USABILITY TEST OF DSPACE AND ITS APPLICATION FOR ORIGINALITY CHECKING

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By

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LETTER OF RECOMMENDATIONS

We recommend the dissertation entitled 'Usability Test of DSpace and its Use for Originality Checking' was studied and prepared by Ms. Lila Nyaichyai. She has conducted the research under the guidance of her supervisor and co-supervisor. We recommend for the final examination by the research committee of the Dean's Office of Faculty of Humanities and Social Sciences, Tribhuvan University, for the requirement of the degree of DOCTOR OF PHILOSOPHY in LIBRARY AND INFORMATION SCIENCE.

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DECLARATION

I, hereby, declare that this dissertation is my own work and that it contains no materials previously published. I have not used its materials for the award of any kind and any other degree. Where other authors' sources of information have been used, they have been acknowledged.

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ABSTRACT

In the context of Nepal and Nepali users of the DSpace software-based digital library (DL), this study focused on evaluating the usability and significance of DSpace for librarians and end-users in Nepal. Despite successful its implementation in other countries, the importance of DSpace's optimal use in Nepali digital libraries, which are gradually expanding, was highlighted. The study aimed to assess usability for Nepali users and examined DSpace installation, operation, and customization for librarians. Two different population categories, librarians, and end-users, were involved in the study using sequentially mixed methods, including interviews, pre-test and post-test questionnaires, unmoderated and moderated usability tests. The research identified a lack of knowledge in Linux command line instructions as a major hindrance for MLISc graduate librarians during DSpace installation. Due to such difficulties, DSpace was used only in eight libraries, mainly in academic digital libraries, with varying collection sizes ranging from 101 to 15,218 items during the study period. The usability of DSpace significantly increased after moderation on librarians, showcasing the effectiveness of the training provided. Among librarians, the factor of usefulness (U) had the most significant contribution to usability, with 70.257% in the pre-test and 73.237% in the post-test. In the pre-test, usefulness (U) and effectiveness (EF) showed significant relations with all other usability factors, except efficiency (Eff). Ease-of-use (EoU) had significant relations with usefulness (U), learnability (LE), and satisfaction (SA). The post-test showed significant relations among all six usability factors, indicating that the training positively impacted the usability of DSpace for librarians. However, for end-users, the factors impacting DSpace usability were different, with factors other than usefulness (U) having a higher

rank. This suggested that end-user's information needs were not fully met by DSpace repository, possibly due to the limited number of collections and a lack of awareness about the resources available in the institutional repository built on DSpace. This finding emphasized the importance of tailoring usability improvements based on user categories to enhance the overall user experience. Furthermore, the study highlighted the importance of DSpace institutional repositories in the context of Plagiarism checking. It recommended constant use of DSpace and suggested enlisting the DSpace repository under Plagiarism checking software to improve the efficacy of Plagiarism detection and combat academic misconduct effectively. The research shed light on the variation in usability and factors affecting usability based on user categories and testing methods, emphasizing the need for customized approaches to address user-specific challenges. Librarians' proficiency in Linux command line instructions emerged as a significant factor affecting usability and highlighted the importance of providing adequate training and support to ensure successful DSpace installation. In conclusion, this study provided valuable insights into the usability and significance of DSpace for Nepali users in digital libraries. By examining the installation, operation, and customization of DSpace and its impact on academic digital libraries, the research identified areas for improvement and highlighted the importance of tailoring usability enhancements to different user categories. The study also emphasized the role of DSpace repository in plagiarism checking and recommended its consistent use and integration with plagiarism detection software to enhance academic integrity.

Key words: DSpace, Usability, Librarians, End-users, Plagiarism, Installation, Customization, Configuration

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION, ACRONYMS AND SYMBOLS

BWS	Best Worst Scale
CAAN	Civil Aviation Authority Nepal
CCT Dharan	Central Campus of Technology, Dharan
CRIS	Current Research Information System
DC	Doublin Core
DL	Digital Library
DSpace-CRIS	DSpace - Current Research Information System
ETD	Electronic Thesis and Database
GCI	Global College International
HCI	Human Computer Interface
IR	Institutional Repository
JSPUI	Java Servlets Pages User Interface
Khwopa	Khwopa Engineering College
KMO	Kaiser-Meyer-Olkin
MET	Metadata Encoding and Transmission
MIT	Massachusetts Institute of Technology
MLISc	Masters in Library and Information Science
NeLIC	Nepal Library and Information Consortium
NHRC	Nepal Health Research Council
NNL	Nepal National Library
OAI-PMH	Open Access Initiative- Protocol for Metadata Harvesting
OLE Nepal	Open Learning Education Nepal
PCA	Principal Component Analysis
SUS	System Usability Scale

TAM	Technology Acceptance Model
TUCDLIS	Tribhuvan University Central Department of Library and Information Science
TUCL	Tribhuvan University Central Library
VIVO	Video in video out
XMLUI	Extensive markup language User Interface

Chapter 1 : Introduction

1.0 Introduction to the study

DSpace software provides systematic platform for an institutional information repository. Simply it is understood as an open source software for creating local digital library, which is accessible, and retrievable globally, and if required, it can be confined for the in-house accessibility. The resources kept in DSpace are open access, and it provides a system for metadata management, file upload, search, and retrieving for every type (text, photo, video, audio, dataset, etc.) of digital assets. It is a web application, that means it is stored in remote server, it could be cloud server, and accessible, through Internet. Researcher, and scholars are able to publish their scholarly works in DSpace. DSpace was originated in 2002 November, later DSpace Foundation and Fedora Commons were merged together, and named DuraSpace in 2009 May. In 2019 July, another collaboration between DuraSpace and LYRASIS was formed. Currently, LYRASIS guide for the DSpace user community (2019). DSpace software has registered databases are than 3,199 till 2022 (DSpace, 2022). The 39% of world's database are created over DSpace software (Formanek, 2023). So, DSpace use has been growing straightforward.

While looking into the individual DSpace repository (digital library) use, implementation of a digital library (DL), and its use has the practical values (Körber & Suleman, 2008). If the implementation could not add value of systems, it gradually becomes phased out. Hence, each system is worthy to check it usability in a regular basis. During the first decade of the 21st century, usability tests were conducted for measuring implementation factors either through users' perception or in usability labs (Kim, 2005). Studies had incorporated users'

opinion and experiences minimizing the components of technicality and administration. Usability was tested for making the system 'relevant and current', and 'measuring the success while utilizing the system' (Jeffcoat King & Jannik, 2005). During 2005-2010 and 2020s, studies were moved in customizing and adding-on in DSpace and again tested usability (Denton & Coysh, 2011; Meyer, 2015; Ottaviani, 2006). For obtaining implementation value, establishing new improvements, and determining the relevance and currency of the system, usability testing has never been out of current. However, it was an untested issue with DL in DSpace in the context of Nepal and Nepali patrons of the service. This study is the first to assess the usability of a DSpace institutional repository and it has demonstrated the value of DL for Nepali librarians and end users. International studies about DSpace has been trending towards developing programming interface and having advanced need assessments for DSpace (Turner, Kinsley, & Becher, 2018). Still these studies implied usability test, where they evaluated effectiveness, ease of use, efficiency and satisfactions.

