson Correlation	.289*	.268	.632**	1
	Sig. (2-tailed)	.046	.065	.000	
	N	48	48	48	48

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Source: Researcher; 2017

#### **4.10 Appropriate Big Data Analytics Model for Investigating E-Resources Usage**

An integrated data analytics model for investigating university library's e-resources usage is a necessary requirement. The model ensures that libraries are able to mine data from all potential localities rather than limiting data analysis to information from log-



files alone. Feedback from interactive platforms such as email trails and ask-a-librarian platforms should be collected based on the effectiveness of this necessary model. This affords the academic libraries capability of correlating usage trends and patterns with subtle gleaned from both online and off-line sources. This confirms the opinion of Pauleen & Wang (2017: 3) as discussed in the literature review that such data emitted from the internetworked information sets may be collected through inter-organizational information systems to eventually avail solutions in response to predefined problems relating through the process of data analytics. Of particular note is the importance of exit surveys by graduating students. In addition, an internal librarian feedback platform should be designed to open a feedback front for individual library staff to comment. There is also a need for inquiry desk reports compilation by the librarian on duty on a regular basis since the current study has established that a big number of students rely on the library staff for information.

#### **4.11 Chapter Summary**

This chapter has analyzed, interpreted and presented the findings of the study. The analysis has been based on the results of data mining and big data analytics as well as survey data obtained through questionnaires. The chapter has applied these in the investigation of electronic resources seeking and usage trends in PAC University library. Inferential analysis has been used to establish the significance of perceived ease of use, perceived usefulness and behavioral control determinants of user interaction with the various websites and e-resources platforms accessible to the library users. The next chapter summarizes the findings, draws conclusions and makes recommendations.

## CHAPTER FIVE

### SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

The purpose of the study was to investigate big data analytics as a tool for analyzing electronic resources usage in library set up in Kenya with reference to Pan Africa Christian University library. This chapter presents a summary of the major findings. The chapter then draws conclusions based on the study objectives and proposes an appropriate big data analytics model for investigating e-resources usage within Kenyan university libraries. The chapter also suggests directions for future research.

Objectives of the study included to:

- Examine the application of big data analytics as a tool for investigating electronic resources seeking and usage trends and patterns in academic libraries.
- Determine the appropriate technologies applicable to data mining and analytics for electronic resource usage in academic libraries.
- Establish the nature of user interaction with the various websites and e-resource platforms accessible in academic libraries.
- Propose appropriate big data analytics model to guide analysis of e-resources usage within academic libraries.

#### 5.2 Summary of the Findings

This part makes a presentation of the major research findings that were made. The research questions raised based on the research objectives are answered in the section below as a follow up from the presentations depicted in chapter four (Data Presentation, Analysis and Interpretation). The study's findings are summarized as follows:

##### 5.2.1 Big Data Analytics and Electronic Resources Usage Trends And Patterns in Academic Libraries

The first objective was to examine the application of big data analytics as a tool for investigating electronic resources seeking and usage trends and patterns in academic libraries. Data mined from the library's server revealed that the mean URL count was 49,

with individual counts per user deviating from this mean by about 63 URLs. Out of the total URL count, the results showed that 50% of the users accounted for only 5.4% of the download volume. It was also established that the bottom third (33.3%) of the respondents had zero logs, meaning they never utilized electronic library resources at all over the one year period under review. In comparison, the top third (33.3%) of the users accounted for 78.9% of the volume of e-resources used. PhD students recorded above average mean log count of 68.5 while Masters level students recorded below average mean log count of 45.10. It can be inferred from the finding that PhD students recorded above average usage when compared to the Masters Degree students who were below average users. From the responses obtained from the respondents, the Masters students were the ones that reported need for information literacy training more as compared to their PhD counterparts. At first, the results confirm the discussion of Segura (2011) that data mining in education and e-learning set up can be used in to obtain information concerning multiple problems and his further argument that data mining can also be used to guide on resource adaptation based on usage patterns of the students. This has been revealed by a show of the trends detailing how the databases are utilized comparatively. This also confirms that knowledge, confidence and ability to use electronic resources, aspects that determine behavioral control of electronic resources which is one of the conditional variables outlined in the conceptual framework, are serious determinants of electronic resource usage trends and patterns. Frequent information literacy training needs to be given to the Masters students in order to build on their information literacy skills, hence give them more confidence and ability to use the electronic resources.

