

JIMMA UNIVERSITY



**JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF COMPUTING AND INFORMATICS
DEPARTEMENT OF INFORMATION SCIENCE**

**THE USABILITY EVALUATION OF DIGITAL LIBRARY
SERVICES IN SELECTED PUBLIC HIGHER LEARNING
INSTITUTIONS, ETHIOPIA**

BY:

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Jimma, Ethiopia

March, 2020

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A research Submitted to the Department of Information Science
In Partial Fulfillment for the Award of Degree of Masters of
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LIST OF ABBREVIATIONS AND ACRONYMS

ASTU: Adama Science and Technology University

CASSM: Concept-based analysis of surface and structural misfits

DL: Digital library

DLS: Digital library service

E-book: Electronic Books

E-catalog: Electronic catalog

E-resources: Electronic resources

FDL: Federated digital library

HEIs: Higher Learning Institutions

HDL: Harvested digital library

ICT: Information Communication and Technologies

IR: Institutional repository

ISO: International Standard Organization

JU: Jimma University

OPAC: Open public access catalog

PHLI: Public Higher Learning Institution

QUIM: Quality in use integrated measurement

SDL: Stand alone digital library

SPSS: Statistical Package for Social Sciences

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ABSTRACT

The goal of this study was focused on usability evaluation of digital library services at Jimma and Adama Science and Technology universities. Usability evaluation is one of the major factor that determine the successfulness of a digital library. The researcher used cross-sectional survey research design. The study applied purposive and simple random sampling techniques and the data was collected through questionnaire and interview. The data is analyzed by using descriptive statistics (Frequency, Percentage, Mean and Standard Division) and inferential statistics using SPSS software version 20. The findings of the study revealed that respondents were satisfied with the majority of the evaluation criteria's such as learnability (40.6%), user-friendly (34.5%), comfortable (42.7%) timesaving (49.3), reliability (39.2), error prevention (42.2%) and aesthetic(41.7%) of the digital library service. The other result showed dissatisfaction regarding the efficiency (40.5%), effectiveness (39.9%), currency (30.4%) and memorability (36.1%) of the services. The perception of respondents towards the services is ineffective. The finding of the study also revealed that different factors inhibits respondents use of the services including power failure, slow internet speed, lack of technical support and unavailability of federated service. A framework that incorporates main and sub components of usability evaluation of digital library designed and proposed. Digital libraries plays a great role in strengthen the academic and research activities of users. The researcher conducted this study from the postgraduate students and library professional perspective. But from the perspective of undergraduate students and administrative staffs could not be studied.

CHAPTER ONE

INTRODUCTION

The aim of this study is to identify how postgraduate students are interacting with usability of digital library services and getting satisfaction from its use for their research and academic activities. The aim has also been to find the perception of postgraduate students, some further requirements, suggestion and the effectiveness of the services.

The digital libraries have been used for the past decades in different forms like academic repositories and digital archives. Academic repositories are related to educational institution records for having e- books, research works and e- journals and articles (Edward, 2009). The digital revolution has brought dramatic changes to information storage, access and retrieving processes in PHLIs, Ethiopia. Usability is one aspect for evaluating the development of digital library services. Digital libraries are a very important asset of any higher learning institutions. A well-run digital library implies the strength of any valuable university and colleges.

1.1 Background of the study

In Ethiopia there are 45 public higher learning institutions (PHLIs) which are organized under 1st, 2nd, and 3rd generations. Most of the first generation and some of the second generations have already organized academic digital library and started to access the services for users. The role of digital library services plays significant role in strengthening a research and academic activities conducted in these public universities. Conducting a research on these academic digital library services based on postgraduate students is very important for students, academic staffs, administrative staffs etc.

To librarians, a digital library is another form of a physical library; to computer scientists, a digital library is a distributed text-based information system or a networked multimedia information system; to end users, digital libraries are similar to the World Wide Web (www) with improvements in performance, organization, functionality, and usability (Fox et al, 1995). There is no standardized definition for digital library.

The creation of digital libraries has made essential impact on teaching and learning process. Digital information services facilitate information services for library users, independent of time

and place. This is much needed especially if active learning styles become the common place (Anunobi & Ezeani, 2011). The main purpose of establishing academic digital library in PHLIs, Ethiopia is to strengthen the research and teaching learning process via accessing effective and efficient digital services for users. Masullo and Robert (1996) stated the roles of digital libraries can play in education: as a resource for teaching (curriculum development), as an environment for learning (student experience), and as authoring space (again, in support of student experience).

Digital libraries provide teachers and learners with knowledge in a variety of media. Digital libraries are accessible in classrooms and from homes as well as in central library facilities where specialized access, display, and use tools may be shared. Remote access allows possibilities for vicarious field trips, virtual guest speakers, and access to rare and unique materials in classrooms and at home (Marchionini, n.d). Academic Digital libraries of PHLIs, Ethiopia were organized to give advantages by accessing electronic resources in the form of text, audio and video. Users can retrieve the necessary information for academic purposes from different locations at any place and time.

Outreach activities are not new to academic libraries. Academic library outreach activities have expanded and evolved in recent years in response to changes both in the library profession and in the broader environment of higher education. In the academic context, outreach has focused on unserved or underserved groups such as high school students and other community users, non-traditional students, international students, and distance learners. There is a rich history of this sort of outreach at the Washington State University Libraries (Gibson and Scales 2000).

The issue of outreach activity designed and implemented in an organized way in PHLIs. Students those participate in extension program, distance education program and in-service program are the users of academic digital library services. They have got a possibility of using and accessing digital information without the restriction of time and place.

In the usability of academic digital library services Blandford and Buchanan (2002) concluded that usability is technical, cognitive, social and design-oriented and it is important to bring these different perspectives together, to share views, experiences and insights. Indeed, digital library development involves interplay between people, organization, and technology. The usability

issue should look at the system as a whole, not as an entity. When we observe academic digital library services of PHLIs, Ethiopia from these perspectives, there is a big problem which is not investigated yet.

According to Marchionini (2000) explained that emergence of digital libraries calls for the need of evaluation of digital library services. Evaluation is a research activity, and it has both theoretical and practical impact. This argument implies that there is strong relation between digital library and evaluation of digital library services. (Chowdhury & Chowdhury, 2003) stated that usability evaluation is a judgment of worth and the main intent is to assess to what extent a digital library meets its objectives and offer suggestions for improvements.

Conducting a research on user centered usability evaluation of academic digital library services in PHLIs; Ethiopia at this infant development stage has multidimensional benefit for users, service providers, and academic library management. Usability evaluation improve the services accessed by academic digital library, develop digital collection, brings user satisfaction of services, solve usability problem and decide usability level of academic digital library. An academic digital library without usability evaluation easily exposed for challenges. It affects the usability of academic digital library services as a whole.

Generally, this study aims to address usability of academic digital library services, electronic resource management, existing evaluation methods, techniques and usability evaluation criteria as a base for usability evaluation of digital library services to be successful and achievable with the study.

1.2 Statement of the problem

Ethiopia has embarked on a higher education institution expansion and reform program of impressive dimension. The number of PHLIs, academic programs and number of postgraduate students increase with the past academic years. In these PHLIs, organizing and developing academic digital library became critical and essential issue for further accessing up to date digital information. Digital library plays a vital role in the collection, acquisition, storage, organization and dissemination of digital information. Users specially, researchers (post graduate students) who need to do research benefited from combination of digitally delivered content with learning

support services, choices, opportunities and enhanced flexibility that digital library and information system provide (Jeng, 2005).

The fastest growth of modern technology related to digital information services is a good opportunity for digital libraries. Usability evaluation of digital libraries is essential for providing high quality services to a broad and diverse population of patrons. Usability is also a methodology that provides different information resources regarding types of digital information services to meet the needs of users and enables them to intuitively use digital library services various features (Berot et al, 2006).

Al-Saleh (2004) identified some main obstacle for making efficient use of digital library that include the insufficient availability of computers and computer labs, lack of professional librarians, lack of awareness instructions for accessing or retrieving information. Jagero, et al (2014) emphasized that required to facilitate the development of user centered digital libraries through user participation and involvement in the Africa university academic digital library. In these study undergraduate students, graduate students, academic staff and electronic resource staffs participated. They tried to identify and ratify the existence of problems in Africa university academic digital library such as lack of users training, bandwidth problem, and lack of cooperation from faculty librarians. Font type, font size, colures, graphics, icons applied by the digital library is also recognized as difficulties in understanding and using the academic digital library. The findings of this research did not incorporate the problems such as lack of professionals, lack of information communication technology (ICT) infrastructure in their studies. The usability evaluation modified by the authors did not contain all the usability evaluation criteria. Jeng (2005) stated that there are different ways that helps to evaluate usability. The author also proposes the usability evaluation model and usability evaluation instruments in depth. The author in his research also examines the issues of user looseness and navigation disorientation, usability difference of users due to age and culture. However, the author in his study did not encompass the existing difficulties from the service provider perspective.

Ali and Aasin (2009) conducted a research in BTH digital library on usability evaluation of digital library. The authors in their research applied qualitative and quantitative approach in the methodology part. They tried to describe the usability testing and inquire techniques for usability

evaluation. In their findings stated that users of Blekinge Institute of Technology digital library mostly satisfied with their user experience, besides they indicate that there are users who are not satisfied and less satisfied. However, in this study, usability evaluation model that facilitate the digital library services was not proposed. The problem that exists in terms of human and material resources not widely investigated. Xie (2006) noted that majority of research on digital library evaluation focused on how users use a digital library, essentially usability studies, to either recommend principles.

At national level, while digital libraries and repositories have been around for some time, the practice of building digital library and repository in Ethiopia is a recent phenomenon. This has been due to lack of relevant IT skill, the cost of commercial technologies. Recent interest from many professionals in the area and the proliferation of free open source technologies to build and manage local resources has led to a number of initiatives by higher education and research institutions (Adlsn n.d)

Wadajo (2011) explained that digital libraries research will be made an interdisciplinary activity across various programmes within the Addis Ababa University (AAU) which focus on the practical problems of large-scale electronic publishing, web information systems, scholarly communication and the long-term preservation of digital information that cover areas like digitization of unique resources for the purpose of preservation and wide public access as well as metadata creation, use, evaluation, standards and workflow.

However, most of the earlier researchers did not integrate very important issues of usability evaluation of digital library services such as different factors that influence usability level of digital library services; some newly discovered evaluation criteria were not applied to evaluate the usability of DLSs; the overall usability and satisfaction level of patrons from postgraduate students' perspective were not identified. In Ethiopia, despite enormous challenges and the inherent benefits from usability evaluation of a holistic digital libraries adequate research has not been undertaken in this area.

Generally, the researcher motivated to address the gaps by evaluating the usability of digital library services to show the satisfaction level of postgraduate students and overall usability of DLSs in public HLIs, Ethiopia.

1.3 Research Questions

In order to achieve the objectives of the study the following comprehensive research questions were attempted to answer:

1. What are the factors that affect the use of digital library services in Ethiopian public higher learning institutions
2. To what extent the digital library service is effective for academic activities of the public higher learning institutions of Ethiopia.
3. What is the perception of users towards digital library services in Ethiopian public higher learning institutions

1.4 Objective of the Study

1.4.1 General Objective:

The main objective of this study is to evaluate the usability of digital library services in selected public higher learning institutions of Ethiopia from postgraduate students' perspective.

1.4.2 Specific Objectives

The more specific objectives of the study are as follows:

- ❖ To explore the factors that affected the use of digital library services in Ethiopian higher learning institutions
- ❖ To identify the effectiveness of digital library services in academic activities of higher learning institutions of Ethiopia
- ❖ To identify the perception of users towards digital library services of public higher learning institutions, Ethiopia
- ❖ To propose a framework that enhances the usability evaluation of digital library services in public higher learning institutions, Ethiopia

1.5 Scope of the study

The researcher purposively selected Jimma University from 1st generation and Adama Science and Technology University from 2nd generation. Jimma University established the academic digital library in 2010 whereas Adama Science and Technology University established in 2013.

Some of the reasons those helps the researcher to select these universities were: Having better information communication technology (ICT) infrastructure, long experience in accessing digital library services, availability of professionals and well trained digital library workers, budgeting system they used to develop academic digital library services and good participation on workshop of digital library held nationally and internationally. The digital library services encompass the services such as OPAC, Institutional Repository, Dspace or Greenstone digital library, E-resources, and eGranary digital library services.

1.6 Limitation of the study

In the research activities of this study there were different limitations. One of the limitations of this research was time. The time given to conduct the research was very short and it was impossible to incorporate the whole PHLIs in the research. It was difficult to collect data from the respondents at the right time and place. Resource was also another limitation of this research. The nature of the research needs adequate resource to facilitate the research activities effectively, but it was not sufficient. It was difficult to get local literature, because such type of research was not conducted.

1.7 Significant of the study

The study was conducted on usability evaluation of digital library services in public higher learning institution, Ethiopia: The case of postgraduate students. Postgraduate students are the actual users of digital library services. They used the services regularly to retrieve current electronic information for their research and academic activities. The findings of this study benefits researchers, undergraduate and postgraduate students and expertise on digital libraries.

The findings also used to systematize and improve the electronics management in academic digital libraries. In the other way academic digital library management now a days are working on outreach activities such as e-learning, distance learning. The findings of this research plays a

vital role in strengthen and bringing a change in the overall outreach activities of digital library management. Professionals and information technology specialist have got a good opportunity to design better digital library system model.

1.8 Operational definition of terms

Digital library: A new forms of information institutions, multimedia information retrieval systems, or information systems that support the creation, use, and searching of digital content

Higher Learning institution: - The HLI can be defined as a university level education. It offers a number of qualifications ranging from Higher National Diplomas, Foundation Degrees to Honors Degrees as a further step, Postgraduate programs such as Masters Degrees and Doctorates (Asiimwe, & Lim, 2010).

Usability: - The term usability is often defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (ISO 9241).

Usability evaluation: Usability evaluation is a fundamental step in the user centered design process of any interactive system be it software, a web site or any information and communication technology or service

CHAPTER TWO

LITERATURE REVIEW

2.0 Conceptual literature

A conceptual framework is a structure which the researcher believes can best explain the natural progression of the phenomenon to be studied (Camp, 2001). It is the ‘blueprint’ or guide for a research. Grant & Osanloo (2014) stated that a framework based on an existing theory in a field of inquiry that is related and/or reflects the hypothesis of a study. It is a blueprint that is often ‘borrowed’ by the researcher to build his/her own house or research inquiry. It serves as the foundation upon which a research is constructed the theoretical framework offers several benefits to a research work. It provides the structure in showing how a researcher defines his/her study philosophically, epistemologically, methodology and analytically

The conceptual framework, thus, aids the researcher in finding an appropriate research approach, analytical tools and procedures for his/her research inquiry. It makes research findings more meaningful and generalizable (Akintoye, 2015). The most important thing to understand about your conceptual framework is that it is primarily a conception or model of what is out there that you plan to study, and of what is going on with these things and why a tentative *theory* of the phenomena that you are investigating. The function of this theory is to inform the rest of your design to help you to assess and refine your goals, develop realistic and relevant research questions, select appropriate methods, and identify potential validity threats to your conclusions Synthesis of concepts and perspectives drawn from many sources. Generally the conceptual frame work used for this study as an end result that brings together a number of related concepts. It addresses a specific research problems and an integrated understanding of issues.

2.1 Overview of digital library.

This section encompasses several concepts of digital library, methods of usability evaluation, approaches of digital library evaluation, usability model, standards and criteria for usability evaluation of digital library services.

Digital libraries are a set of electronic resources and associated technical capabilities for creating, searching and using information. In this sense they are an extension and enhancement of

information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds; static or dynamic images) and exist in distributed networks (Borgman, 1999).

According to Wilson et al. (2003), the term digital library is now a days used to indicate both the system that implements the service of a globally accessible library and the digital content of the library itself and of documents that are maintained and disseminated. Identifying the problems in providing services to users and in receiving the service by users is very important to analyze and resolve the problem.