DSpace software for creating DL is being buzzing words among Nepali librarians. However, the end-users are still less aware about its usage. Very limited software engineers are keeping their services for DSpace installation and configurations in Nepal because library services have gained less priority from authorities (Nyaichyai, 2023). Some Nepali librarians are capable to install and configure it by themselves. In such environment, this study has tested over librarians for knowing their views after the operation of DSpace from installation to data input and dissemination. Likewise, it examined the same among end-users to record their experiences of using it. It utilized the DSpace repository which was set in participants' affiliated libraries. With them the usability was tested on

DSpace repository. In this study, DSpace repository, digital library, or institutional repository terminologies have been used.

The study turned to be 'two side bladed sword' in the sense that it helped participants known about the DSpace uses and its functionality, and it had recorded the usability factors from them. The usability factors were usefulness (U), ease of use (EoU), effectiveness (EF), efficiency (Eff), learnability (LE), and satisfaction (SA). The study provided evidences of libraries on how well the given DL service was usable for users. It also proved its value after its implementation. The study is useful for library authorities, librarians, and researchers of related field. Since, it had taken Nepalese context for the first time in usability test of DSpace instances, it registered Nepal for the worlds' literature on DSpace, and usability test.

There are some customizations made in DSpace user interfaces, and browsing options, upon which the usability test was focused. It gave the feedback for the customization, too. Primarily, it tested the quality of implementing DSpace, i.e., having usability value. Secondarily, it hypothesized the relation between ease of use and usefulness, effectiveness and efficiency, usefulness and effectiveness, ease of use and efficiency, and the possible use of plagiarism checking after having the digital institutional database. It has the practical solutions for the problem of plagiarism in some extent, and it made users capable for using the DSpace repository for solving their information needs.

1.1 General background of the study

Digital libraries (DL) are known as system that store and disseminate information in digital form. The formats of digital objects encompass text, image, video, and others. However, Witten clarified DL is not simply a "digitized library"

(Witten, Bainbridge, & Nichols, 2009). He added in defining DL that it must inherent the system to access, retrieve, select, organize and maintain the digital collection. The organization system and maintaining system is equally important for any digital library. While access and retrieval of information is basically concerned for end users and selection, organization and maintenance fell under librarians' domain. So, to perform all these tasks, DL as an information system requires six components functioning together: 1. Information (collection and storage of data and information); 2. Technology (hardware and software); 3. Process (activities of users and others); 4. Staffing and skills (quantitative and qualitative aspects of competencies); 5. Management system and structure; and 6. Other resources (particularly time and money) (Heeks, 2011). These all six components are made available in DL software. Fedora, DSpace, ArchiveSpace, VIVO are some of the names of DL software (Lyrasis, n.d). Above mentioned software is open-source software. There is another type of DL software that are proprietary, that means an individual's rights over the software development. The DSpace is one among many open-source DL software, about which this study focused on.

DSpace is oriented toward academic libraries. According to the homepage of DSpace, it is useful for: 1) institutional repository; 2) prompt operation, supportive mechanism and changeable system; 3) combining other tools that assist in scholarly work (DSpace, 2016). These qualities contribute organizing different kinds of research materials. Smith et al. (2003) explained how in the context of addressing the increasing challenges organizing many research papers, DSpace was designed and launched in 2002 to meet the need of multi-disciplinary research communities. Pyrounakis, Nikolaidou, and Hatzopoulos (2014) compared among

five open-source software, namely, DSpace, Fedora, Greenstone, Eprints, and Invenio and concluded that each software has their own characteristics, and they are useful for particular case rather than being fitted for all kinds of cases. DSpace is useful for research dataset, electronic thesis and database (ETD) in Word and PDF that use authority file for subject headings. DSpace is also suitable for image, video and audio files. For the purpose of electronic thesis and dissertation (ETD), DSpace is considered better solution, which many academic libraries required for.

DSpace, an open-source software, was set open by Massachusetts Institute of Technology (MIT) team after it was successfully launched in MIT in 2002 March. It is designed to operate in UNIX platform, multi-tasking operating system together with other open-source middleware and tools. Other open source software are: PostgreSQL for relational database management system, Apache and Tomcat**,** a web server and Java Servlet engine, etc.(Smith et al., 2003). DSpace supports for all sort of file format for submission. It permits changes in metadata fields as the local needs (Bollini, Cortese, Groppo, & Mornati, 2017; Navirathan & Jeyakananthan, 2018). There are flexibilities such as adding google analytics, email alerts and so on. The provision of communities, sub-communities and collection make users clear about the hierarchy of the knowledge management for the digital resources.

As noted by Pyrounakis et al. (2014) about the characteristics of DL software, DSpace is looked upon these characteristics for clearer understanding.

1. Digital object in DSpace

The smallest digital object of DSpace is called item. An item has two things coordinated. One is metadata and another is digital content corresponded to

each metadata. The metadata has used qualified Doublin core (DC) (Pyrounakis et al., 2014; Searle, 2010).

2. Collection and relations support

Since DSpace is a federated system, the arrangement of communities, sub-communities and collection are suitable one. These arrangements are hierarchical. DSpace manages the metadata on name, descriptions, logo of communities and sub-communities. The metadata for Collections are made up of items. Those collections are managed within sub-communities and communities.

3. Metadata and digital content

DSpace utilizes 15 elements of metadata, namely Creator, Contributor, Publisher, Title, Date, Language, Format, Subject, Description, Identifier, Relation, Source, Type, Coverage, and Rights that is the standard of Doublin core ("Metadata basics," 2022). They are stored in Postgresql or Oracle database (Pyrounakis et al., 2014). Doublin core is the initiatives made for library catalog in web. It helps indexing and searching information. Lucene or solr search engines supports for the search in DSpace.

4. Object Management

In DSpace, there are two options for item inputs: one is through submission, and another is by batch import from harvesting data through The Open Achieve Initiative Protocol for Metadata Harvesting (OAI-PMH). In the first case, called web submission, there is particular workflow to be followed.