Further findings revealed that 64.5% (20) of the users accessed only one database, 32.3% (10) of the users accessed two data bases and only 3.1%(1) of the users utilized 3 databases. No user utilized more than 3 databases over the one year period under review. In addition, 77.3% of the respondents mostly used e-journals, 36.4% used e-book central, 27.3% used library catalogue, 13.6% used e-book depository and 7.1% visited institutional depository. Therefore, majority of the respondents used e-journals most often. The most popular databases were e-books (25.5%) and ebscohost (25.5%) collectively accounting for 51% of the e-resources used. Ten databases were never used at all during the one year period under review. Majority (60.4%) of the respondents found out about additional library resources through the website and 50% obtained

information from staff, suggesting that respondents relied on these two information sources. Results also showed that only 33.3% of the respondents were aware of the university library's Gmail account and only 22.9% were aware of the Ask-a-librarian platform. From these findings, it can be deduced this group of users have already developed perceptions that the paths to access electronic resources are difficult to navigate.

### **5.2.2 Appropriate Technologies Applicable to Data Mining and Analytics for Electronic Resource Usage in Academic Libraries**

The second objective was to establish the appropriate technologies applicable to data mining and analytics for electronic resource usage in academic libraries. Results showed that data mining and analytics technologies for electronic resources usage such as Web log analytics, Browser history and proxy server logs were appropriate for this particular academic library. As for Google analytics and cookies they were irrelevant for tracking and analyzing e-resource usage in this research. Specifically, proxy server logs enabled the analysis of e-resource usage intensity and database preference that could not have been accurately revealed through any other technique

### **5.2.3 Nature of User Interaction with the various Websites and E-Resource Platforms Accessible in Academic Libraries**

The third objective was to establish the nature of user interaction with the various websites and electronic resource platforms accessible in academic libraries. Results from inferential analysis showed that usage intensity was significantly correlated to behavioral control factors such as knowledge, confidence and ability to use e-resources as well as possession and control over e-resource devices such as laptops. However, the correlation between usage intensity and perceived usefulness and perceived ease of use were not statistically significant, meaning that there was no direct relationship between perceived ease of use of the library's e-resource platform, along with perceived usefulness of the e-resources, on the intensity of e-resource usage. Nonetheless, there was a strong positive correlation between behavioral control and perceived ease of use which in turn, significantly correlated to perceived usefulness, implying that perceived behavioral control increased with rise in perceived ease of use. Further, perceived usefulness also increased with increase in perceived ease of use. This is a strong indication that users'

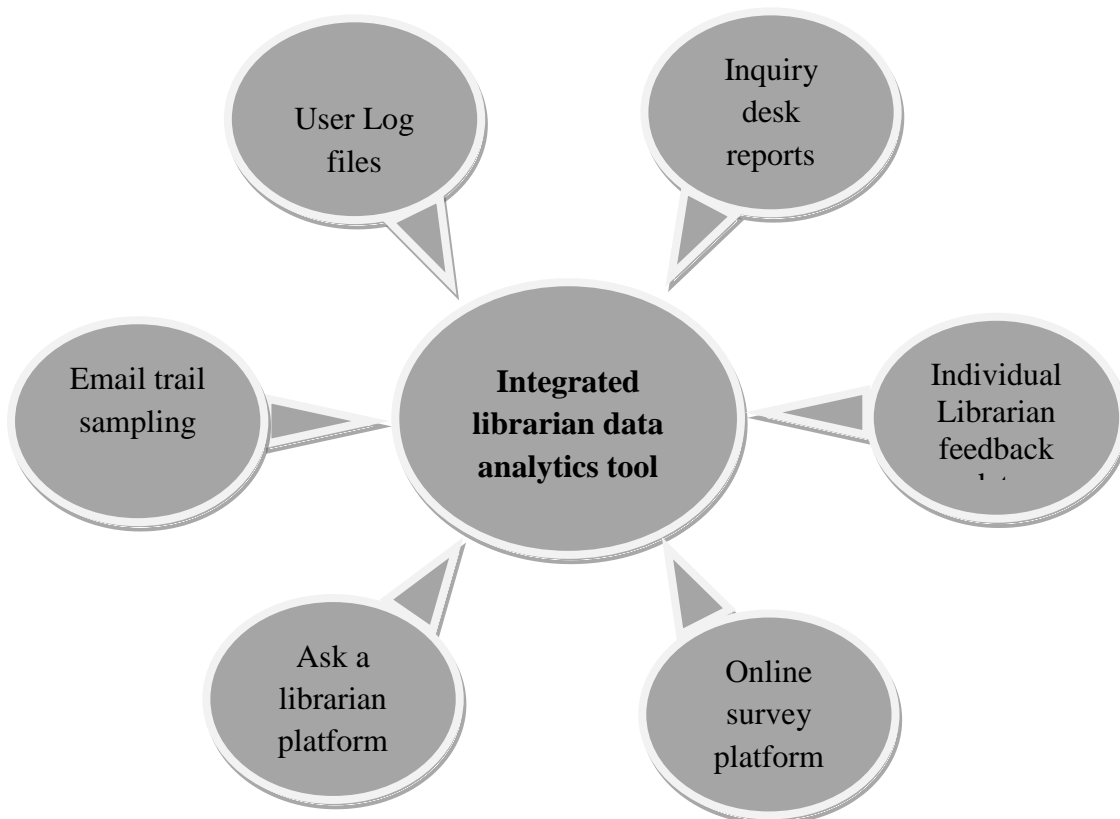
perception of usefulness of e-resources increased with ease of use of the e-resource platform. Behavioral control also increased with ease of use of the platform. Finally, usage intensity increased with increase in behavioral control.