The development of DL has a very short history of development. According to Saracevic and Covi (2000), it was predicted in 1965 that future libraries will be highly innovative and different in structure, processing and through application as compared to a traditional library. At the end of 1990s research and practical development exploded in the field of digital library globally with the internet proliferation, and that internet has created unprecedented possibilities to discover and deliver human knowledge. In the 2000s growth of many different efforts related to digital libraries continued at a high speed. Nowadays, DL is the result of all the hard work which is being done in the previous decades (Candela et al, 2011)

Many libraries are in transit from the traditional towards the digital library. In traditional libraries activities of the libraries were performed manually with the tools like card catalog in physical building. The notion of library has long expanded beyond the physical building of the library .In a digital library, electronic resources are stored and made available in digital forms, and the services of the library are also made available electronically. These electronic collections allow users from everywhere at any time to consult the material without doing any harm to fragile documents

Digital libraries are a set of electronic resources and associated technical capabilities for creating, searching and using information. In this sense they are an extension and enhancement of information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds; static or dynamic images) and exist in distributed networks (Borgman, 1999).According to Wilson et al.(2003), the term digital library is now a days' used to indicate both the system that implements the service of a globally accessible library and the digital content of the library itself and of documents that are maintained and disseminated. Identifying

the problems in providing services to users and in receiving the service by users is very important to analyze and resolve the problem.

Digital library services are considered as services or resources accessed and/or provided through digital transactions. Services range from the relatively straightforward, such as provision of online tools, virtual space for collaboration and sharing of content to online reference services, and more complex distributed and interactive systems as digitized local archive collections purposefully linked to the local school curriculum through virtual learning environments. In the role of access provider, the digital library also establishes links to other public information providers for sharing societal goals such as lifelong learning and health and wellbeing, across education, health and the arts (Buchanan & McMenemy, 2010). According to Jiang (2004), digital library service elements divided into five functional services: information providing services, information organization services, interaction services, and information retrieval services. (Bernard, 2006) stated that relationships between producers, users, documents, and technologies are key elements for best services. In order to provide best services many librarians and information specialist have examined the opportunities, among them (Pomerantz, 2008) explored digital library services, in both possible senses: services provided digitally by physical libraries, and services provided by digital libraries. He found that libraries provided a superb environment for service science to investigate new ways to produce value for users.

The researcher adopted the definition of digital library given by Buchanan & McMenemy (2010) for this study. Digital library purposefully organized to access electronic information resources in different digital library services. There is also a possibility of getting up-to-date information from other sources available around the world without the restriction of time and place. There are different types of digital library such as stand-alone, federated and harvested digital libraries

- **Stand-alone digital library (SDL).** This is the regular classical digital library implemented in a fully computerized fashion. SDL is simply a library in which the holdings are digital (scanned or digitized). It is also self contained and the material is localized and centralized.
- **Federated digital library (FDL).** A FDL composes several autonomous of SDLs that form a networked library with a transparent user interface. The different SDLs are

heterogeneous and are connected via communication networks.

- **Harvested digital library (HDL).** This is a virtual digital library providing summarized access to related material scattered over the network. It holds only metadata with pointers to holdings that are “One click away” in cyberspace. The library developed by library Professionals, or computer scientists.

The two public universities; JU and ASTU have already established stand-alone digital library and accessed different services.

2.2. Definition and Importance of Usability

Usability is defined in varied terms by numerous researchers. Most of the ones we have found offer similar definitions and most of the definitions include at least a core of the same attributes. Usability can be defined in different contexts like ease of use, task performance and ease of learning (Nielsen, 2003). The ISO (25010:2010) stated as the usability in general the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. In this definition, effectiveness means the accuracy and completeness with which users accomplish specific goals, efficiency is the resources expended in relation to the accuracy and completeness with which users achieve goals, and satisfaction is described as the comfort and acceptability of use. While usability is defined in a general context, web usability is more specifically defined as clarity, simplicity, and consistency in the website design, in order to allow users to perform their tasks easily (Cappel & Huang, 2007).

Shackel (2009) describes usability as “technology’s capability to be used easily and effectively by the specified variety of users, given particular guidance and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios”. Usability is a multidimensional construct that can be examined from various perspectives. The term usability has been used broadly and means different things to different people. Some relate usability to ease of use or user friendliness and consider from an interface effectiveness point-of-view. This view sense, makes as usability has theoretical base on human-computer interaction (Jeng, 2005).

According to Nielsen (2000), usability has become a question of survival in the economy of the internet. For the Usability Professional's Association (UPA), usability is directly related to

quality of the product, as well as to the user's efficiency, effectiveness and satisfaction. This same association defines usability as a set of techniques developed to create usable products, with a user-centered approach. Nielsen (2003) considers that the usability of a system can have five quality components:

- **Learnability:** How easy is it for the users to accomplish basic tasks the first time they encounter the design?
- **Efficiency:** Once users have learned the design, how quickly can they perform tasks
- **Memorability:** When users return to the design after a period not using it, how easily can they Re-establish proficiency?
- **Errors:** How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
- **Satisfaction:** How pleasant is it to use the design?

Jeng (2005) believes that usability is a property of the total digital library system where all the components should work together efficiently in producing effective and convenient digital library service. Digital libraries are powerful tools if they are usable, useful and users benefit from them. User-based measure of evaluation for digital libraries is imperative in understanding how well the system serves and fulfils the needs of its targeted users.

2.3 Methods of Usability Evaluation

The primary purpose of conducting evaluation research in a library setting is three: 1) to understand user interaction with library resources and services; 2) to capture data that inform the planning, management, and implementation of library resources and services; and 3) to substantiate the research gap. Integrated research, evaluation, and planning efforts, through various measurement approaches and methods, can assist libraries to efficiently and effectively develop, implement, and change resources and services that meet user information needs over time. They can also provide an understanding of the broader social context of libraries from a user perspective (Bertot, nd). There are a number of methods to evaluate usability. These are: formal usability testing; usability inspection; card sort; category membership expectation; focus groups; questionnaires; think-aloud; analysis of site usage logs; cognitive walkthrough; heuristic evaluation; claims analysis; concept-based analysis of surface and structural misfits (CASSM); and paper prototype (Blandford et al., 2004). The goal of a usability evaluation is to assess the

degree to which a system is effective (i.e., how well the system's performances meet the tasks for which it was designed), efficient (i.e., how much resources such as time or effort is required to use the system in order to achieve tasks for which the system was design), and favors positive attitudes and responses from the intended users (ISO, 1999)

To gauge the performance of particular digital libraries, evaluative study is one of possible ways where the actual users of digital libraries' interest and concerns in using these information systems can be investigated and understood. Evaluation can play both a formative role, helping to continually refine and update goals, objectives, and services; and a summative role, helping to ascertain whether the goals and objectives are being met. Hence, evaluating academic digital libraries is also crucial in meeting users' requirements of using digital libraries systems for academic purposes (Thompson, McClure and Jaeger, 2003). As a result, the paradigm of information accessing & searching is shifting away from professional-mediated mode to end-user self service mode. So in order to understand the shift of information service and trends, evaluation of digital services is important (Krishnamurthy, nd). The researcher was applied survey method preferable for usability evaluation of digital library services in PHLIs, Ethiopia.

2.4 Approaches of digital library evaluation

There are no standard definitions or approaches to library evaluation approaches, strategies, or practices. Each evaluative approach offers potential information – based on collected data – particular to a specific area of focus within a library. The area of focus may be broad in scope such as a library's digital collections and presence or defined narrowly for a specific task within a specific setting such as a special digital collection, feature, or service. Researchers and practitioners may use a number of approaches to evaluate library resources and services from multiple perspectives and the approaches may be library-centered or user-centered. Each approach is part of an evaluative process that includes planning, data collection, and evaluation as components of the evaluation (Bertot, nd).

Evaluation of a digital library is equally important during its development and later during its use. The phase of development is especially important if we want our users to become firmly oriented toward the use of digital libraries in future. To achieve this, digital library system builders should evaluate often and early and exploit existing good practices within library science (Blandford, 2007).

According to Saracevic (2000) digital libraries are usually evaluated only on one level and that one level can rarely answer question from another. This creates difficulties since digital libraries are complex information systems which require complete understanding of operation of all of its components.

Sumner and Marlino (2004) propose three approaches – cognitive tools, component repositories, and knowledge networks - with specific examples drawn from the Digital Library for Earth System Education (DLESE) and the NSDL for educational digital libraries. They conclude that the three approaches can help to deconstruct the digital library metaphor to generate better understandings about the impact of a library on educational practice. They also claim that these three models can reflect the complex interactions between humans, technology, and context in educational digital libraries. Saracevic (2004) specified the following broadened list of approaches for digital library evaluations:

- **Systems-centered approach:** most prevalent. Involves study of some aspect of performance includes assessing effectiveness and/or efficiency of some feature or some specific design or some technological component applied in a number of studies with results that may inform specific choices in design or operations.
- **Human-centered approach:** also widely applied. Involves study of behavior in respect to give information needs, such as information seeking, browsing, searching or performance in completion of given tasks, either predetermined or observed in natural settings. Used in a number of studies that illuminated human behavior, requirements, needs, or difficulties encountered provide implications for design, but indirectly rather than directly.
- **Usability-centered approach:** Involves assessment of different features, particularly in respect to portals, by users. It is a bridge between systems- and human-centered approaches. Used in several studies with mixed, or self-evident results.
- **Ethnographic approach:** Involves study of life-ways, culture and customs in a digital library environment. It also involves study of impact of a digital library on a given community which Applied successfully in a few studies, with illuminating results, particularly as to impact
- **Anthropological approach:** Involves study of different stakeholders or communities and their cultures in relation to a given digital library applied in one study with interesting results illuminating barriers between stakeholder communities.

- **Sociological approach:** Involves assessment of situated action or user communities in social setting of a digital library applied in one study with disappointing results.
- **Economic approach:** Involves study of costs, cost benefits, economic values and impacts. Strangely, it was applied at the outset of digital library history (e.g. project PEAK) but now the approach is not really present at all. The researcher used human-centered approach which plays a dynamic role in investigating the performance of digital library services from users perspective..

2.5 Existing usability models and standards

The type of evaluation model to use rather depends on the objective of the evaluation itself, nature of the digital library, targeted users and its contents. Usability studies conducted by Kassim and Kochtanek (2003) on academic digital library were performed through the use of mixture usability models: focus groups, Web log analysis, database usage analysis, satisfaction surveys and remote usability testing. Their studies are attempted to understand user needs, find problems and desired features, and to assess overall user satisfaction.

Marchionini et al. (2003) emphasized that information needs of users are central to all libraries, digital or otherwise. They added that all designing, implementing, and evaluating digital libraries must be rooted in the information needs, characteristics, and contexts of the people who will or may use those libraries. Thus usability aspect in evaluating digital libraries is important to understand how far the systems are capable of meeting users' information needs. Saata (1980) explained that based on the integrated research result, the evaluation model for DL user interfaces was established from the perspectives of students, teachers, and experts and served as the reference for decision making. There are various usability modes recommended by scholars some of them are described below,

2.5.1 Eason Model

Eason Model is proposed by Kenneth Eason (1984) and available his model in an early issue of Behavior and Information Technology. Eason Model has 3 aspect, task, user and system. For task it has 2 subs attribute that is frequency and openness. User has three sub attributes that is knowledge, motivation and discretion. System has ease of learning, ease of use and task match. Eason Model cannot measure or compute usability without considering users and their target task. It is causal type of model because it has input that is independent variable and or result that is dependent variable. A causal model is one that makes prediction about causality. Eason model

seen usability as the result of several interacting variables or “multivariate” (Uitm & Alam, 2010).

2.5.2 Shackel Model

Shackel Model was developed by Brian Shackel. In this model, there are 4 attributes such as effectiveness; learn ability, flexibility and attitude. Shackel Model does not mass the dimension, recognizing that the importance of each of these may different from project to project. Shackel model emphasizes measurement of a number of human factors, relating to human performance and approach (Lee & Kozar, 2012). Modified Shackel model and adapted the model into usefulness, effectiveness, learn ability (or ease of use) and attitude or likeability, Marsico, & Levialedi (2004) said that definition with one or more of four criteria in Booth model are generally accepted by usability community.

2.5.3 Nielson Model

Nielson Model was developed by Jacob Nielson (2003). The main model is system acceptability and usability is part of usefulness. Other characteristics that contribute to the main model are utility, usefulness, practical acceptability and social acceptability. Under usability it has five characteristics such as easy to learn (learn ability), efficient to use (efficiency), easy to remember or memorize (memorability), few error and subjectively pleasing (satisfaction). Nielson Model focus on acceptability that mean if the system is not useful such as did not meet the user requirement, it will not accept it either it usable or not.

2.5.4 ISO 9241 – 11 (2010) usability standards

ISO 9241 is an international standard for guidance on usability based on process oriented. Nielson and Shneider man are among the committee members in the development of ISO Guidelines. For ISO 9241 – 11 has three attributes that are effectiveness, efficiency and satisfaction. ISO 9241 – 11 are put together from a different usability viewpoint. Effectiveness describes the interaction from the process perspective, efficiency which focus on results and resources involved and satisfaction which is a user viewpoint (Abran, et al., 2003). ISO 9241-11 has objective measures of usability.



Figure2.1: Usability sub characteristics according to ISO 9241 – 11 (source: Folmer& Bosch, 2004).

- Effectiveness: refers to the completeness at which users achieve specified goals;
- Efficiency: refers to the resources used in completing a task; and
- Satisfaction: reveals positive attitudes toward using the system (ISO, 2010).

2.5.5 ISO 9126 (2001) usability standards

The approach was quality model of the product and initially published in 1991 and refined over the next ten years by ISO's group of software engineering experts. ISO 9126 is an extension of previous work done by McCall, Boehm, FURPS and others in defining a set of software quality characteristics. ISO 9126 divided into four parts which address respectively to the quality model, external metrics, internal metrics and quality in use metric. The internal and external measurements are functionalities, reliability, usability, effectiveness, maintainability and portability (Abran, et al., 2003).

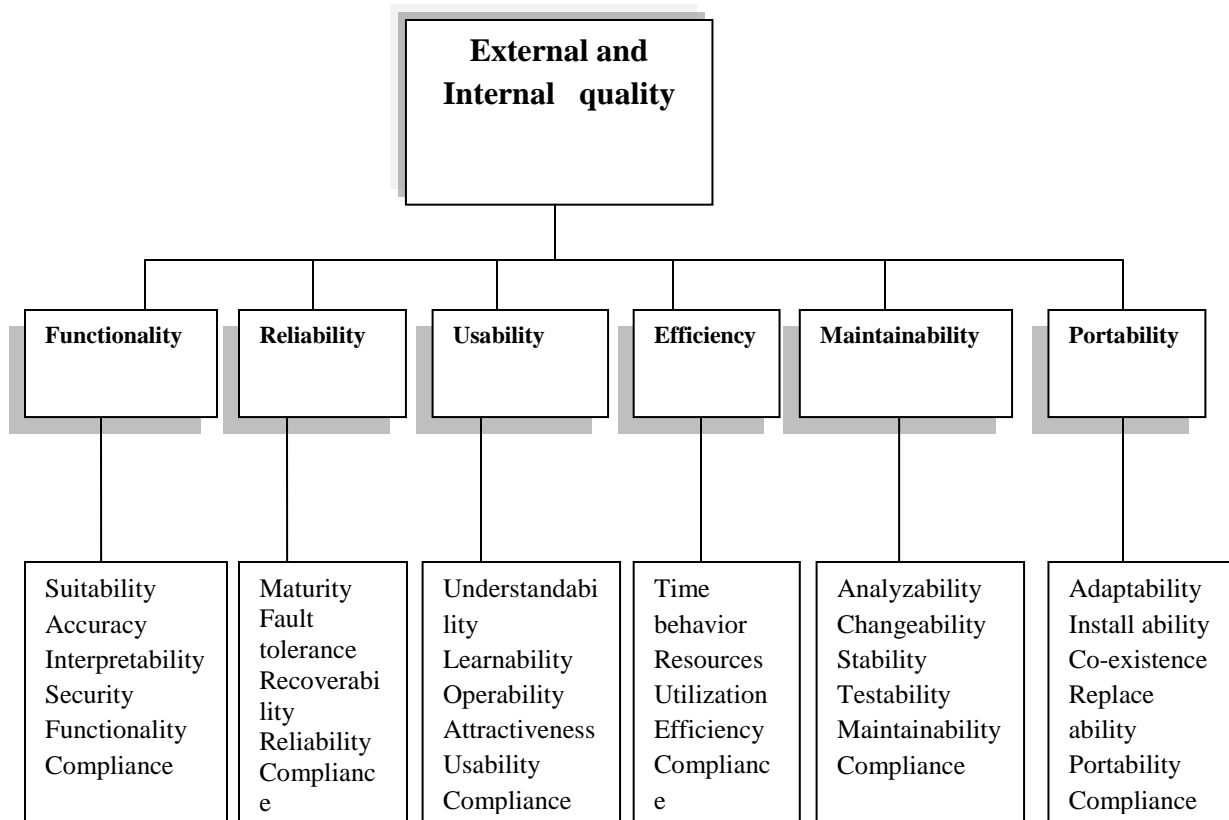


Figure 2. 2:- ISO 9126-1 model external and internal usability approaches (source: Folmer& Bosch, 2004).