5. User interface

In DSpace 6 version two web interfaces Java server pages user interface (JSPUI) and Extensive Markup Language User Interface (XMLUI) for end-users were facilitated and in DSpace 7 introduced new one (Donohue, 2022).

6. Access control

DSpace calls users e-people. It has the options for making groups of e-people based on their role given, and authority given to them. Users' authentication is controlled through username and password, or Internet Protocol (IP) addresses.

7. Multiple language supports

DSpace supports 22 languages web interface and supports UTF-8 Unicode system, so it is supportive for other languages except 22 languages.

8. Interoperability features

DSpace is supportive as data provider and as data harvester. The Open Achieve Initiative Protocol for Metadata Harvesting (OAI-PMH) software assists for interoperability of DSpace.

9. Level of customization

DSpace web interface is configurable in both Java server pages user interface (JSPUI) and Extensive Markup Language User Interface (XMLUI). There are provisions to customize on browsing filters. It also supports for plug-in.

10. Extended services support

Extra services are possible to add in DSpace. For instances, audio-video streaming, Moodle integration, social networks, language packages, digital preservation, statistics and many more (Verlicchi, 2023, February 08). Statistics has been integrated as default in DSpace 7.X version.

11. Preservation support

Each unique Bitstream is present in the DSpace object. Such a Bitstream is reliable for identifying a specific file format. Such distinct Bitstreams aid in data migration and backup.

12. Installation/community supports

On DSpace a community is contributing. Hence, it is continuously evolving software. Due to the contribution of community, it has many extensions made possible, for example Dublin Core metadata Toolkit, Batch import for bibliographic formats (Endnote, BibTex, and CSV)

13. Collection hosting/Cloud support

DSpace has special option provided for hosting in cloud which is known as DSpace Direct. It facilitates hosting DSpace repository which is searchable for end users and manageable for content administrator (DSpace, 2019).

With these features, DSpace is a promising DL software, adaptable and reliable one. It has been installed by more than 3,199 institutions as reported in the annual report FY 2021-2022 (DSpace, 2022). The installation number was increased by 1.48 % to last year. The growth of DSpace installation is significantly increasing: in FY 2021/22, a total of 3,199 DSpace installations were recorded, whereas 3015 in FY 2020/21, and 495 installations in FY 2019/20.

Table 1.1.

Increasing number of DSpace installation in the World

Fiscal year	DSpace installation number
2021-22	3199
2020-21	3051
2019-20	495

Source: DSpace annual reports.

The popularity of DSpace grew steadily since then. The addition was from Nepal too since DSpace installation grew. Nepal cannot be left behind in using DSpace for DL.

1.1.1 Introducing DSpace in Nepal

The need of digital content generation from developing countries has long been felt. Like all other developing countries, Nepal lacks creation of digital content in many folds. In terms of creating digital material, Nepal is in a situation comparable to that of India in 2004 (Jeevan, 2004). Nepal has the problem of little interest, copyright issue, lack of Information Technology (IT) infrastructure, lack of software knowledge and so on. However, the efforts to cover these gaps gave the opportunity to have its own digital content in Nepal. There are important contents that developing countries could rely on for digital publications (Jeevan, 2004; Kulesz, 2011). One of the software platforms for digital content generation or digital publication is DSpace as implemented by some libraries of Nepal.

DSpace has been gradually popular in Nepali libraries. Nepali libraries started to apply this software in 2008 (Pradhan, 2014). The skill and perception toward DSpace are important causes that effects on the increase of DSpace digital repositories in Nepal.

Eight DSpace repositories are being maintained in Nepali libraries. Among them, Nepal National Library has also initiated delivering the digital library service. Among these repositories, Tribhuvan University Central Library (TUCL) has recorded the highest 12860 items (TUCL, 2022a, 2022b), which is still a nominal number. Other digital libraries of Nepal are: Tribhuvan University Central Department of Library and Information Science (TUCDLIS) having 156 items (TUCDLIS, 2022), Tribhuvan University Dean office of Humanities and Social Sciences (TUFOHSS), Nepal Library and Information Consortium

(NeLIC), which is shown inactive now, Global College International (GCI) having 1141 items (Global College Internationl, 2023), etc.

In the context of Nepal, most of the documents were prepared as a part of project documents, case study and so on. While in academia, thesis and teachers' hands out are such kind of original sources of information, but they seldom come into published form. These forms of documents are known as gray literature. Its publication and preservation in digital form is the most viable digital content of Nepal. DSpace is an appropriate option for them.

Increase in digital content has posed a challenge of avoiding duplications. If there is easily accessible information repository, production of any other original documents could be checked its duplication easily. Many researches work in academia of Nepal are still unchecked for plagiarism. Plagiarism checking is hotly discussed issue in present context of academic research work in Nepal.

1.1.2 Usability test of DSpace

DSpace has a significant contribution for DL in Nepal. However, the human resource available in library sector of Nepal is lacking capabilities to operate it. Nepal has limited number of library professionals, who have graduated Master's in Library and Information Science (MLISc). These graduates studied in only at the Master's level, who are eligible to enroll from multidiscipline (Manandhar, 2022; Nepal Library Association, 2021). So, library software becomes a new topic for MLISc graduates of Nepal. When they worked as library professionals, there are still new things to be known about library software. Moreover, the use of library software has been continuously changing. As the availability in the market, the changes occurred. So, learning new things has been the continuous process for Nepali librarians. And same goes for library end-users.

In the case of DSpace use in Nepal, library professionals handle the digital content administration, and there are end-users seeking information in DSpace. The need of testing usability has significant practical values because usability means the quality of being practical use. Usability test was popular for Internet use and graphic user interface. It is equally important for software users interface and the system to know how well they are accepted and implemented by the users (Wichansky, 2000). In the case of DSpace use, its usability is yet to uncover to Nepali librarians and end-users because the basic issue in Nepal is to expand its use rather than evaluating its use. Although, it has been used in few libraries, due to the lack of their evaluative studies, libraries are unaware about their success and failure, or the value added or value reduced. It means a lot investigating to find the quality of DSpace being able to provide good service to users. Thus, usability test is a kind of evaluative study.

The usability test is the test of users' acceptance of the software and the system (Sasmito & Nishom, 2019). Both quantitative and qualitative data were analyzed as a usability test. The components - usefulness, satisfaction, ease of use, and ease of learning were observed for testing usability (Jubaedah, Yulia, Muktiarni, & Maosul, 2020).