The results summarized above confirm the applicability of the Technology Acceptance Model, as outlined in the literature review, to this research. The model detailed that the actual usage of a system will be determined by some external factors such as perceived usefulness of the system, perceived ease of use and behavioral control of the system. These factors, which are also conditional factors in this research, have been tested in this research by trying to assess the correlation levels between these three external factors and also whether each one of them influences the intensity of electronic resource usage independently and the results revealed that when a user obtains behavioral control (which is influenced by aspects such as knowledge, confidence, ability to use e-resources and possession of social computing devices such as laptops, ipads) they build the perception that the databases are easy to use. This in turns creates in them the perception that the electronic databases are useful to their research work and eventually this heightens the intensity of electronic database usage among the same students.

Results showed that 74% of the respondents encountered access challenges. It was also found that 65.4% of the respondents were able to get to the items, but it was a somewhat frustrating/annoying process, while 19.2% of the respondents were able to get to the items, but avoided having to do so because the process was so painful, which completely underscores the 'User logic' or 'user centric' aspect discussed in the literature review and its importance when applied in the library set up as compared to the "library logic" aspect. The mean usage intensity score for respondents who were trained/orientated on e-resource usage was 69.0 while those who had not received training was 29.8, suggesting that usage intensity was more than twice as high for those who were trained as it was for those who had not been trained. Further, 83% of the respondents said they needed more training on the university's e-resources. Another aspect is that through availability of internet connectivity, access to information by information seekers is enhanced as discussed in the literature review and majority (79%) of the respondents were able to access on campus WiFi while 77% of the respondents had off-campus access to e-resources, meaning that internet access was not a barrier to usage intensity.

#### 5.2.4 Proposed Big Data Analytics Model for Investigating E-Resources Usage

The fourth objective was to propose appropriate big data analytics model to guide analysis of e-resources usage within academic libraries. In view of the study findings, an integrated data analytics model for investigating university library's e-resources usage is proposed as illustrated in Figure 23. The model ensures that libraries are able to mine data from all potential fronts rather than limiting data analysis to information from log-files alone. This affords the university with the capability of correlating usage trends and patterns with subtle gleaned from both online and off-line sources. The implication of this is that an online questionnaire should be designed and embedded on the university library's website. Similarly, feedback from interactive platforms such as email trails and ask-a-librarian platforms should be linked to the online survey questionnaire and user log files. In addition, since the current study has established that most students rely on the librarian staff for information, inquiry desk reports need to be compiled by librarian on duty on a regular basis. Of particular note is the importance of exit surveys by graduating students. In addition, an internal librarian feedback platform should be designed to open a feedback front for individual library staff to comment.