Under usability it has five characteristics such as understandability; learnability, operability, attractiveness and usability compliance (Abran, et al., 2003). The advantage of ISO 9126 model provides a framework for making trade-offs between software product capabilities and the attributes are applicable to any kind of software including computer programs and provide consistent terminology for software product quality. Usability sub characteristics according to ISO 9126 (2001) standards:

- **Learnability:** -refers to how easy it is for casual users to learn a system. In the websites with high learnability users feel they are able to start using the site with the minimum of introductions and everything is easy to understand from the start.
- **Attractive:** -websites are visually pleasant, and appeal the interest of the users, whether it is functionality or information.

- **Operability:** - indicates the capability of a website to be easily operated by users. Users of the website must be comfortable with the manner through which services and content are presented in the website and be able to use the website easily without being frustrated or confused (Tsigereda, 2010).
- **Understandability:-** the user comprehend how to use the system easily

2.5.6 Quality Use Integrated Measurement

Quality in Use Integrated Measurement (QUIM) is developed by Ahmed Seffah et al., (2006). It is consolidated model for usability measurement and metrics. It combines various standard and model such as ISO 9241 and ISO 9126 are combined into a single consolidated, hierarchical model. It outlines methods for establishing quality requirements as well as identifying, implementing, analyzing, and validating both process and product quality metrics. This model is appropriate for novice user has little knowledge of usability and can be applied by usability experts and non-experts. QUIM model consists of 10 factors and subdivided into 26 criteria or measurable criteria, and lastly into specific metrics consist 127 specific metrics. The 10 factors consists Efficiency, Effectiveness, understandability, Learnability, Productivity, Safety, Reliability, Accessibility, Usefulness and Universality. The model is used to measure the actual use of working software and identifying the problem. In QUIM model association factors with criteria and metrics in a clear and consistent way. It also usable generally and can adapt in specific context of use cited in (Aziz & Kamaludin, 2014).

2.6 Criteria for evaluating digital library services

According to Fuhr (2007) stated criteria is actually a core of the evaluation study and converse parameters, factors, and measures used to assess the quality of what is evaluated and every aspect of a digital library being evaluated. Usability evaluation criteria measure functionality, performance, and outputs. Saracevic's (2004) aims mentioned in the form of a set of guidelines for evaluation of DLs in which five dimensions “construct for evaluation”, “context of evaluation”, “criteria reflecting performance as related to selected objectives”, “measures reflecting selected criteria to record the performance”, and “methodology for doing evaluation” were indicated.

Aasin and Ali (2009) in their study of usability evaluation of digital library services used attributes of the usability efficiency, effectiveness, learnability, user friendly, reliability, comfortable, error prevention, memorability, currency, timesaving, and aesthetic as a criteria to evaluate the usability of Blekinge Institute of Technology digital library, Sweden. Stone (2001) explained the usability evaluation criteria as follow

Table2. 1Criteria and their description

Efficiency:	All about the working environment of an interface. Users are able to perform their tasks quickly and efficiently through it.
Effectiveness:	Concerned with task completion in relation to user goal, in particular success rates
Learn ability:	User interaction with his/her perceptions about the system for the first time and how he/she learns to interact with the design of the system, learning and understanding of an interface, how a person gets used to using it and gets maximum benefits out of it and simple.
User friendly:	It should minimize the efforts of the users and maximize the result they get from it in relation to expected results
Comfortable:	Feeling comfortable while working through the interface. There should not be irritating points and complexities or errors while a user are working through the interface
Error prevention:	If a user working to perform some tasks fails to perform anything or he/she gets an error and he/she is unable to correct it then probably he/she will give up trying to perform his/her tasks.
Time saving:	Timesaving considers the time of users spend when they are using the services
Aesthetic:	Aesthetic refers to the text type, font size and the visual attractiveness of the interface of each digital library service.
Reliability:	To a large extent, determine whether or not the resource is accepted and put to further use
Currency:	Considers the extent to which the information is sufficiently up-to-date for the task it is to be used for.
Comfortable:	Some users use an interface sporadically and do not use it again for some time so when they come to use it again there may be a problem concerning how well they can keep in their memory how to use it again.

The criteria specified above were mostly used for usability evaluation of digital library services. The researcher believes that these criteria are appropriate for usability evaluation of digital library services. The functionality, development and the challenges of digital library services can easily identified using these criteria.

2.7 Related works

The study on the usability of digital library has been conducted internationally over the past years in many domains to evaluate the overall usability level of digital library services and satisfaction level of users. This section presents a number of previous studies related to the usability evaluation of digital library in generally and specifically to those related to digital library of higher learning institutions in different parts the world. However, none of the studies yet conducted in Ethiopia as mentioned in the previous chapter.

Aasim and Ali (2009) conducted a research on “Usability of digital library of Blekinge Institute of Technology, Sweden. The authors used usability and users as a basic issue to evaluate and judge the Blekinge Institute of Technology digital library services. Mixed research design applied by authors to cover the students requirements and problematic issues and to produce results that specificity the validation of results and techniques used in finding. The sample size designed for the study was 48 those were the users of Blekinge Institute of Technology digital library. The authors used different instruments such as thinking aloud protocol, questionnaire and interviews to collect data from respondents. The researchers in their finding ratified that some users of Blekinge Institute of Technology digital library were confused and less satisfied in performing searching activities when they were using the services of BTH digital library. The finding obtained from the overall satisfaction of users showed dissatisfaction regarding the usability of Blekinge Institute of Technology digital library.

In the other way a study was conducted in UK by Sallako and Buchanan (2009) on “Evaluating the usability and usefulness of a digital library, university of Strathlycle, Glasgow”. The study was a pilot study on an interactive search system developed by a health service as part of their e-library service. It encompasses summative and test-oriented that focused up on ascertaining user satisfaction. The authors used electronic questionnaire to collect data from thirty seven respondents. The final results that the authors specified were positive overall. However, some

respondents were dissatisfied with the digital library in particular with regard to efficiency, terminology, navigation and relevance. Navigation system which integrated to the digital library was not straight forward and constructing search queries was difficult for users.

A study was also conducted in Nigeria by Anyim (2018) on E-library Resources and Services: Improvement and Innovation of Access and Retrieval for Effective Research Activities in University E-libraries in Kogi State Nigeria. The study intended to identify: e-library resources in university e-libraries, e-library services provided, to ascertain: the level of user's satisfaction with the effectiveness of digital library resources, the level of user's satisfaction with the effectiveness of digital library services, and to determine: the areas for improvement and innovation to enhance access to e-library resources, the areas for improvement and innovation to enhance information retrieval from e-library resources. The researcher in his study used descriptive survey as a research design. The total population of the study is 240. The population comprises e-library users making up of 15 postgraduate students and 35 academic staff of Salem University (SU) Lokoja; 70 postgraduate students and 60 academic staff of Kogi State University (KSU) Anyigba; and 60 academic staff of Federal University Lokoja, exclusive of its postgraduate students. No sample used for this study due to the manageable size of the population. Data for this research was obtained through a structured questionnaire. The researcher used simple percentages and frequency tables to analyze the result of his study. The final result of the study justified that the university e-libraries in Kogi State, Nigeria have lack of institutional repository, DVD-ROM and official portals; audio/video conference services is not available; respondents were dissatisfied with the digital resources and information services provided in the various university e-libraries and dissatisfied with efficiency of digital library services.

Jeng, et al (2014) conducted a research on the title An assessment of the usability of the African university digital library, Mutare, Zimbabwe .The study sought to facilitate the development of user centered digital libraries through user participation and involvement The study population for the research consisted of 30 undergraduate students, 18 graduate students, 12 academic staff and 2 electronic resources staff. Questionnaires, interviews and indirect observation were used to collect data. Data presentation on summary of results using usually critical were presented in tables and figures. Data interpretation was performed on usefulness, efficiency, learnability,

effectiveness and satisfaction of digital library. The findings of the study justify that there was general dissatisfaction of users regarding the usability evaluation of the African university digital library, especially in terms of the adequacy of the collection and the system respond time, Band with problems, lack of user training, and lack of cooperation from faculty librarians were noted as the main inhibitors to the attainment of the highest degree of usability for the digital library in terms of satisfying user needs and expectations.

Imaran, et al (2017) conducted a study on Usability study of digital libraries: An analysis of user perception, satisfaction, challenges, and opportunities at university libraries of Nanjing, China. The core purpose of this study was to stimulate the culture of excellence in DL resources and services, while focusing on graduate and postgraduate students. Mixed methods research design and quantitative and qualitative approaches were used. Questionnaire was designed to collect factual data in quantitative phase whereas an interview guide was used to collect the qualitative data. A total of 250 research students from five universities and fifty students from each university were targeted to fill the questionnaire. For interview five libraries ‘ IT professionals were selected, one from each academic library. The SPSS (13.0) package was used to process and interprets the data. The findings of the study justify that graduate and postgraduate students were fully aware of the existing digital library resources and services. Additionally, the findings of the study showed that digital library resources had accelerated the respondents’ research activities. The result of the study identified that significant problems for most of the respondents were lack of assistance, and slow downloading. The study also showed that respondents, overall, considered DL resources and services imperative and were extremely satisfied with the authenticity of information, display of research results, and interface of the DL

Generally, the authors were conducted a research on usability evaluation of digital library services in higher learning institution and educational institution around the world. The related works specified above have direct and indirect relation with this study. The study which is conducted by the authors Imaran, et al (2017), Jeng, et al (2014) and Anyim (2018) were not incorporated some main usability attributes as evaluation criteria for usability evaluation of digital library services, the role of digital library services in strengthening the research and academic activities of public higher learning institutions were not widely specified, satisfaction level of users, perception of users regarding the services and the overall usability of digital

library services were not fully identified by these authors. Additionally, most challenges faced users and the available constraints of the digital library services were not investigated in detail by the authors Sallako and Buchanan (2009) and Aasim and Ali (2009). These are the uncovered areas by the authors and this study conducted to fill these gaps.

2.8 Conceptual framework

Conceptual framework is a visual or written product, one that explains, either graphically or in narrative form, the main things to be studied the key factors, concepts, or variables and the presumed relationships among them Miles and Huberman (2011). Theoretical framework of a study is the system of concepts, assumptions, expectations, and theories that supports and informs this research. It is also a key part of design. Therefore, based on theoretical aspects the conceptual framework of the study was merged and combined from different literature review with variables shown as follows:

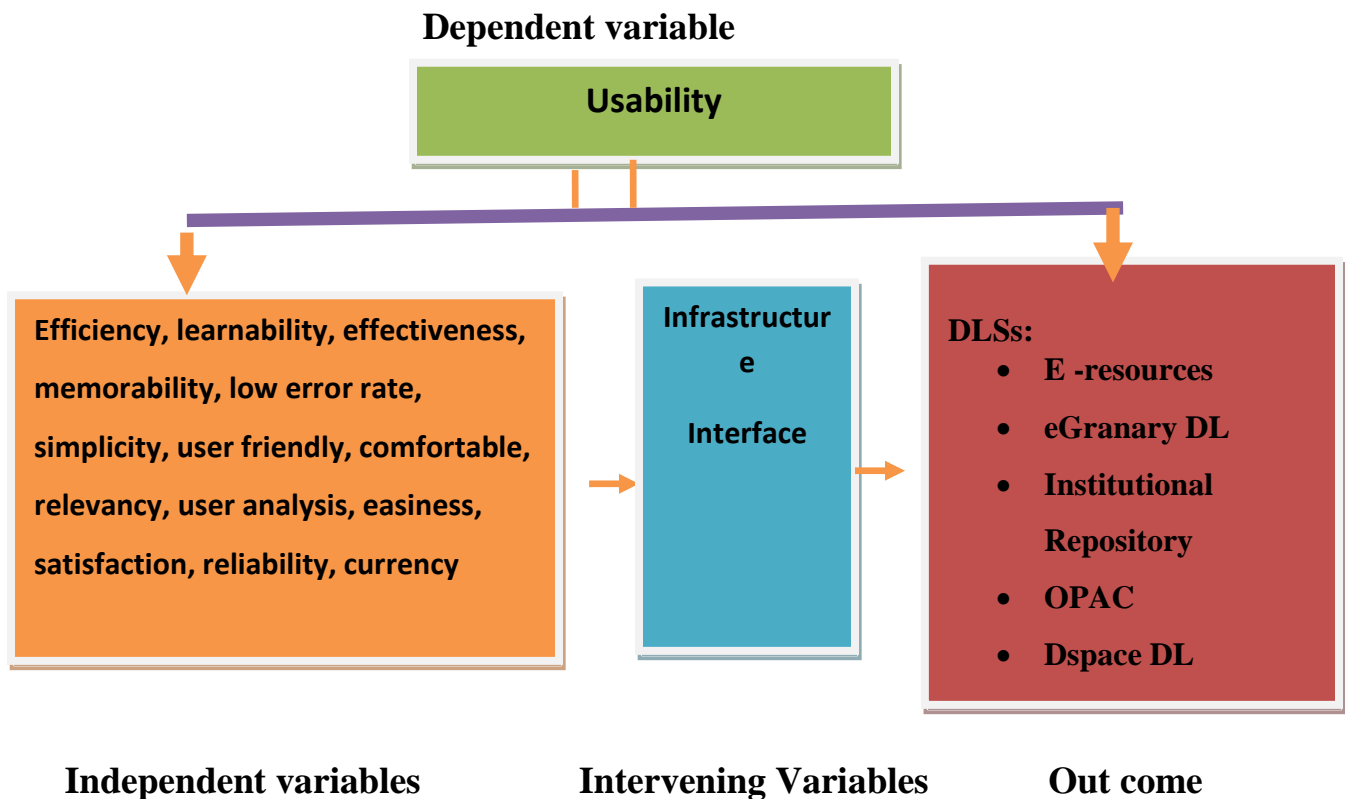


Figure2.3: conceptual frame work modified from (Ndakalu, 2014)

In the modified conceptual framework the independent variables efficiency, effectiveness, Learnability, Memorability, error prevention, user friendly, comfortable, timesaving, aesthetic,

reliability, currency and the dependent variable usability were added. The digital library services E-resources, eGranary digital library, Institutional Repository, OPAC, Dspace digital library, Green stone digital library and eGranary digital library services are justified as an outcome. The conceptual framework strives to explain the dependent and independent variables. It is also clearly shows that how these variables are interconnected. Intervening variables explain the relation or provide causal link between the independent and dependent variables

Generally, in this chapter the short history of digital library, its origins and development, definition of digital library from different perspective clearly explained. Explanation on the importance of usability, types of methods used to evaluate DLSs and approaches of usability evaluation that helps the researcher were given. Existing usability models, standards and criteria used for usability evaluation of DLSs also justified. In the other way, the design of conceptual frame work that offers several benefits to a research work illustrated

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1 Study design

This study was conducted through a cross sectional survey which enabled the researcher to collect data in depth on views, opinions, practices and impacts. Qualitative and quantitative approaches were also used to collect and analyze data. The qualitative approach aims to cover the student requirements and problematic issues that contain detailed descriptions of each issue and identify the factors that are involved in usability evaluation process. The quantitative approach aims to produce results that specify the validation of results and techniques used in finding those results after analysis (Usman & Aasim, 2009). The reason for using both qualitative and quantitative approaches was to improve the quality of research by ensuring that conclusions arrived at were more likely to be correct and accepted as such.

3.2 Study area

In Ethiopia there are 45 public universities which are established in different regional states of the country. These universities are authorized by ministry of education and grouped under 3 generations based on their established period. The researcher selected two (2) public universities; Jimma University (JU) from 1st generation and Adama Science and Technology University (ASTU) from 2nd generation purposively. The need of well organized information communication technology (ICT) infrastructure for digital library services, long experience on academic activities and electronic resource management, and the complexity of the research restrict the researcher to select the two universities

The researcher believes that these two universities represent the public Universities in Ethiopia as they have relative development level with their respective categories and all also have well organized digital library and infrastructures that facilitate the access of services for users and enhance academic activities. Jimma University is a public higher learning institution established in December 1999 by the amalgamation of Jimma college of agriculture (founded in 1952), and Jimma institute of health sciences (established in 1983). JU is Ethiopian's first innovative community Oriented higher learning institution that located some 355 km to southwest of Addis

Ababa, the capital city of Ethiopia, and about two km to the northeast of Jimma City Centre (JU, 2014).