In regards to DSpace software, librarians are one group of users who play the role of administrator in the DSpace digital library system, while all other kinds of users are end-users. Their experiences, and opinion in regards to DSpace could be a decisive thing on how well DSpace will be implemented in Nepali libraries. The effectiveness and ease of use is common factors for testing usability. Usability testing is to identify the acceptance of system, human computer

interaction (HCI), for which three criteria are categorized: first, how the system supports users' task to achieve their goal; second, how the system is usable for users, and third, how pleasant the user interface is for users (Battleson, Booth, & Weintrop, 2001). The International Standards Organization (ISO) has identified effectiveness, efficiency, and satisfactions to be examined on specified users in a specified context of use of some product and system. ISO had identified the relevancy of usability study for regular use, enabling new users, infrequent use, users from verities of capabilities, reduce use errors, enabling maintaining task, and relevant for designing, evaluating system and productions aiming to develop, procure, review, and market it (International Standard Organization, 2018). This study attempted to test DSpace on librarians and end-users to examine how effectively they used it with little or no experience of using it before.

1.2 The statement of the problem

In industrialized nations, digital libraries are a very widespread development. However, digital libraries in impoverished nations like Nepal are typically restricted to online database subscriptions rather than creating their own digital institutional repository. Although today's documents are produced digitally, many institutions in Nepal still produce original documents that are hidden away in a corner. Information that is available in digital form can be easily stored in a system that allows for quick access and retrieval when needed. These sources of information cannot add value to society or to human beings unless they are stored in a system that allows access. A publication that spreads information widely is the digital library.

The unpublished nature of gray literatures is contributing the duplication and unauthorized use of information, which is still unchecked in Nepal, hence reliability of academic works was questioned many times. Duplication of work is waste of time and effort. On the other hand, copying other's work without giving proper credit to original author is committing crime termed as plagiarism. For sound academic environment and honesty in academic work, duplication checking is needed. But manual duplication checking is time consuming and tedious, hence digitization of institutional collections is required and then it is possible to check duplication searching all databases**.** Hence making digital institutional repository give way to checking duplication with the help of any plagiarism checking software and make the database be checked in.

There is no question on the importance of institutional repository. The unturned stone hold the question how well such institutional repository has been using. Unless and until users use them, they are of no value. The usability study of DSpace repository falls on this category. Librarians are learning to use it, but it is equally important to evaluate how effective, efficient, easy and useful for them in achieving their professional goals.

It was already stated that DSpace was originated in the USA, one of the advanced countries of the world. Hence its use in developing countries may have different stories. As Park mentioned that the lack of research in the use of software in developing countries is responsible for "underutilization" (Park et al., 2009) of information system. Hence, it is worth to test the usability of DSpace from the perspective of both end users and library professionals. Computer know-how in library professionals and end-users, positive attitude toward ICT in institutional authoritative, availability of resources (time, money and man power)

and so on are some factors that increase the use of DSpace. Similarly, these factors are equally responsible for affecting the usability of DSpace.

This research is necessary for learning how the use of DSpace can be extensive in Nepal and what major factors are significant for testing the usability of DSpace. Likewise, it is significant to find out effectiveness of plagiarism checking based on institutional repository built by using DSpace. In Nepal, very few evaluative studies were held because the use of digital library software and building institutional digital repository are still in their initial phase.

A basic query is raised on how well the DSpace software was used and perceived by Nepali librarians and end-users. If they positively perceive DSpace and, it will promote the use of DSpace. Some studies had tested the usability of DSpace on its limited aspects in other countries. For example, tests were based on installation procedure usability, document uploading usability (Körber & Suleman, 2008). However, these studies were conducted long before.

The context of Nepal in terms of technology-based library system is a bit different. Nepali librarians are neither completely computer technologist nor do they remain computer illiterate for their profession. In this regard, they tend to hire outsourced technician to install DL software. Similarly, Nepali end-users should be boosted to use DL by the librarians. So, usability testing, at other hands, is being awareness campaign, too.

Usability does not limit to the features of the software itself, rather it is depended on how the users perceive it while using it. With the particular circumstances and features of Nepali librarians and end-users, it is very important

for service providers and libraries to know the capability of their use so that they can adopt changes if requires.

1.3 Research question

1. How are the knowledge and skill of users influenced usability?
2. How do different usability factors impact on usability?
3. How is the number of digital documents in DSpace help tracing plagiarism?

1.4 Objectives of the study

The general objective was to assess the test of usability of DSpace in the context of end users and library professionals.

The specific objectives of the study are:

1. To examine the influence of librarians' knowledge and skill in DSpace usability.
2. To identify the significance of usability factors for improving usability of DSpace.
3. To analyze the use of DSpace repository for checking plagiarism.

1.5 Scope of the study

DSpace software was studied as the central part of the research. It studied on the technological properties of the software. In addition, the ease of use, usefulness, effectiveness, efficiency, learnability, and satisfaction from DSpace were tested on end-users and library professionals.

Regarding end users' categories, the study incorporated Bachelor, Masters, Masters of Philosophy (MPhil), Doctorate in Philosophy (Ph. D) students, and faculties were involved.

On the other hand, plagiarism control test was limited to Master's thesis submitted to university level. It did not disclose any particular thesis, but explained DSpace repository as being traced during plagiarism detection.

1.6 Significance of study

In the field of digital library in Nepal, it is an important research that perceived DSpace as a useful tool for the possibility of building digital library. Moreover, the information sources fed in the DL is institutional information productions. Hence, it is a significant work in the field of library science, research and academic institutions of Nepal in organizing institutional and original information sources. DSpace enabled libraries being digital publishers and allowed library professionals contributing better information service. This study helped to test the relationship between ease of use and usefulness of DSpace for library professionals and end-users. Since, it researched over both library professionals and end-users, its conclusions are comprehensive. It is a useful reference for practical implementation of DSpace.

Library services have been broadening in service perspective due to DSpace repository. In addition, this repository was kept as one of the sources for originality (plagiarism) tracing that has enhanced the quality of research work and maintaining academic integrity.

1.7 Definition of key terms

DSpace: DSpace is a software designed for building institutional repository system. It was developed in 2002 as a collaborative effort between Massachusetts Institute of Technology (MIT) and Hewlett-Packard. The source code of DSpace has been uploaded freely in the Internet. Hence it is known as open-source

software that is customizable (Aljohani & Blustein, 2015b; Baudoin & Branschofsky, 2003; Donohue & Digilio, 2024, February 09; Lyrasis, 2021; Rajović, Kosanović, & Ševkušić, 2018).

Institutional Repository: The collection of information sources produced within an institution are organized into any system is understood as institutional repository (Nunda & Elia, 2019; Shiweda, 2018). In this present paper, institutional repository is named as DSpace repository too.