**Figure 24: Integrated Data Analytics Model**

### 5.3 Conclusions

Drawing from the findings and discussions made in the study, this study made the following conclusions:

- Big data analytics is a necessary and powerful tool for investigating electronic resources seeking and usage trends and patterns within academic libraries. Through big data analysis and data mining, usage patterns and trends such as usage intensity as measured by URL counts, log file size in kilobytes, database usage counts and specific databases accessed that might not have accurately been revealed through other tools are unearthed. In the current study, big data analytics has enabled the discovery of variations in usage patterns between PhD students and master's degree students and between users who received training/orientation and those who did not. It has revealed user preferences and intensity of utilization of various databases and helped in detection of redundant databases. It has further facilitated the analysis of correlation or lack thereof, between usage intensity and perceived usefulness, perceived ease of use and behavioral control variables. However, where online survey systems are not integrated in the library's e-resource platform, the power of big data can be enhanced greatly by the integration of traditional tools of data gathering and analysis such as off-line questionnaires and interviews. In the current study for instance, big data did not reveal the feelings, perceptions and attitude towards the academic library's e-resource platform without the integration questionnaire data into the analysis.
- All the data mining and analytics technologies for e-resources usage were appropriate for this particular academic library except Google analytics and cookies which were irrelevant for tracking and analyzing e-resource usage in this research. Specifically, proxy server logs enabled the analysis of e-resource usage intensity and database preference that could not have been accurately revealed through any other technique.
- From the usage patterns, it was clear that the level of utilization of PAC University library's e-resource platform was low. Some of the databases accessible through the platform were redundant. Further, only two databases

namely e-book central and ebscohost were the most popular among users while the rest were barely being utilized if at all. For most students, just one or two databases were sufficient in meeting their research needs.

- Accessing the e-resource materials was a challenging process. Difficulty in accessing the e-resource databases seemed to be a major reason behind the low utilization of academic library's e-resource platforms. Students who managed to access the materials did so but got frustrated and annoyed by the process while others who were able to access the platform avoided the process altogether because it was so painful.
- Student orientation and training on usage of the academic library's e-resources was an effective intervention strategy that has the potential to enhance usage intensity. Although the academic library trained and orientated most students before engaging with the e-resource platform, the training offered was not adequate and there was an expressed need for further training.
- There was low awareness and usage of the university's interactive platforms for communication with the library staff. With the exception of information already made available in the library website, students relied on library staff, meaning that they had to physically visit the librarian at work or probably make a phone call, thereby incurring time and money costs.
- Students' self-efficacy as reflected through behavioral control dimensions was a key determinant of e-resource usage behavior. Behavioral control factors such as confidence in usage of e-resources, knowledge to use e-resources, availability of resources such as laptop, ability to use the e-resources and control over using the e-resources did have a direct influence on usage intensity. There was a strong influence of behavioral control the students had over access to e-resources on their perceived ease of use the e-resource platform. This in turn strongly influenced perceived usefulness of the e-resource materials availed by the university library. The theoretical framework therefore becomes very applicable to this research since the perceptions that users have on the usefulness of the electronic resource databases as well as their perceptions on how easy they are to use did influence the way in which they utilized the resources.



## **5.4 Recommendations**

Based on the foregoing conclusions, recommendations are made to enhance both utilization of the academic library's e-resources and the overall efficiency of the e-resource platform. The proposed big data analytics model for investigating e-resources usage within academic libraries is also discussed.

### **5.4.1 E-resource Usage Patterns and Trends established from Big Data Analytics**

Overall efficiency of the academic library's e-resources could be improved by removing redundant databases from the platform. If the university seeks to reduce costs, the ten databases that were never used over the one year period under review are attractive targets for cost-cutting. However, given the future potential for their use, such efficiency measures should take into consideration the long-term view and strategic direction of the university. A cost-benefit analysis of the same is recommended before implementing such a measure.

### **5.4.2 Determinants of E-resource Usage Patterns and Trends**

In order to increase utilization of e-resources availed by the academic library, immediate attention should be accorded to Master's degree students. Specifically, two measures are recommended. Firstly, the university should undertake mandatory orientation of all new students every semester and at least one refresher training every semester for old students. A read-only user-guide should be tagged to the library's website in order to serve as a memory bank for off-campus students. The university librarians should take the initiative to create awareness of the library's interactive platforms by sending periodic memos through the available email facilities and responding to queries in real-time. The library should consider User logic' or 'user centric' aspect when designing all its systems which will involve shifting the focus on the users and bringing their input on board as opposed to "library logic" where the library staff create a system based on what they believe is good for the users.

## **5.5 Suggested Areas for Further Study**

Further studies are suggested as follows:

### **5.5.1 Creation of the Library Integrated Analytics Model into Software**

Future research efforts is recommended on how the proposed integrated data analytics model can be developed into a software tool that generates real time reports to inform decision making by university managements. Such a software tool should have commercial value.