Adama Science and Technology University (ASTU) is 2nd generation public university located some 80km to east of Addis Ababa, the capital city of Ethiopia, It was established in 1993 E.C. The university has branches in Adama town, Asella, and Bishofitu, Oromia Region and in Addis Ababa, Ethiopia. But this research was conducted at the main campus of Adama Science and Technology University.

3.3 Study Population

According to Burns and Grove (2001), a study population is defined as all elements (individuals, objects and events) that meet the sample criteria for inclusion in a study. The population of the study was comprised both Master students and PhD candidates of higher learning institutions of Ethiopia. The researcher believed that postgraduate students are the actual users of digital library services for their research and academic activities. They have self-efficacy regarding basic computer skill and internet that helps them to access and search the services. They can also easily justify their perception of digital library services in supporting academic activities.

The total population of postgraduate students in JU is 3149. Out of them in Agriculture and life science 178 Masters and 57 PhD candidates, in Business and Economics college 201 Masters and 8 PhD, in Social Sciences and Humanities college 217 Masters and 19 PhD candidates, in Technology institute 131 Masters and 85 PhD candidates, in Education and Behavioral college 107 Masters, in Law and Governance college 72 Masters, in Natural Science 211 Masters and 11 PhD, and in Institute of Health Science 823 Masters and 129 PhD candidates (JU, 2018). Similarly, the total population of postgraduate students in ASTU is 551. Out of them in school of Civil Engineering and Architecture 97 Masters and 5 PhD candidates, in school of Mechanical, Chemical and Material Engineering 139 Masters and 42 PhD candidates, in school of Electrical Engineering and Computing 132 Masters and 14 PhD candidates, and in school of Applied Natural Science 112 Masters and 10 PhD candidates (ASTU, 2018). The total population of postgraduate students of these two universities is 3700.

Table3.1: Population of the study

No	University	Status of Postgraduate students		
		Masters	PhD	Total
1	JU	2840	309	3149
2	ASTU	480	71	551
	Total	3320	380	3700

Source: Human resource office and Registrar office of (JU, 2018, and ASTU, 2018)

3.4 Sampling techniques and Sample size determination

3.4.1 Sampling technique

The researcher used both purposive and simple random sampling techniques. Purposive sampling technique was used to select respondents who were professionals and have enough knowledge about usability of digital library services for the purpose of interview whereas simple random sample technique was used to select samples from postgraduate students. Simple random sampling is an effective, low resource consuming method of sampling that can be used as a variety of situations as a reliable sampling method. It can be concluded in shorter time duration and gives better chances that the sample represents the whole population. It is free from errors in classification, bias, and prejudice. In the other way the simple random sampling could not be in use where the units of the population are heterogeneous in nature. A simple random sample was employed by choosing elementary units in such a way that each unit in the population has an equal chance of being selected (Gravette, 2011). For sample which selected through simple random sampling, the researcher has got list of colleges or schools, departments, list of postgraduate students from the office specified above then proportion for each college and department were calculated and finally lottery method was used to select samples. The detailed figure of sample size determination is discussed below specifically.

3.4.2 Sample size determination

Sample size depends largely on the degree to which the sample population approximates the qualities and characteristics of the general population. The sample size is determined using the sample size determination formula and proportional allocation of subjects also done by (Kothari, 2004) formula. According to Asri (2016), it is practically impossible to take a complete and comprehensive study of the entire population, because of the nature and pattern of distribution of the elements of the population. Therefore, the sample size was calculated using the formula proposed by Kothari (2004).

$$n = \frac{Z\left(\frac{\alpha}{2}\right)^2 * P(1 - p)}{d^2}$$

Where

n = sample size

Z ($\alpha/2$) = 1.96 (95% confidence level for two side)

N = total population of academic staff

P= proportion of population

d= degree of accuracy desired setting at (5%)

q = 1-p Where: d = 0.05, p = 0.5, $\alpha=0.05$

Therefore the value of **n** was calculated as follows

$$n_0 = \frac{1.96^2 * 0.5 (1- 0.5)}{0.05^2} = 384$$

$$nf = \frac{no}{1 + no / N}, \text{ Where}$$

nf = the desired sample size when population is less than 10000

n = the desired sample size when population is more than 10000

N = the estimate of population in each university

Considering the population correction factor into account the sample size should be:

$$n = \frac{384}{1 + 384/3700} = 348 \text{ (sample size)}$$

Therefore, the total sample size is 348 postgraduate students. To proportionally allocate samples for each universities total sample size of all Universities are multiplied by the ratio population size of the proportional to total population

That is:

$$nh = (Nh/N)*n$$

Where:-

nh = sample size for the proportion

Nh = the population size for the proportion

N = Total population

n = total sample size

The sample size of postgraduate students from each university calculated as follow

$$\mathbf{JU} = (3149/3700)*348 = 296$$

$$\mathbf{ASTU} = (551/3700)*348 = 52$$

To find out the sample size at the college or school level and departments based on the number of postgraduate students calculated

That is:

$$n_1 = \frac{n * N_1}{N}$$

Where:

n= total number of students in single college

N1= sample size

N= total population

Table 2.2: Sample at colleges or School level

Universities	Colleges or Schools	Total population	Sample taken
Jimma University	Agriculture and life science	235	$\frac{235 * 348}{3700} = 22$
	Business and Economics	209	$\frac{209 * 348}{3700} = 20$
	Education and Behavioral science	107	$\frac{107 * 348}{3700} = 10$
	Natural Science	222	$\frac{222 * 348}{3700} = 21$
	Social Sciences and Humanities	236	$\frac{236 * 348}{3700} = 22$
	Jimma Institute of Technology	1116	$\frac{1116 * 348}{3700} = 105$
	Law and Governance	72	$\frac{72 * 348}{3700} = 7$
	Institute of Health Science	952	$\frac{952 * 348}{3700} = 89$
Adama Science and Technology University	School of Civil Engineering and Architecture	102	$\frac{102 * 348}{3700} = 10$
	School of Mechanical, Chemical and Material engineering	181	$\frac{181 * 348}{3700} = 17$
	School of Electrical Engineering and computing	146	$\frac{146 * 348}{3700} = 14$
	School of Applied Natural Science	122	$\frac{122 * 348}{3700} = 11$

In this study, purposive and simple random sample were employed to select the study sample. Purposive sampling was used to select library professional for interview whereas simple random sampling was used to select samples from postgraduate students of the two public universities

3.5 Data collection instruments

There are different types of data collection methods used for research studies. The selection of the data collection methods depend on the research objective and research design. Data collection was done by questionnaire, interview and observation in order to achieve the objective of the study. Fixed alternative questionnaire method was used to collect data from the postgraduate students. The researcher used Likert – type items to ask the respondents to respond to statements by choosing “strongly disagree” (scored a”1”), “disagree” (scored a “2”), “neutral” (scored a”3”), agree (scored a”4”) and “strongly agree” (scored a”5”) or “strongly dissatisfied” (scored a”1”), “dissatisfied” (scored a “2”), “neutral” (scored a”3”), “satisfied” (scored a”4”) and “strongly satisfied” (scored a”5”). The semi-standardized face-to-face interview method was used to collect data that could not be directly observed. The wording of the questions was flexible, the level of the language may be modified, and the interview may choose to answer questions and to provide further explanation if requested. Respondents have a greater ability to express their opinions in their own words when using this type of interview structure. Observation was conducted based on the checklist prepared for the study.

3.5.1 Questionnaire

In order to meet the objectives of the study, questionnaire was used as one of the data collection instruments. Questionnaires were administered to postgraduate students in the two universities (JU and ASTU). The questionnaire is divided in two sections; the first section was aimed at gathering the demographic information of the respondents. The second section addressed various themes in the background and objectives of the study. The questionnaire also incorporates both closed ended item and few open ended item that gives an opportunity to insight their feeling and belief freely. Data distributors and collectors were recruited by researcher in each university. The questionnaires were adapted from previous related research and individual questions formulated by the researcher and approved by advisors.

3.5.2 Interview

Interview is one of the commonly used instruments for collecting data. Kothari (2004) and Koul (2006) explained it as a method of collecting data through oral communication (verbally). This method was employed in the study to acquire qualitative data about usability evaluation of digital library services in public higher learning institutions and obtain relevant data that was not handled by the questionnaire were carried out. The interviewees were selected based on the willing they have to participate. The researcher was conducted an interview with directors of the university libraries, ICT team leaders and heads of digital library namely, six interviewees from JU and ASTU libraries.

3.5.3 Observation

Mullings (1984) stated that Observation is a way of collecting data in a purposeful and systematic manner about the behavior of an individual or a group of people at a specific time and place. Observation studies events as they actually occur and also what people do rather than what they say. Observation can also be used to study both users and usage. Observation data were used to describe the activities, subjects, and the meaning of the observations from the observer's perspective. Such data were needed as a supplement to verify the information provided in the questionnaires. The researcher carried out the observation activities in the two selected public universities based on the checklist prepared based on related literature review. The main points incorporated under the check list were ICT infrastructure for the services, internet speed, access locations for the services, mechanism for evaluating usability of digital library services and the availability of awareness services.

3.6 Source of data

In this study the researcher used primary and secondary source of data. Primary source of data recognized as data collected for a specific research in response to a particular problem using questionnaire and interview. It gives high opportunity to organize firsthand information from postgraduate students. Additional data were obtained from secondary sources such as articles and previous conducted researches were acquired.

3.7 Data Collection Procedure

The main instruments used to collect data were questionnaire, interview and observation. The preparation of questionnaire strictly performed based on suitable and very important questions modified from related research. The well developed questionnaire was approved by the advisors for further research process. To go to the universities where respondents exist, the researcher asked official letter from information science department for faithful cooperation of the universities. Finally, the letter was submitted to JU and ASTU academic vice presidents registrar offices and then to colleges and departments.

3.8 The Study Variables

The researchable title must incorporate dependent and independent variables. Dependent variable is a variable that is affected or explained by another variable whereas independent variable is a variable that cause change in other dependent variable (Jabar et al., 2013). In this study the dependent variable is usability of digital library services. The independent variables were focused on usability evaluation criteria such as efficiency, effectiveness, learnability, comfortable, user-friendly, error privation, currency, memorability, timesaving and ecstatic. They serve as a guide line for usability evaluation of digital library services.

3.9 Pilot test data collection instruments

The purpose of a pre-test exercise was to test reliability and validity of the data collection instruments Reliability is the extent to which a procedure yields the same answer time after time In testing reliability, the researcher was interested in knowing if the instruments bring consistency for the research. Bernard (2011) stated that validity refers to the accuracy and trustworthiness in terms of the instruments used for research, data and findings. Validity analysis for instruments conducted based on pilot study.

Pilot study is an activity which is done before starting actual data collection. It was done to test the questionnaire and geared towards establishing whether the questions were clear, appropriate, etc. In the pilot study 10% or 30 postgraduate students those were representative of the sample population from JU and ASTU participated. The original questionnaire distributed for pilot study and finally the researcher made a correction based on the feedbacks of the respondents of the pilot study. At the end of all activities completed related to pilot test. Finally, questionnaires distribute for target sample population in the two universities.

3.10 Data Quality Control

From the very beginning data collectors were seriously selected and short orientation on data collecting was given. The orientation mainly focused on the overview and techniques of data collecting process. Discussion and sharing experience was made to get input that strengthen data collecting process and made necessary adjustments. Completeness and consistency were checked at the site when data collecting conducted regularly and continuously by the researcher.

Generally, all the necessary activities were proved before data analysis to increase the validity of the research.

3.11 Methods of Data Analysis

Data analysis is the process of bringing order, structure and meaning to the mass of collected data. After the required amount of data was received from the field, it was reviewed for any inconsistencies. The data was analyzed using statistical software, SPSS version 20 and both descriptive and inferential statistics (model summary, ANOVA, and coefficient) were done. The researcher has classified, analyzes, interpret the output before the complete meaning of the study was given. Then, the data was described using percentage, frequency distributions, mean, figure, tables and a summary report developed. For qualitative data, the relevant data also obtained through interview and observation. The written interview notes identified, narrated and summary report developed. The data which was also collected by observation based on the checklist organized the results in a purposeful and systematic manner.

3.12 Ethical considerations

Ethical consideration is a critical issue for both the researcher and respondents. All activities of this study concerning the objective, purpose and benefit were specified to the study population. The full cooperation and oral consent of the study participants were taken. The researcher motivated the respondents to feel free and express their ideas without any internal and external pressure. To keep the validity and reliability the researcher avoid jargon words, confusing and ambiguous questions.

Generally, in this chapter proper research design and approaches those are appropriate for the study selected and identified. The correct sample size was correctly calculated and sample size determination performed based on the existing current formula. Activities for data quality

control, method used for data analysis and study variables of the research organized and clearly explained.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Results

This chapter focused on results, analysis and interpretation that reached to discussion of the findings. Under the results of the study response rate, socio demographic information such as gender, age, educational status, internet browsing experience of respondents, distribution of respondents over the two public universities, questionnaires distributed and analysis of questionnaires, interview and observation regarding the usability evaluation of digital library services consecutively presented. Additionally, descriptive statistics on study variables were summarized in percent, mean, and standard deviation. The results of inferential statistics were also presented in Tables showing the regression results as: model summary, coefficient and ANOVA

4.1.1 Response rate

The researcher hoped to consider responses from 348 respondents and hence gave out 348 questionnaires as explained in the sampling framework in the third chapter of this study. However, due to some none and incomplete responses, only 296 responded to the questionnaires. Among the 348 distributed questionnaires, 5 questionnaires from ASTU respondents and 47 questionnaires from JU respondents were not returned. These number shows that 85 percent of the questionnaires filled and returned. According to Luutu (2015) who argues that response rates of 60 percent or more are regarded acceptable for research studies. This implies that the response rate for this research was adequate and appropriate for analysis of this particular study. Table 4.4 below shows the participation level of respondents or summary of the response rate from these two universities

Table 4.1: Response rates of samples

No	Name of public higher learning institutions	Number of Questionnaires		
		Distributed	Collected	Percentage
1	ASTU	52	48	92%
2	JU	296	248	84%
Total		348	296	85%

4.1.2 Socio Demographic information

This section provides the socio-demographic characteristics of the respondents that include distribution of the respondents, gender, age, educational status and experience of internet browsing. The demographic results in this study included the following:

4.1.2.1 Distribution of respondents over the two public universities

The total number of respondents in the two public universities is 296. Out of this 48 respondents were from ASTU whereas 248 respondents were from JU.

Table 4.2: Distribution of respondents over the two public universities

	Frequency	Percent	Cumulative Percent
Valid JU	248	83.8	83.8
ASTU	48	16.21	100
Total	296	100.0	

Table 4.2 above shows that among the 296 respondents, 248 (82.4%) of the respondents were from Jimma university whereas 48(17.6%) of the respondents were from Adama Science and Technology university. In Jimma University, the number of postgraduate students those attend in teaching learning activities in the existing year is greater than Adama Science and Technology University. The capacity of each University to accept the students' enrolled in the academic activities brought a difference

4.1.2.2 Gender of the respondents

The study gave a chance to the respondents to state their gender in the questionnaires and the result summarized in Table 4.3 below

Table4. 3: Gender of the respondents

	Frequency	Percent	Cumulative Percent
Valid Male	252	85.1	85.1
Female	44	14.9	100.0
Total	296	100.0	

This study intended to consider the perceptions and views of both males and females. the appreciation of reality may differ depending on the respondent`s sex. The finding depicted as showed in Table 4.6 above, indicated that 44(14.9%) of the respondents were involved in the study whereas male respondents participated in the study were 252 (85.1%). This implies that majority of the respondents were male, a fairly true reflection of Ethiopia public universities.

4.1.2.3 Age of respondents

The study gave a chance to respondents to select their appropriate age in the questionnaire and the result summarized in Table 4.4 below

Table 4.4: Age of the respondents

Age	Frequenc y	Valid Percent	Cumulative Percent
18-23	46	15.5	15.5
24-29	150	50.7	66.2
30-35	59	19.9	86.1
36-41	27	9.1	95.3
> 41	14	4.7	100.0
Total	296	100.0	

According to the data obtained and as depicted in Table 4.4 above, the age range of the study participants was 150(50.7%) for 24-29, 59(19.9%) for 30-35, 46(15.5%) for 18-23, 27(9.1%) for

36-41, and 14(4.7%) for above 41 years old. Majority of the respondents were at the age 24-29. This shows that public higher learning institutions were giving an opportunity of postgraduate program at the preferable age of students. It also shows that a vast majority of research scholars belong to the specified age group

4.1.2.4 Educational status of respondents

The researcher sought to establish the educational status of the respondents about their highest education attainment in terms of the conventional public higher learning institutions structure in Ethiopia. This was done because it was presumed that the education qualification could inform knowledge on the subject of study

Table 4.5: Educational status of respondents

Status	Frequency	Percent	Cumulative Percent
Valid Master's degree	255	86.1	86.1
Doctoral degree	41	13.9	100.0
Total	296	100.0	

According to Table 4.5 above, majority of the respondents 255 (86.1%) were master's students while 41 (13.9%) of the respondents were doctoral candidates. This implies that public higher learning institutions were given more attention to train students in master's degree rather than doctoral degree. Highly educated and trained students perform tasks within their professional competence.