Dublin Core: Dublin core is the standard that describe 15 elements to include while cataloging web resources. It determined the metadata elements that is accepted as world standard. Information about digital documents were categorized into three, namely content, intellectual property and instantiation (Baker, 2000; Weibel, Kunze, Lagoze, & Wolf, 1998).

End-Users: Those users who utilize the services given by library and library professional are identified as end-users. End-users are not required to know whole digital library system in detail. They are expected to know how to access information and retrieve them. For this study purpose, PhD, MPhil, Masters, and Bachelor's level students were considered as end-users.

Usability: it is the quality of the system that makes users easy and convenient to use the system for fulfilling their information need (Ghasemifard, Shamsi, Kenari, & Ahmadi, 2015; Scholtz, Mahmud, & Ramayah, 2016).

Effectiveness: The quality that produces the intended or expected result. It is the quality that contribute to perform well. If the design of the system is effective, it performs better.

Efficiency: Efficiency incorporate the need of using lesser physical and mental effort. Lesser time consume, lesser thinking requirement for users etc. is the measuring factors for efficiency.

Satisfaction: Satisfaction is the state in which people feel after utilizing the system. User satisfaction is influenced by a number of elements, including easily understood words, system labels that are visible, and pertinent information. It is the way in which users react to the system in accordance with their emotional, mental, and physical needs and how well they believe the system is meeting those needs.

Learnability: It's the aptitude for system learning. Learnability is higher if users of the system could pick things up quickly, even without any instruction. Effective guidance, uncomplicated processes, and computer proficiency might influence the learnability.

Academic quality: Aside from having a strong and advanced degree, academics also uphold all ethical standards in their pursuit of it. When writing research papers, the student can manage plagiarism and duplication.

Originality Check: It means to check for plagiarism, in layman's terms. The word plagiarism comes from the Latin plagiarius, which meaning "kidnapper." In the academic realm, plagiarism primarily has moral and ethical connotations (Reitz, 2004). This thesis uses the term "plagiarism check" to avoid using imprecise language.

1.8 Organization of thesis

The study is organized in four chapters, namely Introduction, review of literature, research methodology, and findings, discussions and interpretation. In

the introduction, DSpace usability test was made familiar. For the wider application of DSpace, the users and library professionals are in need to evaluate usefulness, effectiveness, efficiency and easiness in operating it. In the precise way, objectives, research questions were set in the introduction. The study is important for users, service providers, and authorities implementing digital libraries.

Second, a variety of usability test techniques were examined and included in this study, with the results illustrating connections, contrasts, and similarities in the chapter on the literature review. This study stands on a solid research foundation due to the review of the research methodologies sections. The study procedure, research instruments, and sample size were all made clear by the review. It also aided in the understanding and development of the research's closing points.

Thirdly, the research methodology part is among the most important one. It is the kitchen of this research. In a keen detail it explained how the research was conducted and what data were collected. It described the analysis framework for the usability, sampling methods, sample size, data collection procedures, and data analysis tools, and methods.

The fourth chapter is the final product of this study. It evaluated and interpreted both qualitative and quantitative data. It brought the insightful conclusions that met the stated objectives of this study. It began by outlining the aspects of the DSpace user interface that could be altered, then it proceeded on to discuss the digital content that was available in order to make it clear which DSpace repository was used for the usability testing.

It also mentioned the installation, configuration, and customization steps in the document for achieving clarity of understanding. Then it has analyzed the collected data as per stated framework. Simultaneously, the analysis has verified and tested the concept. It came to the important conclusions and findings based on those analyses.

Chapter 2 : Literature review

2.1 Institutional repository tools

The DSpace software is mostly utilized for digital repositories maintained by academic institutions, which operate by several local names. The acquiring, management, distribution, and preservation of institutionally owned information sources in digital format were fundamental tasks for institutional repositories (IRs). Pre-prints, journal articles, talks, learning materials, theses, datasets, and more were all included. These functions have demanded extra skill and duty on librarians regarding digital collection management (Chang, 2003). Those extra skills are the skill of operating and administering institutional repository making skill, handling the software in operational level and in management level. Similarly, the additional responsibility includes curating digital content as well.

The repository permitted material from the campus library system and archives, as well as the digital asset management system, to be coordinated. Institutional Repository (IR) are unique, locally generated, scholarly needed information resource. The production of this kind of digital content can also help overcome the growing knowledge gaps that exist between industrialized and developing nations.

During the first decade of the 21st century, the deployment of institutional repository was evolving slowly because even the developed countries built few numbers of the IR. According to the survey of 2005 presented in the conference ‘Making the strategic case for institutional repository’, the numbers of IR were barely reached to few hundreds in European countries. There was very vague availability of national policy for building institutional repositories (Van

Westrienen & Lynch, 2005). However, it was claimed that the IR has the potential to be ‘an engine of change’ for the higher education institutions in providing the broader platform of scholarly communication. IR expert were more focused on ‘scholarly communication’ rather than ‘scholarly publishing’(Lynch, 2003).

Most of the research articles published on institutional repository are case studies. DSpace was utilized for academic institutional repository, however some supported for the proprietary software when there is the absence of local technical expertise (Shu Liu, 2011). Regarding IR implementation, software was selected unanimously (Allard, Suzie, Mack, Thura R. and Feltner-Reichert, 2006). But, it is worth to examine the software assessment. Usability study is one of the effective tools for software assessment.

The federating system DSpace satisfied the requirement for a "multidisciplinary repository." Since it is a multidisciplinary repository, separate collections relating to different subjects may be created. The repository aimed to preserve research works, data set, audio-video, images, and many other materials. DSpace made it easier for academic staff members to submit their papers on their own, with options to edit, improve, or approve submissions. Title, language, and submission date are required metadata items when submitting to specific collections; other metadata elements are optional. The Dublin Core metadata Standard was adhered to by DSpace.

DSpace, an open-source software, was set open by Massachusetts Institute of Technology (MIT) team after it was successfully launched in MIT in 2002 March. It is designed to operate in UNIX platform, multi-tasking operating system together with other open-source middleware and tools. Other open-source

software is PostgreSQL for relational database management system, Apache and Tomcat**,** a web server and Java Servlet engine etc. (Smith et al., 2003). Gradually, DSpace was selected by other universities too (Hulse, Cheverie, & Dygert, 2007; Lam & Chan, 2007).

Practical implications and functioning mechanism play a significant role in the success or failure of IR development; flawless software alone will not enough. A mediatory staff was needed for the better implementation of IR because academic faculty members were unlikely to post items into it (Devakos, 2006). The mediators were the librarians. In addition to software, policies and operational procedures play a crucial role in the outcome.