### **5.5.2 Predictive Data Modeling Using Time Series Approaches**

The current study established that although a significant number of the databases made available through the university library's e- resources were redundant, there was a high potential for their use in the future. However, this was based self-reports rather than predictive analysis of trends using time series data. Therefore, a future study should forecast future usage potential for each database by modeling time series data extracted from the log files.

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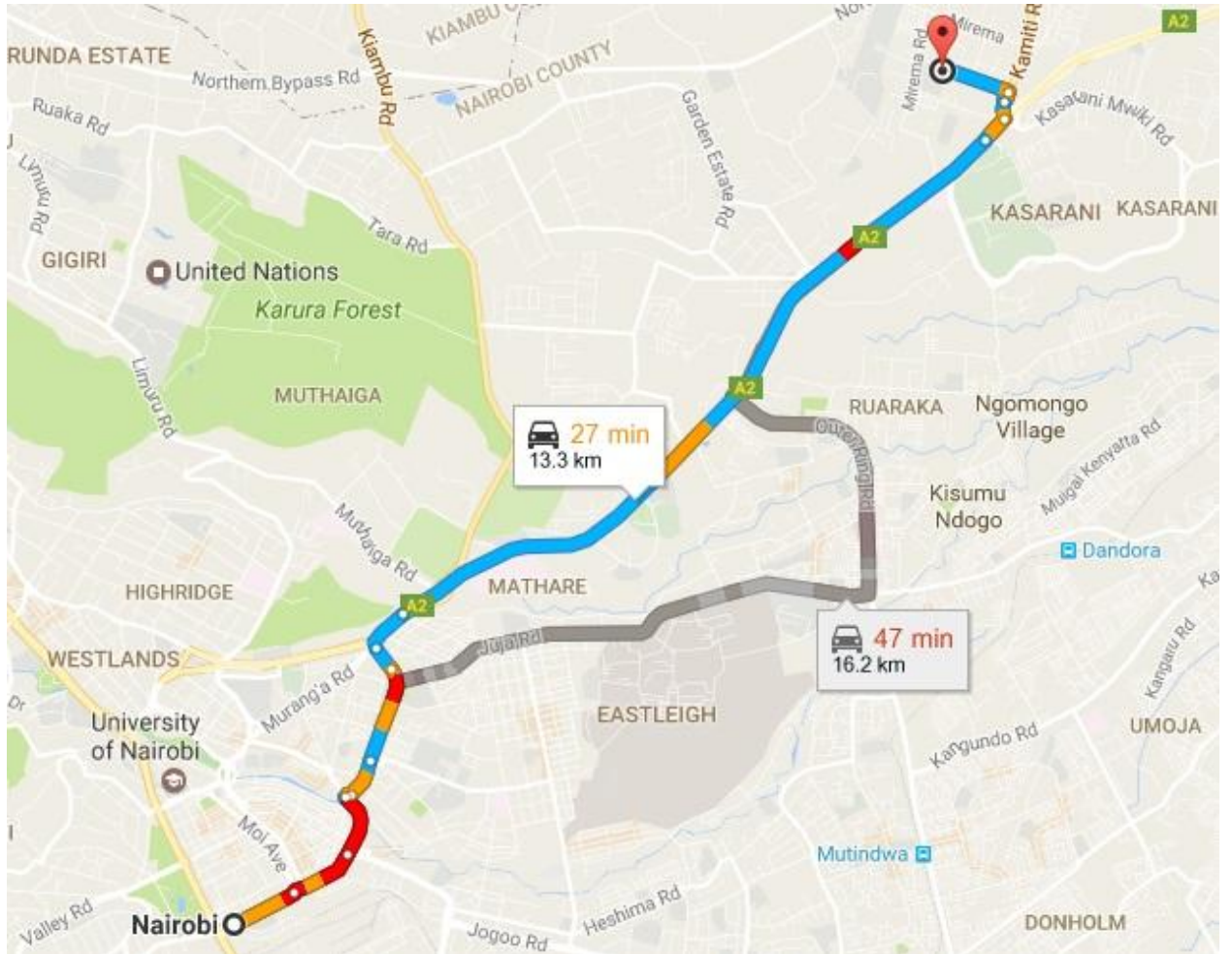
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## APPENDICES AND ANNEXES

### Appendix I: Map of Study Area





## Appendix II: Questionnaire

The library creates tools and services that support students, researchers, and faculty in the case of a university library, in their various research duties. This study is conducted with the intention of establishing how library users utilize the e-resources databases at their disposal so that the university can understand best what is of utmost interest to their users and also be able to design services that will help them conduct their research effectively. This questionnaire has a few questions that should only take a moment of your time to complete. Please respond by ticking (✓) against your preferred response for questions with options or filling in your suggestions or comments on the blank spaces provided.