4.1.2.5 Internet using experience

The responses collected from postgraduate students in the two selected public universities concerning internet browsing experience was stated in the table 4.6 below as follows:

Table 4.6: Experience of the respondents

	Frequency	Percent	Cumulative Percent
Valid 1-2 years	59	19.9	19.9
3-5 years	106	35.8	55.7
Over 5 years	131	44.3	100.0
Total	296	100.0	

As depicted in Table 4.6 above, majority of the respondents 131(44.3%) have more than five years of experiences, 106(35.8) respondents have 3-5 years and 59(19.9%) respondents have 1-2 years of experiences. This finding implies that majority of respondents can easily access digital library services through internet because they have over 5 years of experience.

4.2 Reliability test

Reliability is most commonly used when the researcher want to assess the internal consistency of instruments. Cronbach's Alpha coefficient was used to test the reliability of the questionnaire. The point 0.7 was adopted which recommended by Young (2003) for the reliability test. The questionnaires which prepared for this research subjected to Cronbach's alpha that helps to establish internal consistency how the items correlate among themselves.

Table 4.7: Reliability test

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Evaluation criteria	.816	.825	21
Services used most often	.790	.836	6
Methods used	.873	.884	5
Access locations	.730	.732	4

According to Table 4.7 above shows that, the value of variables shows the value above 0.730. Zikmund & Babin (2010) stated that, if the Cronbach's alpha coefficient shows value equals or over than 0.6, the measure is accepted and fair measure. Therefore, it is concluded that the instruments have a very good level of reliability.

4.3 Quantitative study result

Descriptive statistics was used to summarize and describe the respondents' perceptions regarding their degree of agreement or disagreement and degree of satisfaction and dissatisfaction on the usability of digital library services at selected public universities of Ethiopia. To analyze the results, the researcher considered the percentage corresponding to the mean (M) and the standard deviation (SD) of the scale for analysis respectively. To interpret the five Likert's scale, the researcher adopted from Alston and Miller (2002) and Mohammad *et al.* (2014), they allocated the value as follow: 1.0- 1.49 Strongly Disagree, 1.5-2.49 Disagree, 2.5-3.49 Neutral, 3.5-4.49 Agree and 4.5-5 Strongly Agree.

4.3.1: Places where students access digital library resources

Accessing digital library services at the right place effectively plays a great role in teaching and learning process, research and academic activities of public higher learning institutions

Table 4.8: Access locations

Indicators	Frequency and Percent					Central tendency		Dec
	SDA F (%)	DA F (%)	N F (%)	A F (%)	SA F (%)	X	SD	
Libraries	25 (8.4)	66 (22.3)	9 (3)	114 (38.5)	82 (27.7)	3.56	1.53	A
Computer Laboratories.	12 (4.1)	28 (9.5)	24 (8.1)	155 (52.4)	77 (26)	3.62	1.47	A
Places Where access points are available	23 (7.8)	162 (54.7)	29 (9.7)	36 (12.2)	46 (15.5)	2.46	1.34	DA

Out of campus(home)	15 (5.1)	133 (44.9)	16 (5.4)	35 (11.8)	97 (32.8)	2.06	1.60	DA
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The descriptive statistics in Table 4.8 above shows that the respondents were agreed on the statements “libraries and computer labs” with (mean=3.56 and 3.62) respectively. Additionally, the respondents were disagreed on the statements “places where access points are available and out of the campus” with (mean=2.46 and mean=2.06) respectively. This implies that majority of the respondents were used digital library resources for research, and academic activities in the two restricted places “libraries and computer labs”. On the other way, respondents were not access the resources out of the campus where they lived. Access and retrieval of e-resources are ineffective due to the limited access places.

4.3.2 Methods used by users to know about the usage of digital library

In a dynamic digital library environment current awareness service which is conducted by public universities of Ethiopia sustains users to get the overall knowledge about the usage of digital library services. Table 4.12, below summarizes the methods used by users to know about the usage of DLSs.

Table 4.9: Methods used by users

Indicators	Frequency and Percent					Central tendency		Dec.
	SDA F(%)	DA F(%)	N F (%)	A F(%)	SA F(%)	X	SD	
Library orientation program	171 (57.8)	30 (10.1)	32 (10.8)	35 (11.8)	28 (9.5)	1.39	1.24	SDA
University’s website	16 (5.4)	25 (8.4)	21 (7.1)	174 (58.8)	60 (20.3)	3.58	1.33	A
Senior students	20 (6.8)	28 (9.5)	21 (7.1)	169 (57.1)	58 (19.6)	3.62	1.33	A

Instructors	28 (9.5)	95 (32.1)	47 (15.9)	59 (19.9)	67 (22.6)	2.01	2.02	SA
User education (workshop, training)	136 (45.9)	50 (16.9)	33 (11.1)	51 (17.2)	26 (8.8)	1.55	1.30	SDA

SA(5)= strongly agree, A(4)=agree, N(3)= neutral, DA(2)= disagree, SDA(1)=strongly disagree

The descriptive statistics in Table 4.9 above shows that the respondents of the two public universities were agreed on the statements “University’s website” and “Senior students” with (mean=3.58 and mean=3.62) respectively. According to the respondents response rate, the respondents were strongly disagree on the statements “library orientation program” and “User education” with (mean = 1.39 and mean = 1.55) respectively. In addition at the mean of 2.46 percent the respondent were disagreed on the statement “Instructors” method. The result justify that few of the methods used by respondents to aware themselves on digital library services. “Library orientation program” and “user education” can play a significant role to aware the respondents on the usage of digital library services but these were not applied. It creates ignorance of the services.

4.3.3 Digital library services used by users most often

Digital library services used different knowledge classification covenant to users to easily access electronic data in the form of text, audio and video. Table 4.12: below shows that digital library services utilize or exploit by users most often.

Table 4.10: Services used most often

Indicators	Frequency and Percent					Central tendency		Dec
	SDA F(%)	DA F(%)	N F (%)	A F(%)	SA F(%)	X	SD	
OPAC service	55 (18.6)	98 (33.1)	26 (8.8)	59 (19.9)	58 (19.6)	2.28	1.6	DA

E- resources service	36 (12.2)	27 (9.1)	21 (7)	137 (46.2)	75 (25.3)	3.68	1.76	A
Institutional repository service	50 (16.9)	110 (37.2)	26 (8.8)	67 (22.6)	43 (22.6)	2.36	1.51	DA
Dspace or Green stone digital library service	19 (6.4)	32 (10.8)	14 (4.7)	195 (65.9)	36 (12.2)	3.54	1.20	A
eGranary digital library service	188 (63.5)	98 (33.1)	10 (3.4)	0	0	1.33	.473	SDA

SA(5)= strongly agree, A(4)=agree, N(3)= neutral, DA(2)= disagree, SDA(1)=strongly disagree

The descriptive statics in Table 4.10 above shows that the respondents of the two public universities were disagreed on the digital library services “OPAC” and “Institutional Repository” with (mean=2.28 and mean=2.36) respectively. According to the respondents response rate, the respondents were also agreed on the digital library services “E-resources” (subscribed journals, open access journals, databases) and “Dspace or “Greenstone” digital library with (mean=3.68 and mean= 3.54) respectively. In the other hand, the respondents were strongly disagree on “eGranary” digital library service with mean=1.33 percent. The finding depicted that the two digital library services “E-resources” and “Dspace or Greenstone” digital library services were used by respondents most often for research and academic activities. Additionally, “OPAC” and “Institutional Repository” services were not used by respondents most often. In the other way, “eGranary” digital library service which is available in JU is un-functional.

4.3.4 Usability evaluation criteria

Usability evaluation criteria plays a great role in assessing how users react to and interact with the system and in allowing users to express personal perception towards electronic information resources and services. The researcher used the widely applied user-centered or human- centered approach. Saracevic (2004) stated that human- centered involves study of behavior in respect to given information needs, such as information seeking, browsing, searching or performance in completion of given tasks, either predetermined or observed in natural settings used in a number

of studies that illuminated human behavior, requirements, needs, or difficulties encountered. The study used the following usability evaluation criteria.

4.3.4.1 Efficiency, Effectiveness and Learn ability of digital library

The attributes of digital library usability such as efficiency, effectiveness and learnability are used as criteria for usability evaluation of digital library services. These criteria mainly focused in evaluating the time taken to search the DLSs, success rate and user interaction.

Table 4.11: Efficiency, Effectiveness and Learn ability of digital library

Indicators and items	Item Code	Respondents' level of satisfaction					Central tendency		Dec
		SDS	DS	N	S	SS	X	SD	
		F(%)	F(%)	F (%)	F(%)	F(%)			
Efficiency In accessing digital library services, the system responds quickly to complete a resource finding take without delay.	EFY1	21 (7.09)	115 (38.85)	53 (17.9)	65 (21.95)	42 (14.18)	2.30	1.66	DS
The digital library services' interface is well designed to find what I want	EFY2	16 (5.4)	125 (42.22)	47 (15.87)	57 (19.25)	51 (17.22)	2.39	1.24	DS

<p>Effectiveness</p> <p>I can usually complete a search task using the digital library services</p>	EFT1	32 (10.81)	131 (44.25)	41 (13.85)	43 (14.52)	49 (16.55)	2.40	1.60	DS
	EFT2	22 (7.43)	105 (35.47)	62 (20.94)	68 (22.97)	39 (13.17)	2.36	1.70	DS
<p>Learnability</p> <p>The digital library services' interface provides appropriate help functions.</p> <p>The terminologies used on the digital library services were easily understandable</p> <p>It was able to access easily what I wanted the first time I began to use the digital library services.</p>	LRN1	16 (5.4)	24 (8.1)	27 (9.12)	144 (48.64)	85 (28.71)	3.76	1.55	S
	LRN2	18 (6.08)	16 (5.4)	21 (7.09)	182 (61.48)	59 (19.93)	3.82	1.40	S
	LRN3	19 (6.41)	166 (56.08)	30 (10.13)	35 (11.82)	46 (15.54)	2.49	1.46	DS

SS(5)= strongly satisfied, A(4)=Satisfied, N(3)= neutral, DS (2)= dissatisfied, SDS(1)=strongly dissatisfied

The descriptive statistics in Table 4.11, above shows that majority of the respondents were dissatisfied on the statements “In accessing digital library services, the system responds quickly to complete a resource finding task without delay.” and “The digital library services’ interface is well designed to find what I want” with (mean=2.30 and mean=2.39) respectively. Additionally, the respondents were also dissatisfied on the statements “I can usually complete a search task using the digital library services” and “I am successful in general in finding resources using digital library services” with (mean=2.40 and mean=2.36) respectively. Additionally, the respondents were satisfied on the statements “The digital library services’ interface provides appropriate help functions” and “The terminologies used on the digital library services were easily understandable” with (mean=3.76 and mean=3.82) respectively. On the other hand, the respondents were dissatisfied on the item code “It was able to access easily what I wanted the first time I began to use the digital library services.” with the mean of 2.49 percent. The result implies that majority of the respondents’ perception is dissatisfied with the respond time of the system, interface design, and a resource finding task. This affects the research and academic activities and the need for electronic information of respondents.. Additionally, majority of the respondents’ perception is is very high and satisfied with the availability of help function and the terminologies used on the interface of each digital library services. This support or strengthen the participation of respondents in teaching learning process which conducted in the universities

.4.3.4.2 User-friendly, Comfortable and Currency of digital library

The usability evaluation criteria user-friendly, comfortable and currency are used to evaluate the role of the services in minimizing the effort and maximizing the result of postgraduate students, comfort ability, and in accessing up-to-date electronic information

Table 4.12: User-friendly, Comfortable and Currency of digital library

Indicators	Code	Respondents' level of satisfaction					Central tendency		Dec.
		SDS F(%)	DS F(%)	N F (%)	S F(%)	SS F(%)	X	SD	
User- friendly It gives me results according to my desired search	USF1	19 (6.41)	132 (44.59)	93 (31.41)	17 (5.74)	35 (11.82)	2.46	1.41	DS
	USF2	13 (4.39)	25 (8.44)	19 (6.41)	187 (63.17)	52 (17.56)	3.89	1.34	S
Minimize my effort and maximize my result	USF1	19 (6.41)	132 (44.59)	93 (31.41)	17 (5.74)	35 (11.82)	2.46	1.41	DS
	USF2	13 (4.39)	25 (8.44)	19 (6.41)	187 (63.17)	52 (17.56)	3.89	1.34	S
Comfortable I do not need any guideline to use this system	COMF1	33 (11.14)	115 (38.85)	44 (14.86)	61 (20.6)	43 (14.52)	2.39	1.62	DS
	COM2	11 (3.71)	12 (4.05)	33 (11.14)	192 (64.86)	48 (16.21)	3.91	1.49	S
No irritating points and complexities or errors while I am searching the digital library services	COMF1	33 (11.14)	115 (38.85)	44 (14.86)	61 (20.6)	43 (14.52)	2.39	1.62	DS
	COM2	11 (3.71)	12 (4.05)	33 (11.14)	192 (64.86)	48 (16.21)	3.91	1.49	S
Currency Information is sufficiently up-to-date for your task	CUR1	21 (7.09)	140 (47.29)	47 (15.87)	35 (11.82)	48 (16.21)	2.49	1.60	DS
	CUR2	14 (4.72)	40 (13.51)	53 (17.9)	139 (46.95)	55 (18.58)	3.60	1.77	S
Information you retrieved is valid	CUR2	14 (4.72)	40 (13.51)	53 (17.9)	139 (46.95)	55 (18.58)	3.60	1.77	S

SS(5)= strongly satisfied, A(4)=Satisfied, N(3)= neutral, DS (2)= dissatisfied, SDS(1)=strongly dissatisfied

According to the descriptive statistics in Table 4.12 above shows that majority of the respondents were dissatisfied on the statements “It gives me results according to my desired search”, and

“Information is sufficiently up-to-date for your task” with (mean=2.46, mean=2.39 and mean=2.49) respectively. Additionally, the respondents were satisfied on the statements” Minimize my effort and maximize my result”, “No irritating points and complexities or errors while I am searching the digital library services” and “Information you retrieved is valid” with (mean=3.89, mean=3.91 and mean=3.60) respectively. This shows that it was difficult for respondents to get positive and valid feedback based on their desired search and to access current electronic information. The perception of respondents is low and the services are ineffective in this area. In the other way majority of the respondents were satisfied by the digital library services in minimizing the effort and maximizing the result of respondents. This increases the perception, academic and research activities and satisfaction of respondents.