2.1.1 Comparison among various IR software

There are two types of IR software available: proprietary software and open-source software. Through case studies on building institutional repository suggested that proprietary software can also be recognized as potential software for IR because the technical complications in open source software is often beyond the capability of librarians (Kelly, 2007). Conversely, the majority of the case studies that have been studied have utilized DSpace, an open source program, as it is predicated on E-print expertise and supports Unicode, which is advantageous for non-Romanized languages (Lam & Chan, 2007). Since September 2002, the well-known Indian Institute of Science (IIS) in Banglore has been using EPrint. IIS is in responsible for handling its 1500 research products a year (Jayakanth, Minj, Silva, & Jagirdar, 2008). Comparisons were upon number of software (Sahu & Karadia, 2015; Saxena, Singh, & Mulchandani, 2014), but they have own specialties, so, the selection of software should be based on institutional needs.

The first entering point into software is the installation of it. Here, the process of installing DSpace has been provided in brief. There are number of steps to be followed. DSpace installation in Windows operating system (OS) and Linux OS is possible. However, Linux OS is preferred for the installation.

Step 1: Update Debian/Ubuntu patches to latest packages

Step 2: Install required system applications: (openjdk-8, postgresql, ant, maven)

Step 3: Install PostgreSQL

Step 4: Configure PostgresSQL permission on a host server

Step 5: Create a user in Postgres.

Step 6: Configure postgres user

Step 7: Configure apache web server

Step 8: Create a 'DSpace' user

Step 9: Create a folder named 'dspce' to host the DSpace executable code

Step 10: Install tomcat9

Step 11: download, compile, and install the DSpace release

Step 12: Save downloaded DSpace into build directory

Step 13: Unzip DSpace

Step 14: Install DSpace

Step 15: Update java

Step 16: Configure DSpace

Step 17: Compile all DSpace in maven

Step 18: Install DSpace and initialize the data

Step 19: Initialize the server.xml for 'dspace' user

Step 20: Create DSpace administrator

Thus, for it to be executable, each of these phases must be carried out perfectly. It's useful to have source code customization options. The main issue mentioned was the ability to modify DSpace IR software to satisfy the unique requirements of Institutional Repository. DSpace uses the Dublin Core (DC) metadata standard and Metadata Encoding and Transmission Standards (MET) for monitoring archive material as its fundamental features. According to the guidelines set forth by the Scholarly Publishing and Academic Resources Coalition, these characteristics are considered fundamental technological needs for IR software (Chang, 2003).

Among the list of open-source software, DSpace, EPrints, and Fedora are important software. Eprint, and Flexible Extensible Digital Object and Repository Architecture (Fedora) are made of institutional repository in 2000 and 2003 respectively, which were both run in Linux operating system (Warr & Hangsing, 2009). The research articles on Eprint and Fedora are published mostly during 2007-2009 (Jayakanth et al., 2008; Neugebauer & Han, 2008; Warr & Hangsing, 2009). There are similar features incorporated in DSpace and Fedora, some example is the possibility of batch import of document (Neugebauer & Han, 2008). In India 209 open source software were applied for institutional repository by various institutions, among them DSpace, and Eprint are in wide use (Gurikar & Hadagali, 2021). DSpace and Eprint has been more popularly used in Serbia as

well (Djokovic, 2021). EPrint was developed from University of Southampton UK, and Fedora developed in collaboration between University of Virginia and Cornell University. One of the common backgrounds of open-source software is that they were developed through the effort made by universities.

Though there are number of open-source software, the use of them is very much dependent on the awareness and capability of librarians to apply them in real-life environment of library (Kampa & Patra, 2020).

Instead of open source software, some institutional repositories have utilized proprietary software too (Kelly, 2007; Shu Liu, 2011). Hence, the experience varied for each library and librarian's evaluative comments on choosing IR software. However, open-source software is the better option for libraries that are facing limited budget problem because it saves the annual fee for licensing software use.

Some of others open source software for digital library are available as follows:

Table 2.1.

List of open source software for digital library and their usability

S.N.	Name of software	Usability comments
1	BiblioteQ	easy for the users, access online research papers, videos, catalogs, books
2	OPAL	trustworthy, easy to afford, implement and use
3	PMB	up-to-date
4	Greenstone	multilingual, cooperated with UNESCO
5	Fedora	facility of batch import
6	EPrint	Popular

Source: (Mintbook, 2022)

2.1.2 Institutional repository in Nepal

Asian countries Japan, Korea and China are in leading position for the global institutional repositories. In South Asia India, Sri-Lanka, and Bangladesh are good in producing institutional repositories, however, other countries including Nepal are poor in developing it (Cho, 2017). Cho (2017) and Gul, Bashir, and Ganaie (2020) have studied Asian institutional repositories and South Asian institutional repositories, both studies presented Nepali institutional repositories only one and the records were unreported in the studies. There are Tribhuvan University Central Library (TUCL), Central Department of Library and Information Science (TUCDLIS), DSpace at Nepal National Library (NNL), Nepal Library and Information Consortium (NeLIC) are some repositories available. DSpace is mostly used software for developing institutional repositories in Nepal and in South Asia (Gul, Bashir, & Ganaie, 2019).

The challenges of IR are difficulties in communicating with IT personnel, meeting the verities of users' need in designing user interface of the IR are technical challenges faced by academic libraries (Joo, Hofman, & Kim, 2019). The similar problems like the fewer competent librarians and inadequate library budget, are the basic problem in Nepali libraries too, which is preventing the libraries in making institutional repositories (Nunda & Elia, 2019). However, DSpace software had helped IR possible for reducing cost as well as protecting copyright and enhanced the scholarly communication (Ejikeme & Ezema, 2019). While Zervas, Kounoudes, Artemi, and Giannoulakis (2019) had indicated the advanced use of DSpace institutional repository. They discussed using DSpace-CRIS as the institution's future repository. The DSpace-CRIS extension is a tool used to access current research information systems, or CRISs for short. It

oversaw research data management, evaluated research output, communicated research findings, and more. It is helpful for identifying new contacts, identifying duplicated activity, and locating a new market for research items (Donohue & Digilio, 2024, February 09). Nonetheless, Nepali IR are still in basic implementation stage. The following descriptions of Nepali institutional repositories helped to understand the level of IR in Nepal.

1. Tribhuvan University Central Library (TUCL) e-Library: DSpace software is used for TUCL e-Library, started in 2012. The Java Servlets Pages User Interface (JSPUI) user interface was customized with local name, logo, and color. It accommodated 12929 items (TUCL, 2022a).