### SECTION A: GENERAL INFORMATION

1. What program are you enrolled in?  
MAL  MAFT  POLD  PhDMFT  MBA  MPCS
2. What is your year of study?  
Year one  Year two  Year three
3. Have you ever received training/orientation on how to use the library's e-resources?  
Yes  No
4. How would you rate your skills in operating a computer?  
Very high  High  Moderate  Low  Very low
5. How would you rate your knowledge of using/navigating the internet?  
Very high  High  Moderate  Low  Very low

### SECTION B: USAGE OF LIBRARY'S E-RESOURCES

6. On any typical day, how do you find out about the university's **additional** library resources?  

<input type="checkbox"/>	Library website	<input type="checkbox"/>	Signs or flyers in the library	<input type="checkbox"/>
<input type="checkbox"/>	Social media (Facebook or Twitter)	<input type="checkbox"/>	Word of mouth	<input type="checkbox"/>
<input type="checkbox"/>	Library newsletter	<input type="checkbox"/>	Library staff	<input type="checkbox"/>

Other (please specify): -
7. How often do you access the university library's website?  
Never  Daily  A few days a week   
A few days a month  A few days in a term
8. How frequently do you use the e-resources available in the university library's website?  
Never  Daily  A few days a week  A few days a month  A few days

in a term

9. Among the listed e-resources in the university's website, which one do you most often use?*(please tick all that apply)*

- Library catalogue
- e-book central
- e-journals
- e-book depository
- Institutional depository

10. How often do you use the e-resource(s) mentioned in Q9 above?

- Daily       A few days a week       A few days a month   
A few days in a term

11. Do you plan to use the other e-resources in the future?

- Yes       No       Not sure

12. Among the listed interactive platforms, which ones are attached to the library website?

- |                 |                          |                          |
|-----------------|--------------------------|--------------------------|
| Facebook        | <input type="checkbox"/> | Ask a librarian platform |
| Twitter         | <input type="checkbox"/> | <input type="checkbox"/> |
| Gmail           | <input type="checkbox"/> | Contact us form          |
| Google+ hangout | <input type="checkbox"/> | <input type="checkbox"/> |
| Linked in       | <input type="checkbox"/> | Don't know               |
|                 |                          | <input type="checkbox"/> |

13. Which among the interactive platforms listed have you ever used to communicate to the library staff? *(please tick all that apply)*

- |                 |                          |                          |
|-----------------|--------------------------|--------------------------|
| Facebook        | <input type="checkbox"/> | <input type="checkbox"/> |
| Twitter         | <input type="checkbox"/> | Ask a librarian platform |
| Gmail           | <input type="checkbox"/> | <input type="checkbox"/> |
| Google+ hangout | <input type="checkbox"/> | Contact us form          |
| Linked in       |                          | <input type="checkbox"/> |

14. How have you benefited from using e-resources?

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15. In your view, are the e-resources available in the university library's website

adequate in aiding your research assignments?  
 Yes  No  Not sure

16. Do you encounter any challenges (e.g., authentication/password requests) when trying to access library items (e.g., articles) on your computer?

Yes  No

17. If you ticked “Yes” to Q16 above, how often do you experience the challenges?

Always  Sometimes  Rarely

18. If you ticked “Yes” to Q16 above, how would you describe your experience?

I am able to get to the items easily.

I am able to get to the items, but it’s a somewhat frustrating/annoying process.

I am able to get to the items, but I avoid having to do this because the process is so painful.

I have tried, but I have not been able to get to the items.

I gave up on trying to access the library’s e-resources

I don't remember.