4.3.4.3 Timesaving, Memo ability, Reliability, Error prevention and Aesthetic of digital library

The evaluation criteria timesaving, memorability, reliability, error prevention and aesthetic are used to evaluate the time lost in searching the digital library services, the attractiveness of the interface and whether or not the electronic resource is accepted by postgraduate students

Table 4.13: Timesaving, Memorability, Reliability, Error prevention and Aesthetic of digital library

Indicators and items	Code	Respondents' level of satisfaction					Central tendency		Dec.
		SDS F(%)	DS F(%))	N F (%)	S F(%)	SS F(%)	X	SD	
Timesaving It is time saving when I am using or searching for resources	TIMS1	12 (4.05)	28 (9.45)	33 (11.4)	146 (49.32)	77 (26.01)	3.70	1.59	S
Memorability It is capable to easily remember how to use the system after not using it for some period	MEM1	16 (5.4)	107 (36.14)	58 (19.59)	66 (22.29)	49 (16.55)	2.39	1.96	DS
Reliability All digital library services are acceptable	REL1	23 (7.77)	16 (5.4)	21 (7.09)	189 (63.85)	47 (15.87)	3.86	1.41	S

and gave me information according to my need and put to further use									
The ability of digital library services to perform and maintain its function under different circumstances	REL2	43 (14.52)	56 (18.91)	115 (38.85)	43 (14.52)	39 (13.17)	3.32	1.84	N
Error prevention The digital library services or the system shows positive feedback at every step	ERRP1	18 (6.08)	114 (38.51)	31 (10.47)	98 (33.1)	35 (11.82)	2.40	1.52	DS
The system which access digital library services have low error rate	ERRP2	35 (11.82)	44 (14.86)	33 (11.14)	152 (51.35)	32 (10.81)	3.78	1.27	S
Aesthetic Text type and font sized are engaging and readable	AES1	12 (4.05)	71 (23.98)	30 (10.13)	115 (38.85)	68 (22.97)	3.54	1.23	S
The interface of digital library services are visually attractive	AES2	42 (14.18)	49 (16.55)	42 (14.18)	132 (44.59)	31 (10.47)	3.61	1.80	S

SS(5)= strongly satisfied, A(4)=Satisfied, N(3)= neutral, DS (2)= dissatisfied, SDS(1)=strongly dissatisfied

The descriptive statistics in Table 4.13, above shows that majority of the respondents were satisfied on the statements “It is time saving when I am using or searching for electronic resources”, “All digital library services are acceptable and gave me information according to my need and put to further use”, “The system which access digital library services have low error rate”, “Text type and font sized are engaging and readable” and “The interface of digital library services are visually attractive” with (mean=3.70, mean=3.86, mean=3.78, mean=3.54, and mean=3.61) respectively. According to the respondents’ response rate, the respondents were dissatisfied on the statements “The digital library services or the system shows positive feedback at every step.” and “It is capable to easily remember how to use the system after not using it for

some period” with (mean=2.40 and mean=2.39) respectively. Additionally, majority of the respondents were undecided on the statement “The ability of digital library services to perform and maintain its function under different circumstances’ with mean=3.32 percent. This implies that all digital library services were acceptable by the respondents and their interfaces were attractive. The digital library services were also save the time spent in searching for e-resources. The text type and font size applied on the interface easily readable for respondents. On the other hand, the system sometimes shows negative feedback and users were faced a problem on accessing the services after not using for some period.

4.3.5 Usability evaluation criteria overall satisfaction level

Usability evaluation criteria were prepared to evaluate usability activities at its highest level that incorporates efficiency effectiveness learn ability user-friendly comfortable currency timesaving memorability reliability error prevention and aesthetic with their respective item indicators.

Table 4.14: The overall satisfaction level

Indicators	Item indicators	Respondents’ level of satisfaction					Central tendency		Dec .
		SDS F(%)	DS F(%)	N F (%)	S F(%)	SS F(%)	X	SD	
Efficiency	2 (EFY1, EFY2)	19 (6.2)	120 (40.5)	50 (16.9)	51 (20.6)	47 (15.7)	2.34	1.45	DS
Effectiveness	2 (EFT1, EFT2)	27 (9.1)	118 (39.9)	51 (17.39)	56 (18.6)	44 (14.9)	2.38	1.65	DS
Learn ability	3 (LRN1, LRN2, LRN3)	18 (6)	69 (23.2)	26 (8.8)	120 (40.6)	63 (21.4)	3.35	1.47	S
User- friendly.	2 (USF1, USF2)	16 (5.4)	79 (26.5)	56 (18.9)	102 (34.5)	43 (14.7)	3.17	1.37	S

Comfortable	2 (COM1, COM2)	22 (7.4)	64 (21.5)	39 (13)	127 (42.7)	46 (15.4)	3.15	1.56	S
Currency	2 (CUR1, CUR2)	18 (5.9)	90 (30.4)	50 (16.9)	87 (29.4)	52 (17.4)	3.25	1.68	DS
Timesaving	1 (TIMS1)	12 (4.1)	28 (9.5)	33 (11.4)	146 (49.3)	77 (26.0)	3.70	1.59	S
Memorability	1(MEMO1)	16 (5.4)	107 (36.1)	58 (19.6)	66 (22.3)	49 (16.6)	2.39	1.96	DS
Reliability	2 (REL1, REL2)	33 (11.1)	36 (12.2)	68 (23)	116 (39.2)	43 (14.5)	3.59	1.62	S
Error prevention	2 (ERRP1, ERRP2)	26 (9)	79 (26.7)	32 (10.8)	125 (42.2)	34 (11.3)	3.09	1.66	S
Aesthetic	2 (AES1, AES2)	27 (9.1)	60 (20.3)	36 (12.2)	124 (41.7)	49 (16.7)	3.57	1.72	S
Overall Usability		7.15%	26.05%	15.37%	34.66%	16.77%	3.16	1.61	S

SS(5)= strongly satisfied, A(4)=Satisfied, N(3)= neutral, DS (2)= dissatisfied, SDS(1)=strongly dissatisfied

The descriptive statistics in Table 4.14 above shows that majority of the respondents were satisfied on the indicators learnability, user friendly, comfortable and time saving of the services with (mean=3.35, mean= 3.17, mean=3.15, and mean=3.70) respectively. Additionally, the respondents were also satisfied on the indicators reliability, error prevention, and aesthetic of the services with (mean=3.5, mean=3.09 and mean=3.57) respectively. In the other way majority of the respondents were dissatisfied on the indicators efficiency, effectiveness, currency and Memorability of the services with (mean=2.34, mean=2.38, and mean=2.39) respectively. This implies that the over satisfaction of respondents regarding efficiency, effectiveness, currency, and Memorability of digital library services is dissatisfied. All services are ineffective in supporting

the academic and research activities of respondents. In the other way, the overall satisfaction of respondents regarding learn ability, user-friendly, comfortable, timesaving, reliability, error prevention and aesthetic of digital library services is satisfied. This implies that the research and academic activities of respondents supported by the services. The summary of usability evaluation criteria overall satisfaction level showed in graphical representation in figure 4 below.

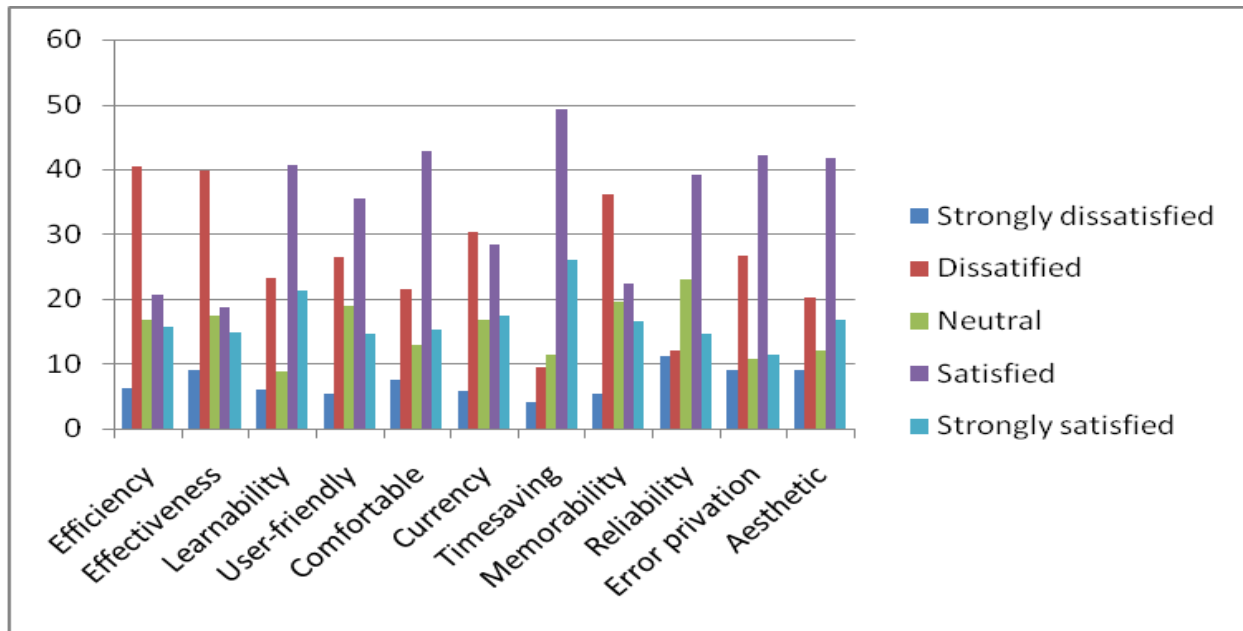


Figure 4.1: Graph of the overall satisfaction level

The study sought to find out usability evaluation criteria overall satisfaction level of respondents. Summary of the findings were indicated in figure 5, above. The majority of respondents were satisfied on learnability, user-friendly, and comfortable with 40.64%, 34.45%, and 42.73% respectively. Similarly, the respondents were also satisfied on time saving, reliability, error prevention and aesthetic of the services with 49.32%, 39.18%, 42.22% and 41.72% respectively. In the other way, majority of the respondents were dissatisfied on the usability evaluation criteria, efficiency, effectiveness, currency and memorability with 40.53%, 39.86%, 30.4% and 36.14% respectively. This shows that that the overall satisfaction level of respondents regarding efficiency, effectiveness, currency, and memorability of digital library services is dissatisfied whereas regarding learnability, user-friendly, comfortable, timesaving, reliability, error prevention and aesthetic of digital library services is satisfied.

4.3.6 Overall usability evaluation

The overall usability evaluation satisfaction level showed in graphical representation, below

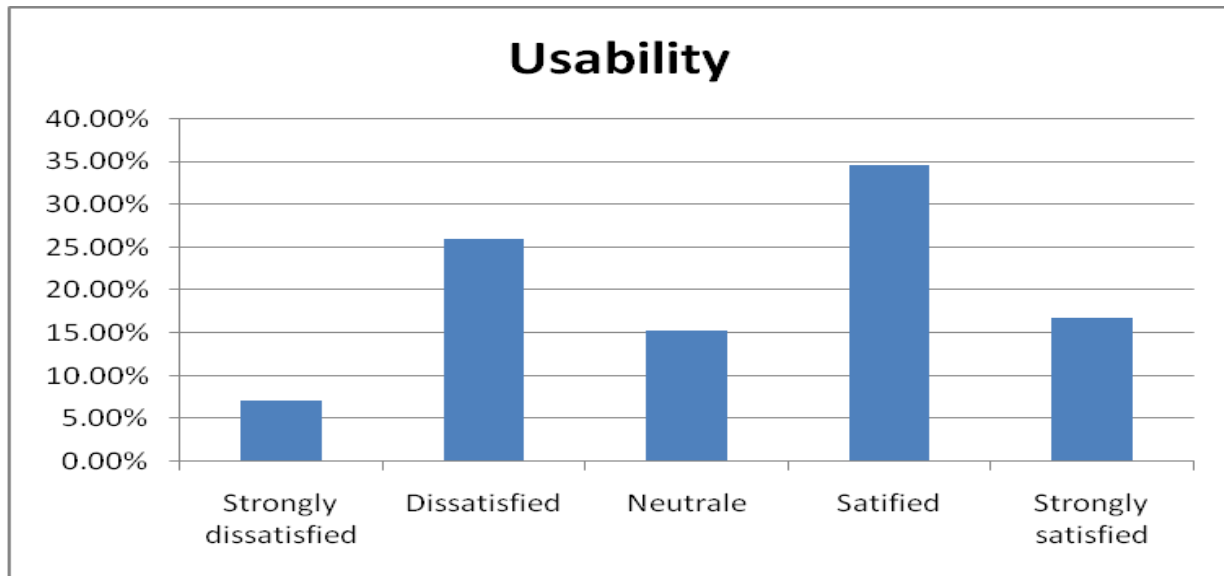


Figure 4.2: Graph of the overall usability

According to figure 5, above the overall usability of digital library services were satisfied and dissatisfied with 34.66%, and 26.05% percent respectively. Additionally, the respondents were strongly dissatisfied, strongly satisfied and undecided with (7.15% and 16.77%, and 15.37%) respectively. The overall usability of the digital library services is satisfied. This shows that the services are effective in supporting the research and academic activities of respondents.

4.3.7. Challenges of digital library services

The respondents of JU and the digital library services available in this public university faced with different challenges showed in Table 1.15 below.

Table4.15: Challenges

Indicators	Frequency and Percent					Central tendency		Dec
	SDA F(%)	DA F(%)	N F (%)	A F(%)	SA F(%)	X	SD	
There is inadequate number of computers	185 (62.5)	33 (11.1)	30 (10.1)	23 (7.8)	25 (8.4)	1.91	1.24	SDA
Power failure	21 (7.1)	26 (8.8)	17 (5.7)	174 (58.8)	58 (19.6)	3.57	1.31	A
Lack of time	25 (8.4)	40 (13.5)	118 (39.9)	36 (12.2)	77 (26)	2.37	1.83	N
Slow internet speed	27 (9.1)	39 (13.2)	19 (6.4)	161 (54.4)	50 (16.9)	3.71	1.70	A
Lack of user education	28 (9.5)	39 (13.2)	20 (6.8)	136 (45.9)	73 (24.7)	3.61	1.47	A
Lack of technical support	15 (5.1)	14 (4.7)	13 (4.4)	37 (12.5)	217 (73.3)	4.03	1.27	SA
There is no federated service for digital library services	18 (8.4)	24 (8.1)	26 (8.8)	179 (60.4)	42 (14.2)	3.55	1.40	A

SS(5)= strongly satisfied, A(4)=Satisfied, N(3)= neutral, DS (2)= dissatisfied, SDS(1)= strongly dissatisfied

The descriptive statistics in Table 4.15 above shows that the respondents of the two public universities were agreed and strongly agreed on the statements “power failure”, “slow internet speed”, “lack of user education”, “lack of technical support” and “unavailable of federated service with (mean=3.57, mean=3.71, mean=3.61, mean=3.55 and mean=4.03 respectively.

Additionally, the respondents were strongly disagreed and neutral on the statements “There is inadequate number of computers” and “Lack of time” with (mean=1.91 and mean=2.37) respectively. The finding shows that the digital library services available in these two public universities and respondents were faced with a lot of problems which emanates from power failure, internet speed, user education, technical support and unavailable of federated service. This brings an influence on academic and research activities of respondents. On the other way, there is adequate number of computers and respondents have enough time for using the services

4.3.9. Regression result

The study aimed to establish the effect of evaluation criteria on usability of digital library services. The factor analysis played an important role in this study. It was also valuable in extracting six factors: efficiency, effectiveness, learnability, user-friendly, reliability and aesthetic. The internal consistency within the collected data and test for reliability, the existence of significant relationship between independent and dependent variable explained with model summary, ANOVA and coefficient in table below

Table 4.16: Regression results

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.751 ^a	.565	.556	.863

a. Predictors: (Constant), Efficiency, Aesthetics, Learnability, Reliability, Effectiveness, User friendly

b. Dependent Variable: Usability

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	279.399	6	46.567	62.468	.000 ^b
	Residual	215.435	289	.745		
	Total	494.834	295			

a. Dependent Variable: Usability

b. Predictors: (Constant), Efficiency, Aesthetics, Learnability, Reliability, effectiveness and User friendly

Coefficients^s

Model	Un standardized		Standardized	t	Sig.	
	Coefficients		Coefficients			
	B	Std. Error	Beta			
1	(Constant)	-.232	.212		-1.093	.275
	Effectiveness	.124	.050	.146	2.468	.014
	Learnability	.142	.052	.123	2.753	.006
	Reliability	.187	.069	.133	2.708	.007
	Aesthetics	1.367	.141	.405	9.720	.000
	User friendly	.140	.060	.143	2.342	.020
	Efficiency	.098	.054	.104	1.800	.073

a. Dependent Variable: Usability

The results of model summary presented in Table 4.16 above shows that the regression model can explain 75.1% of the variance in the dependent variable. When adjusting the number of estimated parameters and study population. The model can contain 56.5% of the dependent variable's variance. R square indicated the variation in usability (dependent variable) due to efficiency, effectiveness, Learn ability, user-friendly, reliability and aesthetics (independent variable). Moreover, the ANOVA results indicated that the model as a whole is significant fit to the data. The regression model was significant at ($F= 62.468, p=.000^b$). The overall model is statistical significant with sig-value of 0.000, this explains the joint impact of the explanatory predictor on the explanatory variables.

The model coefficient results presented above shows that t-test of effectiveness had a beta coefficient of .146 at ($p=0.14$), Learn ability a beta coefficient of .123 at ($p=.006$), reliability a beta coefficient of .133 at ($p=.007$), aesthetic a beta coefficient of .405 at ($p=.000$), user-friendly had a beta coefficient of .143 ($p=.020$), and efficiency had a beta coefficient of .104 ($p=.073$). Since, the p-value is less than 0.05; these indicate that usability evaluation criteria through the above variables have a statistically significant effect on usability.