2. Dean office of Humanities and Social Science, TU (tufohss) e-Library: DSpace software is applied for the repository of the Dean office of Humanities and Social Sciences, TU. It has 190 items collected. Currently the site notified that it is out of reach. Some update or server service is required. The url is http://dspace.tufohss.edu.np:8080/jspui. However, the user interface was kept in the default form. No customization was made on it. It was started by 2018.

3. Central Department of Library and Information Science, TU (TUCDLIS e-Library): It has 157 items were accommodated. Apart from thesis, the department has used is as the periodic named " CDLIS Bulletin" e-publication platform as well. It has customized the default DSpace user interface with office logo, color and name. It was started by 2020, that is still well-functioning (TUCDLIS, 2022).

4. Nepal National Library: From 2009 Nepal. Due to heavy destruction in the year 2015 earthquake (Sijapati), the digital library made in DSpace was stopped exist now.

5. Nepal Army Library: Nepal Army Library has also maintained the digital library on DSpace. The URL of this library is https://www.nepalarmy.mil.np/nawc/library. However, it required authorized user name and password to access it.
6. Nepal Health Research Council (NHRC): In 2015 NHRC has established digital library, named as NHRC Digital Repository. It has technical reports, annual report, acts, and other collection are developed. Altogether 798 items were deposited here ("Nepal Health Research Council e-Library," 2015). DSpace version 6.3 has been applied for the e-library.
7. Civil Aviation Authority Nepal (CAAN): The office of Civil Aviation Authority of Nepa (CAAN) has been maintaining digital repository too. It has 101 items deposited, and it was started by 2016. There was the default DSpace user interface has been applied. The URL of the repository is http://dspace-caan.healthnet.org.np:8080/caan ("DSpace Repository," 2016).
8. Nepal Library and Information Consortium (NeLIC): From 2009 NeLIC started the digital repository, however currently it is out of reach. The URL of the repository is https://www.nelic.org/open-access-repository/.
9. Global College International (GCI): GCI e-Library is in operation as well. It deposited 1627 items, mostly related to course curriculum text books.

Nine DSpace repositories are thus kept up to date in Nepali libraries, while the Nepal National Library is no longer providing the service. The front page of these DSpace repositories has been altered, mostly by retaining the formal institutional logo and changing the name. The default design of DSpace includes other information items, color usage, browsing options, search options, and search history. The largest collection of items, 2512, is found in TUCL's repository; nonetheless, this is still a nominal total.

2.2 Customizing DSpace

While viewing such evaluative experiences on IR software, Ottaviani (2006) tested DSpace on expert users (library staff) and end-users (undergraduate and graduate students) of University of Michigan, where the DSpace institutional repository was given name as Deep Blue, where DSpace was modified as per the result of usability tests. It was discovered that the search results should list the date, title, and author in the order of relevancy as per the test specified under searching and browsing DSpace, and for future adjustment. The "just-executed" search word should also be displayed in the search bar's left corner. It is recommended that the contact information for the item's "depositor" be included on the item page, however this is considered difficult, if not impossible, for reasons of personal privacy.

Ottaviani (2006) mentioned the term 'submission' was modified into 'deposit' on the original DSpace because he argued 'deposit' denotes meaning as *'may not be accepted'* and *'archives'*, which at real sense, DSpace meant for. It is in the sense that users are allowed to deposit items, however, the central authorized e-people are responsible for approving them finally. Other modifications were made in name of 'bit stream' into 'file', remove checksum

option from deposit form, 'cancel/save' into 'cancel/postpone', administrator is not allowed to remove item, provide option in edit metadata page like 'exist and save changes' and 'exist and do not save changes' was given. The authors emphasized that the test was undertaken successfully since users completed all the tasks in the modified DSpace.

While around the same year, DSpace version 1.4 was configured and customized DSpace was implemented in Indian Institute of Technology Kanpur (IITK), where they added cross collection search in advance search, browse by new collection and recent submission, browse by supervisor of thesis, and show citation impact of thesis stored in DSpace. Similarly, they redesigned 'registration form', additional elements of roll number, degree and department which was useful to give a particular e-group. They redesigned the feedback form too. Since the purpose of DSpace Institutional Repository (IR) of IITK was devoted for electronic thesis dissertation (ETD), they claimed the customization was performed as per their organizational need, which was claimed better met by such new customization (Mishra, Vijaianand, & Shukla, 2007). It seems the institutional requirements should be identified firstly, then we can effort in customizing DSpace. The practical implication in real library environment is very much necessary to find out the further requirement to be incorporated in DSpace.

DSpace, Eprint, Invenieo, Archimede, use relational database, which means they shared similar table of common attributes for database (Google cloud, 2007) for describing digital documents. Furthermore, DSpace has flexible data model that can be customized according to organizational need. But the DSpace data model is meta-data scheme. Normalized data scheme denotes to one-to-one correspondence between entities of data model and the relations of database (Van

der Lans, 2012). Whereas meta-data scheme describes a standard data format and data elements. Among different meta-data scheme, DSpace uses Doublin Core Metadata Scheme (University Libraries, 2022). Customization in DSpace is easier than Fedora, another digital library system (Khan, 2019).

Customization is not a compulsory thing but it is the possibility for organizations. It extends the services from DSpace. Nevertheless, Nepali institutional repositories in DSpace are found having minimal customization. Basically, they are customized at the user interface by using institutional logo, name, and color. Some of them are not even changed these things even. Customization user interface has been widely used (Yang, Zhang, & Chen, 2020). DSpace has extended with current research information system (CRIS) in 2012 (Donohue & Digilio, 2024, February 09). Yang et al. (2020) has brought the display of natural language in metadata at interface layer, but remain Doblin core metadata scheme at deeper layer, replace Google map with leaflet map, and revealed readership activity map. Washington, Dulek, and Ramirez (2019) has facilitated uploading items with the help of University faculty members' CV with the creation of structural workflow. Hazarika and Ravikumar (2019) and Hazarika, Handique, and Ravikumar (2020) have successfully integrated document viewer and Digital Imaging and Communication in Medicine (DICOM). This sort of advance customization is very fascinating and it has contributed to DSpace community. Reviewing this advancement, DSpace use in Nepal is in very primitive stage. Yet, the usability for Nepali users is worth investigating.

2.2.1 Plagiarism checking software plugin in DSpace software

The extension and add-ons compatibilities of DSpace version 6 has been listed, for instance, DSpace-CRIS, CKAN integration, audiovisual streaming,

video/audio streaming, content & usage analysis, document streaming, document viewer (no flash required), documents viewer module, optical character recognition (OCR) and transcription, image zoom, international image interoperability framework (IIIF) image viewer, information conversion suite, listing & reports, metadata quality module, Moodle integration, social networks, authority control, and digital preservation (Mornati, 2019), but there is not anti-plagiarism checking software add-ons compatibility mentioned.