19. Do you feel you need more training for these types of resources?

Yes  No  Not sure

20. Do you have accessible WiFi on campus?

Yes  No

21. Do you have off campus access to the e-resources provided by the library?

Yes  No  Don’t Know

**SECTION C: LEVELS OF CLIENT SATISFACTION**

*In this section, please tick against the box which corresponds to the answer that closely resembles your opinion regarding the usefulness of the library’s e-resources.*

Perceived usefulness dimensions	Strongly disagree	Slightly disagree	Slightly agree	Strongly agree
22. The e-resources enables me to accomplish assignments more quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. The e-resources has improved my quality of research work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. The e-resources makes it easier to do my assignments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. The e-resources has improved my research work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. The e-resources gives me greater control over	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

my school assignments.				
27. The e-resources enhances my effectiveness in research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Generally, the e-resources are relevant, accurate and up to date	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*In this section, please tick against the box which corresponds to the answer that closely resembles your opinion regarding the ease of use of the library's e-resources.*

Perceived ease of use dimensions	Strongly disagree	Slightly disagree	Slightly agree	Strongly agree
29. My interaction with the e-resources has been clear and understandable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Overall, the e-resources are easy to access and use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Learning to use the e-resources was easy for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. I rarely become confused when I use the e-resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. I rarely make errors when using the e-resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. I am rarely frustrated when using the e-resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. The library's website has a user-friendly interface	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. The library's website is easy to navigate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*In this section, please tick against the box which corresponds to the answer that closely resembles your opinion regarding your ability to use the library's e-resources.*

Behavioural control dimensions	Strongly disagree	Slightly disagree	Slightly agree	Strongly agree
37. I am able to confidently use the e-resources.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. I have the knowledge to use the e-resources.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39. I have the resources such as a laptop with which to access the e-resources.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40. I have the ability to use the e-resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41. I have control over using the e-resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

42. What changes would you recommend in order to improve effectiveness of the library's e-resources?

Website

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Interactive platforms

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E-resources

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*Thank you for your time*

## Appendix V: UON Recommendation



**UNIVERSITY OF NAIROBI**

**FACULTY OF ARTS**

**DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE**

Telephone: +254 20 318262, Ext. 28095  
Telegram: Varsity  
Fax: +254 20 2245566

P.O. Box 30197- 00100 GPO  
Nairobi, Kenya.  
dnjiraine@uonbi.ac.ke

**Our Ref: UON/CHSS/FOA/DLIS/303C**

**Date 28/09/2017**

**TO WHOM IT MAY CONCERN**

Dear Sir/Madam,

**RE: RECOMMENDATION FOR WAKAHIA SAMUEL – REG NO: C54/81081/2015.**

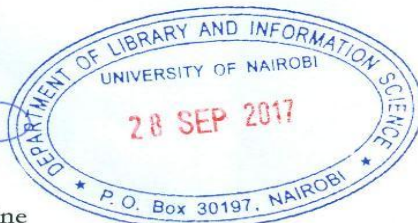
The above named is a bonafide student at the University of Nairobi undertaking a Master of Library and Information Science (MLIS). He is currently in the process of collecting data as part of the requirements for the course.

His topic is **“Big Data Analytic as Tool for Investigating E-Resources Seeking and Usage Behaviour in Kenyan University Libraries”**.

Any assistance accorded to him will highly be appreciated.

Regards,

A handwritten signature in blue ink, appearing to be 'DN', written over a circular official stamp.



Dr. Dorothy Njiraine  
**Ag. Chairperson**  
Department of Library & Information Science (DLIS)

## Appendix VI: NACOSTI Permit



### NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,  
2241349, 3310571, 2219420  
Fax: +254-20-318245, 318249  
Email: [dg@nacosti.go.ke](mailto:dg@nacosti.go.ke)  
Website : [www.nacosti.go.ke](http://www.nacosti.go.ke)  
When replying please quote

9<sup>th</sup> Floor, Utalii House  
Uhuru Highway  
P.O. Box 30623-00100  
NAIROBI-KENYA

Ref: No **NACOSTI/P/17/31125/20196**

Date: **22<sup>nd</sup> November, 2017**

Samuel Kairigo Wakahia  
University of Nairobi  
P.O. Box 30197-00100  
**NAIROBI.**

#### **RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on *“Bg data analytics as tools for investigating e-resources seeking and usage behaviour in Kenyan University Libraries,”* I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **20<sup>th</sup> November, 2018.**

You are advised to report to **the Vice Chancellors of selected Universities, the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

**GODFREY P. KALERWA MSc., MBA, MKIM**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The Vice Chancellors  
Selected Universities.

The County Commissioner  
Nairobi County.