4.4 Qualitative Analysis

As described or highlighted in chapter three of this research, interview was made with purposively selected professionals who were responsible for digital library and have willing to participate in the study. The researcher carried out interviews with directors, ICT team leaders and heads of digital library of the two public university libraries namely, three respondents from JU libraries and three respondents from ASTU libraries. The interview activities conducted totally with six respondents or interviewees. The respondents were also professionals and they have a long experience on digital library administration. The interviewing process conducted in the respondents' or interviewees' office after they agreed for interview. Recordings were obtained through the use of the researcher's Smartphone. The total length of the interview was 30 minutes. The recorded Interviews were transcribed immediately following the interview. This is done to add more depth and breadth to the quantitative data and provided detailed information about use and perceptions of users regarding digital library services.

The result of interview shows that the two university libraries are working on digital library to achieve their goal and mission and sustain their respective competitiveness. All interviewed respondents were believed that up-to-date electronic information resource is very essential for their research and academic activities. The respondent were also in agreement that the digital library has many problems such as lack of professionals, budget, copy right, ICT infrastructure, overhead scanners and standardized mechanism that used to evaluate usability of the services. But having modern structure for digital library, developing infrastructure and working on human and material resource development are essential to increase the perception and to bring satisfaction of users.

On the question how do you explain the development of digital library services reached now in your university libraries? The director of JU libraries stated that “JU libraries started to access DLSs for users in 2003 E.C to change the traditional environment of the academic library. Until now, the DLSs organized and accessed are OPAC service, Institutional Repository service, E-resources service, Dspace digital library service and eGranary digital library services” The other respondents ICT team leader and head of DL of this university libraries stated that “eGranary digital library service has already stopped to give a service due to technical errors”. Additionally, one respondent from this university said that “It is difficult to say that the development of digital library is fast when we compare the number of services exist with the year the digital library started” In line with this,, respondents of ASTU libraries stated that “ASTU libraries started to access DLSs in 2005. Until now, the university libraries accessed OPAC service, Institutional Repository, Greenstone digital library and E- resources services”

Another question asked by researcher was: is there well organized digital library structure and electronic resource management in you university libraries? All respondents of JU libraries respond that “There is structure which established to facilitate the activities of DLSs. But this structure was not well organized in human and material resources”. Additionally, ICT team leader of this university libraries justify that “Electronic resource management was not ascertain in our university libraries”. Similarly, interviewees of ASTU libraries respond that “There is well organized structure for DLSs. The electronic resource management was also instituted but it was not fully applied”.

The respondents responded on the question “Where do you access the DLSs to the users in your university libraries?” All respondents were mentioned that “All DLSs were accessed in the university campus, specifically in the library, lab and where access points were available” This leads to restrict users to access the services for their research and academic activities at any place and time.

Another question asked by researcher was: How do your university libraries evaluate the usability of DLSs? All respondents of ASTU libraries respond that “There is no established or developed mechanism for the purpose of evaluating the usability of DLSs. However, the usability evaluation of DLSs performed using the report produced by the head of DL and submitted to the university libraries regularly with fixed intervals. Additionally, one respondent

described as “There is regular meeting at the end of a week to evaluate the overall activities of DLSs. In this meeting a report which is prepared by sub sections presented and finally discussion was held to give a solution for constraints raised by participants”. In line with this all the interviewees of JU libraries respond that “There is no standardized mechanism that used to evaluate the usability of DLSs. The report prepared by the head of DL and submitted to the university libraries. This was the only method used to evaluate the usability of DLSs”. Thus, the researcher concluded that there was weak and traditional controlling system in the two public universities

The respondents responded on the question “What are the challenges exist in accessing DLSs in your university libraries? If the challenges of digital library were not solved, users can be dissatisfied with the services. All respondents respond that “ lack of professionals, lack of modern materials that used to scan printed information resources, lack of enough budget, copyright, lack of long term and short term training for professionals and sub professionals, lack of well organized ICT infrastructure, and lack of electronic resource management were the available constraints of digital library services”. Additionally, one respondent from ASTU said that “Users have no an opportunity to access each service under one umbrella rather than to go round to access the services”

Another question asked by researcher was: What is your suggestion and opinion to improve the DLSs in your university libraries? All respondents respond that “The top management of the university should give attention on major issues of the university libraries such as budget, capacity building, to develop ICT infrastructure. The university libraries also should give consideration for usability evaluation of DLSs, develop well organized electronic collection development policy, establish and work with electronic resource management, ascertain good relation with local and international universities, enlarge access points, work on digital library promotion, and entrance the services using mobile application”. In line with this two respondents from JU said that “there should be well organized controlling system for DLSs, the satisfaction level of users should be evaluated continuously, access points should be installed at comfortable places based on user destination, awareness service and user education should be given for users with fixed intervals were the suggestions given by the respondents”

Similarly, the respondents of the two public universities explained their views on the question “What is the impact of internet in accessing DLSs? Most of the respondents of the two public universities mentioned that “When there is not internet users can access all digital library services with help of Local Area Network (LAN)”. In line with this one respondent from JU said that “It is possible to access the whole services even if there is no internet except e-resources service”.

4.5 Result and discussion of the observation

As highlighted in chapter three of this research, observation was conducted by the researcher based on the check list prepared for the study. The checklist incorporates issues such as internet connection and speed, status of digital library services, access locations of the services, electronic equipment, mechanism that applied for usability evaluation and awareness service. In ASTU the observation activities performed for one week whereas in JU for two weeks. The observation result that shows under ICT infrastructure for the services, wired and wireless internet connections were installed in the two public universities, JU and ASTU. The wired connection used to access the services in the library and computer labs whereas wireless connection used to access the services where access points were available. There were sufficient computers in the computer labs and libraries to access OPAC and other services. However, few number of access points installed in selected places or buildings without full facility. Users have not the opportunity to access the services using wireless connection at any places in the campus of the two public universities..

The other point that the researcher observed was the speed of internet. There is no constant speed of internet, it varies time to time and goes up and down. Additionally, the researcher observed the location of access. Users can access all digital library services except eGranary digital library in the campus of the two public universities. Whereas users can not access all digital library services out the campus due to ICT infrastructure and copyright issue. The eGranary digital library service which is available in JU has already stopped to give a service for users

In the other way, the researcher observed the availability of mechanism that used to evaluate the usability of digital library services. There is no standardized mechanism that encompass usability evaluation criteria and that used to evaluate the usability of digital literary services. The two

public university libraries were conducted the usability evaluation process based on the report produced by the head of digital library and supervision performed by professionals and sub professionals. The researcher also conducted the observation activities on the availability, and applicability of awareness service in the two public university libraries. Awareness service that incorporates library orientation program, user education and technical support is not available. In the two public university libraries there is no independently organized section or responsible professional or sub professional to give the service for users continuously on the usage of digital library services.

4.6 Discussion of the findings

The current study explored the usability evaluation of digital library services of public higher learning institutions, Ethiopia. Eleven variables have been identified to evaluate the usability of digital library services, these variables are: efficiency, effectiveness, learnability, user friendly, comfortable, currency, timesaving, memorability, reliability, error prevention and aesthetic. In this sub section of the study discussion of the major findings clearly clarified based on the effectiveness of digital library services in strengthening the research and academic activities of respondents, satisfaction level and perception of respondents and the overall usability of digital library services.

4.6.1 The perception of users on digital library services

The finding shown under digital library services access locations where respondents of the two public universities were used as shown in Table 4.8 above majority of the respondents were preferred places such as libraries and computer labs to access the digital library services for their research and academic activities. It is impossible for respondents to access the services at any place and time in the campus of the two universities and out of the campus. The role of access point in accessing the services for respondents was weak. The finding confirms with the finding of Nadkalu (2014), conducted a study on “Access and utilization of digital information services in academic libraries: the case of university of Nairobi”. The finding depicted that in Nairobi university majority of users, 42.1% percent were used university libraries to access digital information resources. Restricting access location of digital library services in both universities directly influence the perception, need of electronic resources and research activities of users.

The finding shown under the methods used by respondents to aware themselves on the usage of DLSs and as indicated in Table 4.9 above, the researcher found out that “University’s website” and “Senior students” were the methods used by majority of the respondents to aware themselves on the usage of DLSs. . But from these sources respondents could not get the necessary information concerning the usage the services as a whole. The methods “Library orientation program” and”User education” could play significant role to aware respondents on the usage of digital library services. However, the two university libraries have no schedules that permanently facilitate these programs. Awareness service which focused on awareness of users on the usage of DLSs was not applied for respondents throughout the year. The respondents to be successful in their research and academic activities and to increase the perception and satisfaction level, they need support and encouragement from instructors. This is in line with the study of Madhusudhan (2010), conducted a research on “Use of electronic resource by research scholars of Kurukshetra university”. The finding depicted that 70% of research scholars learned about the services and available electronic resource through guidance from their friends (students), colleges, followed by self-interest. In this university there was no mechanism that developed to aware users on the usage of the services. Both study clearly depicted that there was a gap between users and the services that deeply persuade the research and academic activities of users in the two universities.

The finding shown under digital library services used by respondents most often and as indicated in Table 4.10 above, the two services “E- resources” (subscribed journals, open access journals, databases) service and “Dspace or Greenstone” digital library services were used by respondents most often. These services were effectively utilized by respondents most often for their research and academic activities. These services were also used to increase the perception and satisfaction level of respondents.

On the other hand “OPAC” and “Institutional Repository” digital library services were not used by respondents most often. This implies that they have low contribution in strengthening the academic and research activities of respondents. The finding confirms with the finding of Nadkalu (2014), conducted a study on “Access and utilization of digital information services in academic libraries: the case of university of Nairobi”. “eGranary” digital library has no

contribution for research and academic activities of respondents because the service has stopped to give a service for respondents

The finding depicted that (95.5%) of the users were used e-journals which incorporated under "E-resources" service and (57.1%) of users were used "E-books" services most often whereas (33.4%) of the respondents were used "OPAC" and (33.3%) of respondents were used "Institutional Repository". In this university "E-resources service" and "E-books"(organized under digital library) services were used by users most often whereas "OPAC" and "Institutional Repository" .services were not used most often. Both study identified the services used by users frequently. The two services "E-resources" and "were also the most advantageous services in supporting the research and academic activities of users.

4.6.2 The effectiveness of digital library services

The finding under the effectiveness of the services encompasses efficiency, learn ability, user-friendly, comfortable, currency, time saving, memorability, reliability, error prevention and aesthetic

The finding shows under efficiency, effectiveness and learnability of DLSs as indicated in Table 4. 11 above, the system organized for the services have low speed that shows a delay in resource finding process. It is also impossible for respondents to retrieve the necessary e-resources at the right time. The interface of each service was designed before 10 years ago. It lacks the necessary links with international databases and digital libraries around the world. The necessary attention was not given for updating or to redesign the interface of each digital library services. Similarly, to access e-resources from the services waiting for a long time and applying a long step expected from respondents. The research and academic activities of respondents were affected by these existing constraints of the system. Respondents were dissatisfied with the efficiency and effectiveness of the services.

On the other hand, the digital library services' interface incorporates help functions to create an opportunity for respondents to solve their searching and accessing problems. The terminologies available on the interface easily understood. However, the system needs ability to access easily what users wanted for the first time. In the usage of DLSs, there was still going to be

considerable number of users who found it difficult to operate the services for first time until the issue of awareness service gap addressed.

On the other hand, the finding shown under the overall usability of digital library in terms of efficiency, effectiveness and learnability of the services as indicated in Table 4. 14 above, the digital library services were ineffective and inefficient in supporting academic and research activities of respondents. The satisfaction levels, perception, and the usability of digital library decreased. However, in the learnability of the services the respondents were satisfied. This is in line with the finding of Anyim (2018), conducted a study on "E-Library Resources and Services: Improvement and Innovation of Access and Retrieval for Effective Research Activities in University E-libraries in Kogi State Nigeria". The finding depicted that 49.2% of users were indicated dissatisfaction with efficiency, 48.6% of the respondents were indicated dissatisfied with effectiveness and 50% of users were indicated satisfied with the learnability of the services. Both research works indicated that the available services were inefficient and ineffective. These influence the research and academic activities of users, their satisfaction level and usability of the digital library.

The finding shows under user-friendly, comfortable, and currency of DLSs as indicated in Table 4. 12 above, the system plays a great role in increasing the results based on the desired search and decreased the effort of respondents when they are using the services. In the process of searching activities there were no irritating points that happen while respondents searching digital library. These facilitate the research and academic activities of respondents. However, to support respondents on the usage of the services there was no guide line or user manual that used to access and retrieve e-resources. The e-resources accessed were not up-to-date for research and academic activities of the respondents. The respondents were dissatisfied. Additionally, The electronic management and electronic resource collection development policy that helps to keep the services with up-to-date e-resources have not been developed and practiced yet in the two public universities. These minimize the perception, satisfaction of respondents and usability of digital library.

On the other hand, the finding shown under the overall usability of digital library in terms of user-friendly, comfortable, and currency of the services as indicated in Table 4. 14 above, the respondents were satisfied with user-friendly and comfortable of the services and dissatisfied

with currency of the e-resources. These imply that there was no aggravating point that happen when respondents were explore for electronic resources and situations that completely restrict respondents to communicate with the DLSs for the need of electronic resources. Concerning the currency of e-resources, it was difficult for respondents to access current electronic resources for their ultimate need. This finding agrees with the finding of Asim and Alin (2009), conducted a research on “Usability evaluation of digital library”. The researchers found that 37% of users were satisfied with the user-friendly of the services and 42% of users were also satisfied with the conformability of the services. In the other hand, 27% of the users were dissatisfied with currency of the electronic resources. Both works justified that users can easily communicate with the services but the research and academic activities of users were not hold up with current e-resources.

The findings shows under timesaving, reliability, error prevention, aesthetic and memorability of DLSs as indicated in Table 4.13 above, the system which organized for the services saved the time of respondents. Timesaving is one of the features that distinguish digital library services from traditional libraries. All digital library services were recognized by respondents. The respondents were also developed high interest of the services. The system shows low error rate when respondents search for e-resources. The system developed with appropriate layout such as font, color and text type used on the interfaces were visually attractive and the system used appropriate format. However, there is a possibility for the system to give a negative feedback that obstacles the need for e-resources of respondents.

On the other hand, the finding shown under the overall usability of digital library in terms of timesaving, reliability, error prevention, aesthetic and memorability of the services as indicated in Table 4. 14 above, the respondents were satisfied with timesaving, reliability, error prevention, aesthetic of the services. The respondents were advantageous with the timesaving of the services and capable of error avoidance to strengthen the research and academic activities and to increase their perception. However, to retrieve e-resources, the respondents were used long steps which could not be easily memorable when respondents came again for using the services. This finding confirms with the finding of Asim and Alin (2009), conducted a research on “Usability evaluation of digital library”. The finding depicted that 50% of users satisfied with the reliability, 42% of users satisfied with error prevention, and 42% of the users were satisfied with aesthetic

of the services. Additionally, 45% of users were dissatisfied with the memorability of the services. Both study depicted that users were satisfied with timesaving, reliability, error prevention, and aesthetic of the services and dissatisfied with the memorability of the services.

Generally, in the usability evaluation of the digital library the respondents were satisfied with learnability, user-friendly, comfortable, timesaving, reliability, error prevention and aesthetic of the services whereas dissatisfied with efficiency, effectiveness, memorability and currency of the services

4.6.3 Challenges of digital library services

The finding shows under the challenges of DLSs as indicated in Table 4.15, above the identified constraints were “power failure”, “slow internet speed”, “lack of user education”, “unavailable of federated service” and “lack of technical support”. This shows that the DLSs available in these two public universities have a lot of challenges. Due to these challenges the available services were not play significant role in strengthening the research and academic activities of respondents and in increasing the perception of respondents. The respondents have little knowledge on accessing and utilization of e-resources because there was no user education that was given on the usage of the services. The speed of internet goes up and down from time to time and the electric power fails suddenly. The federated service that used respondents to access all services under one umbrella was not developed. The necessary links among the services that facilitate the research and academic activities of respondents were not established. The digital library services and the academic and research activities of respondents were directly affected by these known constraints and their satisfaction and perception completely decrease. However, in the two public universities there were enough computers to access the services in the labs and libraries. The finding confirms with the finding of Anunobi and Ezeani (2011), conducted a study on “Digital library deployment in a university challenges and prospects”. The finding depicted that challenges such as lack of awareness, internet access and speed, poor infrastructure, lack of technical support, power fluctuation and lack a sustainability plan were the constraints exist in the digital library. Both study depicted that the digital library service has many problems which were not solved until now.

4.6.4 Regression analysis on usability evaluation

According to Table 4.20 above the model summary indicates positive and moderate effect between usability evaluation criteria and usability of digital library services. R- square value is 0.565 which means that usability evaluation criteria has 56.5% influence on usability of digital library services. Since, the calculated p-value was less than 0.05 it was concluded that usability evaluation criteria have a statistically significant effect on the overall usability.

The model ANOVA presented in Table 4.21 above shows that the regression model was significant at (F= 62.468, p=.000) respectively. Since, the result p-value was less than 0.05, it was concluded that usability evaluation criteria has a statistically significant effect on usability of digital library services in higher learning institutions. Additionally, the model coefficient results presented in Table 4.20 above shows that t-test of efficiency, effectiveness, learnability, user-friendly, and aesthetic have a beta coefficient was positive and p-value is less than 0.05. This indicates that the evaluation criteria through the above variables have a statistically significant effect on usability

4.6.5 Proposed framework for usability evaluation of digital library services

The main purpose of the proposed framework for usability evaluation of digital library services is to create a normal and effective interaction between the user and the system, to bring the overall satisfaction and to increase the perception of users on digital library services. The proposed framework is also based on reviewed theoretical and discussions presented in the literature review. It presents the researcher's schematic drawing of the study variables and shows how the study has been thought out. Previous researchers have proposed usability evaluation framework that used to evaluate the usability of digital library services and overall satisfaction of users. The framework has tried to use efficiency, effectiveness, learnability, and satisfaction as an attribute and usability evaluation criteria. They also tried to incorporate some criteria under satisfaction. But very important criteria have not encompassed as a whole. The study accepts incorporated perspectives of different variables which cover usability, usability attributes, evaluation criteria, digital library services in to a single model.

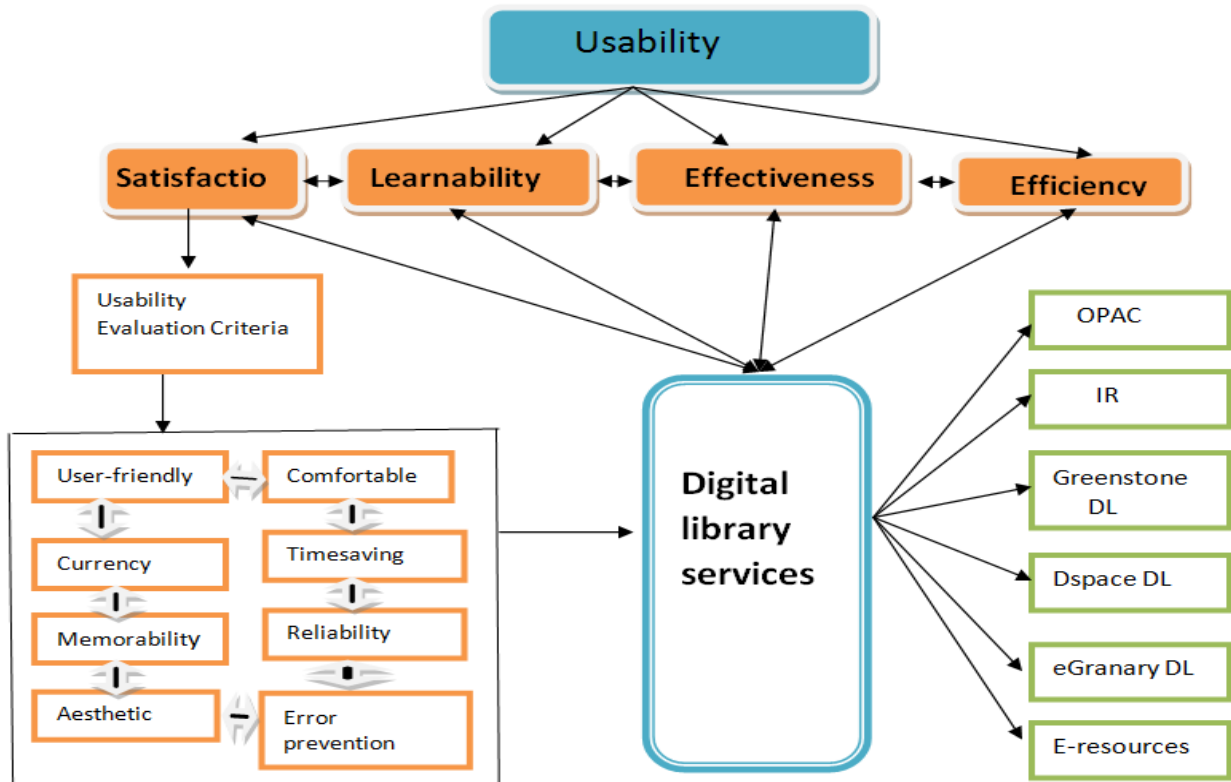


Figure 4.3: proposed framework for usability evaluation of DLs.

Source: modified and adopted from (Guvava et al., 2014)

The proposed framework above incorporates main component and sub components used for effective work flow. Usability is used in the framework as a dependent variable and main component that encompass sub attributes; satisfaction, efficiency, effectiveness and learnability. Usability is also a property of the total digital library services where all sub components should work together efficiently in producing effective and convenes services. All sub and other main components have direct and indirect relation with this main component.

- Satisfaction:** Users can easily understand functionality and services and to utilize those services for their academic and research purpose
- Learnability:** Easy for users to learn the procedures or to make the system usable and the availability of help function that support users
- Efficiency:** Task completion time, steps required to complete and response rate
- Effectiveness:** Accuracy and completeness of information retrieved task completion base on user goals
- User friendly** Users can quickly get what they are looking for

Comfortable	Guideline is not expected to use the services and no error while users searching the system
Aesthetic	The consistence of color, font types, attractiveness, enjoyable and pleasant enough
Currency	Deliver current electronic information related to current situation
Reliability	Performance of the services fault tolerance, availability and recoverability
Timesaving	The time the digital library services takes to load or perform tasks
Memorability	The capable of users to remember the steps used to access electronic resources after not using it for some period
Error prevention	The system have low error rate and shows positive feedback at every steps.

The sub components organized under usability and specified above are used as an attribute and evaluation criteria for digital library services. There is strong relation between them and with the DLSs that used as main component for the framework. The sub component satisfaction has other sub components; user friendly, reliability, currency, timesaving, Memorability, aesthetic and error prevention. These are used as evaluation criteria for DLSs to identify level of satisfaction and perception of users. They also have direct relation with the DLSs. Martensen (2003) emphasized the fact that the user satisfaction is created as an interactive result of electronic resources, collections of electronic and printed publications, technical facilities, library environment, the human side of user services and user value. Satisfaction provides a milestone to improve users' knowledge and reading skills

Digital library services provide variety of electronic information resources to satisfy diverse information requirement of users. These helps to create, manage, and preserve digital content for the use of academic activities. The DLSs is the other main component of this framework that integrates OPAC, Institutional Repository, eGranary digital library, Dspace digital library, E-resources (databases, e-journals, e-books) and Greenstone digital library services. The usability evaluation process performed on DLSs and all usability evaluation criteria have strong relation with these component. The process of evaluating DLSs will continue until users satisfied

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

This chapter deals with the conclusion and recommendation part of the study according to the survey conducted.

5.1 Conclusion

There is a growing tendency of using digital library services by postgraduate students for accessing and retrieving relevant electronic resources that led them for better utilization of digital library services. In rapidly changing information age, public universities of Ethiopia required not only to improve digital library services, electronic collection, and facilities, but it also should look after users and continue taking their feedback to discover the overall satisfaction of the services and electronic collection up on which the users have shown their concern.

In public higher learning institution of Ethiopia there is high demand of using electronic information resources. This led to conclude that constantly changing demand of users and to fulfill facilities needed for digital library services in the two public universities. The digital library services available in the two universities are not competent locally and globally. The digital library services accessed by the two public universities have many problems like interruption of power supply, internet speed, lack of user education and unavailability of federated service. Based on the findings of this study, the researcher concluded that the use of digital library services had an impact on the research and academic activities of postgraduate students of Ethiopian public universities; however, there was a need for them to acquire more education in the usage of digital library services.

5.2 Recommendation

Based on the study findings the researcher forwarded the following recommendations in order to increase the satisfaction level of users and to improve facilities of the services..

- The current study may provide necessary directions to understand the issues of usability of digital library services. Additionally, the findings of this study provide an initial understanding of the way towards further research in this area. The researcher has taken only public higher learning institutions so, future research should be focus on other areas such as private higher learning institutions
- Digital library services were getting wide spread and popularity in student's day to day research and academic activities. With increasing use of digital library services by students, it is logical to expect the next step to incorporate these services in all level of learning environment. As a result it is also recommended to see the impact of services use and benefits for students' academic activities in all level of education starting from elementary to higher education in a wide manner.
- To ensure increased usage of digital library services in the public universities, the university libraries management should came up with solutions those increases the reliability of internet connectivity, electric power and the expansion of access location of digital library services.
- In order to keep the development of digital library services and to ensure successful utilization and accessibility of electronic resources in academic libraries; public university libraries should formulate proper mechanism or criteria to evaluate the usability of digital library services regularly and continuously.
- It is very important to use federated service to access all digital library services from one umbrella. It avoids the users to use long path to access the services and save their time of searching. The university libraries management should implement the federated service for effective usage of digital library services

In general, all concerned bodies should be work together, all professionals and sub professionals should be contribute new mechanism on the area he or she does and by creating conducive digital library environment to users.

5.3 Future work

To make the DLSs more usable and secure for users, the research has raised some important ideas and suggestion for future work that can be developed in further studies. The research suggested that the two public universities management should consider the most common usability evaluation criteria, problems identified in this research in order to improve the overall usability of DLSs. Further a research on usability of digital library services may be carried out with public and private universities. Researchers should focus to design usability evaluation frameworks for the possibility of using it to other higher learning institutions

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Appendix
Jimma University
College of Natural Sciences
Department of Information Sciences
Questionnaire for postgraduate students

Dear respondent,

The questionnaire is designed to collect data for the research entitled “Evaluation of the Usability of Digital Library Services in Public Higher Education Institutions, Ethiopia for the partial fulfillment of degree of masters of Information Science (Information and Knowledge Management). The aim of this study is to evaluate the usability of DLSs in PHEIs. The study will be primarily benefits postgraduate students and other users in different universities, Ethiopia. I would also like to confirm that the information you provide will only be used for the compilation of this research and academic purposes. Your faithful cooperation for responses is extremely plays a dynamic role for the achievement of this study. I appreciate you for devoting your time to provide meaningful answers, suggestions etc. All your responses will be kept confidential. Before answering the questions please, visit all digital library services from your university’s website available as a link.

If you need clarification, please contact me by e-mail: bal_kew@yahoo.com and phone number: 251911919030

Appendix ‘A’

Section one: socio-demographic information

Instruction: kindly tick the appropriate box corresponding to the response of your choice. You may tick() as many as possible.

1. Name of your Institution

Jimma University

Adama University

3) Your age:

18–23 Years

24–29 Years

30–35 Years

36–41 Years

Over 41 Years

4) Your Gender:

Male

Female

3) Years of Experience with the Internet:

1–2 Years

3–5 Years

Over 5 Years

4) What is your current educational level:

Master's Student

Doctoral Student

Section two: Use of digital library services

1) Digital library services available in your university

1.1 Is there OPAC service Yes No

If Yes, what is the present status_____

1.2 Is there Institutional Repository service Yes No

If Yes, what is the present status_____

1.3 Is there Greenstone digital library service Yes No

If Yes, what is the present status_____

1.4 Is there eGranary digital library service Yes No

If Yes, what is the present status_____

1.5 Is there Dspace digital library service Yes No

If Yes, what is the present status_____

1.6 Is there Greenstone digital library service Yes No

If Yes, what is the present status_____

1.7 Is there E-resources service Yes No

If Yes, what is the present status_____

Section two: General information about the use and users awareness of DLSs.

2.1 How do you know the usage of digital library services?

Put a tick () mark on the corresponding box that you feel goes with your judgment regarding the methods used to know about the usage of digital library services

1= strongly disagree 2=Disagree 3=Neutral 4=Agree 5=strongly agree

Indicators	1	2	3	4	5
From Library orientation program					
From University's website					
From Senior students					
From Instructors					
From User education program (workshop, training)					

If you have other additional suggestion /idea/ about the DLSs write here on the space provided_____

2.2. Which Digital library service used most often?

1= strongly disagree 2=Disagree 3=Neutral 4=Agree 5=strongly agree

Indicators	1	2	3	4	5
OPAC service					
E-resources service					
Institutional Repository service					
Green stone digital library service					
eGranary digital					

library service					
Dspace digital library service					

If you have other additional suggestion /idea/ about the DLSs write here on the space provided _____

Section Three: Usability evaluation criteria

Direction: Please indicate your agreement by ticking one of the responses on the provided space or boxes (√) mark or write the appropriate answers

Items Choice: (1) Strongly Dissatisfied (SS) (2) Dissatisfied (S) (3) Neutral (N)
(4) Satisfied (NS) (5) Strongly satisfied(SS)

3.1 Efficiency, Effectiveness and Learnability

Indicators	Variables	1	2	3	4	5
Efficiency	In accessing digital library services, the system responds quickly to complete a resource finding task without delay.					
	The digital library services' interface is well designed to find what I want					
Effectiveness	I can usually complete a search task using the digital library services					
	I am successful in general in finding resources using digital library services					
Learnability	The digital library services' interface provides appropriate help functions.					
	The terminologies used on the digital library services were easily understandable					
	It was able to access easily what I wanted the first time I began to use the digital library services.					

If you have other additional suggestion /idea/ about the DLSs write here on the space provided _____

3.2 User friendly, Comfortable and Currency

Items Choice: (1) Strongly Dissatisfied (SS) (2) Dissatisfied (S) (3) Neutral (N)
 (4) Satisfied (S) (5) Strongly satisfied(SS)

Indicators	Variables	1	2	3	4	5
User friendly	It gives me results according to my desired search.					
	Minimize my effort and maximize my result					
Comfortable	I do not need any guideline to use this system					
	No irritating points and complexities or errors while I am searching the digital library services					
Currency	Information is sufficiently up-to-date for your task					
	Information you retrieved is valid					

If you have other additional suggestion /idea/ about the DLSs write here on the space provided _____

3.3 Timesaving, Memorability, Reliability, Error prevention and Aesthetic

Items Choice: (1) Strongly Dissatisfied (SS) (2) Dissatisfied (S) (3) Neutral (N)
 (4) Satisfied (NS) (5) Strongly satisfied(SS)

Indicators	Variables	1	2	3	4	5
Timesaving	It is time saving when I am using or searching for resources					
Memorability	It is capable to easily remember how to use the system after not using it for some period					
Reliability	All digital library services are acceptable and gave me information according to my need and put to further use					
	The ability of digital library services to perform and maintain its function under different circumstances					
Error prevention	The digital library services or the system shows positive feedback at every step.					
	The system which access digital library					

	services have low error rate					
Aesthetic	Text type and font sized are engaging and readable					
	The interface of digital library services are visually attractive					

If you have other additional suggestion /idea/ about the DLSs write here on the space provided _____

Section Four: Difficulties/barriers faced by respondents on using DLSs

Direction: Please indicate your agreement by ticking one of the responses on the provided space or boxes (√) mark or write the appropriate answers.

1= strongly disagree 2=Disagree 3=Neutral 4=Agree 5=strongly agree

Indicators	1	2	3	4	5
There is inadequate number of computers					
Power failure					
Lack of time					
Slow internet speed					
Lack of user education					
Lack of technical support					
There is no federated service for digital library services					

Appendix ‘B’: Interview questions

Interview questions for library director, ICT team leader of the university libraries and head of digital library

1. How do you explain the development of DLSs inn your university libraries?
2. Is there well organized digital library services structure or implemented electronic resource management in your university libraries?
3. How do your university libraries access the DLSs to the users?
4. How do you register users of digital library?
5. Is there a possibility to access DLSs using mobile application?

6. How do you control or evaluate the usability of DLSs in your university libraries?
7. What are the challenges of DLSs in terms of human resource and material resources in university libraries?
8. What is your suggestion and opinion to improve the DLSs in your university libraries?

Appendix ‘C’

For Researcher Only

Section One: Observation Check List of DLSs Availability & Efficiency

Evaluation table (Make it thick with this “√” mark on the space provided)

No	Item	JU						ASTU						
		Availability			Access location			Availability			Access location			
		Always	Some times	Not Used	Library	Computer lab	Access points	Always	Some time	Not Used	Library	Computer lab	Access points	
1	Digital library services													
2	Internet connection and speed													
3	Access location													
4	Electronic equipment													
5	Usability evaluation mechanism													
6	Awareness or customer service													