Unplag, renamed as Unicheck software was said to have its extension to integrate with DSpace in 2016 that was renamed as Unicheck software. Klymenko (2017, July 28) assured the possibility of integrating Unicheck, a similarity checking software with other Learning Management Software and others through standard integration technologies. The Unicheck explored the similarity across the Internet sources and the institutional repository fed into it. The similarity report is highlighted with yellow colour for matched one and blue for the citation. It is available both for free and paid.

Through literature, it has not been discovered that the DSpace software has a plug-in for plagiarism detection software. The alternative is to provide data from the DSpace repository to a particular plagiarism detection tool. After being eligible of being original, that mean without plagiarized, documents should be posted; if not, they can first be checked for originality before being added to the DSpace repository. The Indian Sodhganga repository has used a similar technique. The Urkund software was used to check for the originality conformation before the thesis was submitted to Sodhganga (Pathak & Malakar, 2016). The use of anti-plagiarism software has been ingrained in academic institutions as a result of their efforts to ensure the originality of academic writing. Research academics, who

mostly use the iThenticate program, are now more conscious of the importance of employing anti-plagiarism software and correct referencing (Divya, 2018).

The absence of cheating, and unauthorized copying is one of the measures for academic integrity. However, Mattar (2021) describes it as the narrower premises of academic integrity. The emphasis on maintaining academic integrity have mentioned to avoid plagiarism. Plagirarism is the use of others' ideas and words without giving proper citation. Whenever, students and faculties produce their academic writings, they are in need to confirm the originality so that they could claim about their own creativity.

Similar to this, institutional repositories must preserve academic integrity so that users can be ensure the quality of repository. In order to achieve academic integrity and scholarly richness or quality up to the criteria, originality check has been one of the most crucial issues, which many universities have implemented.

There are numbers of plagiarism checking software available, some of them are open-source software and some of them are proprietary. However, very little literature has suggested the feasibility of incorporating any plagiarism checking software in DSpace software, despite comparative studies on the effectiveness of several plagiarism checking programs (Ali et al., 2011). Most plagiarism checking software scans Internet-based content rather than those in local collections. It is challenging to find the local resources being copied. DSpace software helps creating institutional repositories or local repositories, which is possible to make them online.

There are number of plagiarism checking software, for example, Plagware, Plagscan, Check for Plagiarism, iThenticate, Plagiarism detection, Academic

plagiarism, The plagiarism checker, Urkund, Docoloc, Safe assessment, Copycatch, Wcopyfind, Eve2 (Essay Verification Engine), GPSP (Glatt Plagiarism Screening Program), MOSS (a measure of software similarity), JPlag, AntiPlagirst, Unplag, Turnitin, Quetext, Copyscape, Grammarly, Paper Rater, Prowriting (Trust Radius, 2023), and so on. AntiPlagiarist, Dupli Checker, Plagiarism Checker, Plagiarsm Detect, PlagTraker, Quetext, and Viper - Plagiarism Scanner are free and open-source software (Sunil & Rajashekar, 2016). However, no plagiarism checking software has been successfully plug-in in DSpace.

The issue of originality checking has been significant in the context of frequent use of artificial intelligence (AI) for writing. There are some software that are designed to trace out AI written text, for example, Copyleaks (Copyleaks, 2024), AI Detector, GPTZero, Originality AI plagiarism checker etc. are listed as the anti-AI plagiarism detectors. Yet, this study specifically incorporated the DSpace repository being traced out as the source of copying text.

2.2.2 Limitation of DSpace

The installation and configuration process of amateur librarian is tough job. On the other hand, the customization demands for skill and depth knowledge. As mentioned in Verma and Kumar (2018), DSpace has several constrains during implementation, including a limited API, a flat file (.text, .csv type of file) and metadata structure, a poor user experience, and a lack of scalability and flexibility. Limited Metadata Features, limited Reporting Capabilities and lack of support for related data are also its limitation. Due to limited API, the integration or plug-in of anti-plagiarism software is not yet succeeded for DSpace. Hazarika et al. (2020) have also prescribed for the separate study on the scalability of DSpace for Digital

Imagining and Communication in Medicine (DCOM) images management. In regards to the limited capacity of revealing use statistics, the DSpace 7X have improved with statistics in-built in it.

2.3 Usability test

In the background of manual library services, use of ICT is new system for both librarians and users. In library services, information communication technology (ICT) has been steadily growing for quick information dissemination, expanding library services, and users' satisfaction (Bhoi, 2017; Chandra & Patkar, 2007). The skill of librarians, and library users is one of the vital elements for the better use of ICT in library services (Essien, Lu, Abredu, & Zotoo, 2022). The ICT has changed the dimension of librarianship, and the new concepts of librarianship has also brought new development in ICT (Akintunde, 2004, June 20-25). Traditional library service has experienced digital transformation as a revolutionary concept, which has converted the role of librarians from information managers to information publishers. Librarians were supported by digital library software for being the leader of digital transformation (Singh & Asif, 2019). Whereas, library users are facilitated with 24 hours and 7 days service from libraries.

Candela, Castelli, and Pagano (2010) evaluated DSpace as one of the effective digital library software in retrieving rich text data. DSpace is regularly revised with new features. The latest stable version is 7.3 presented on July 21, 2021(Donohue, 2022; Donohue & Digilio, 2024, February 09; Lyrasis, 2021). All over the world, the recorded installation of DSpace is 3199 in the fiscal year 2022 (DSpace, 2022). DSpace repository is active in 133 countries. DSpace community is the largest open source repository community (DSpace, 2022) . Due to numbers

of features, Pyrounakis et al. (2014) has explained DSpace as the best one among five open source software, namely, DSpace, Fedora Commons, Greenstone, Eprints and Invenio, whereas, Abifarin and Imavah (2019) has identified the more effective precise information retrieval in Greenstone in compare to DSpace. Yet, the largest supporting community of DSpace has made it the most preferable one. It has been the choice of academic, non-profit organization and commercial organizations for digital repository ("DSpace Repository," 2016). Nevertheless, the regular evaluation of system has value for the better implementation. The use of digital library software and its usability for librarians and end-users is worth evaluating to be competitive all the time (Najafgholinejad, 2023).

The system put under usability test was DSpace software, used for institutional repository making. As different literatures have suggested, the present study also applied DSpace users-based study. DSpace software is not newly made software, however its use in Nepal is relatively new. The issue to how well it has been used by Nepali users is the central question. Nepali librarians, and end users are still new users for DSpace. DSpace was initially applied by some Nepali librarians in 2012. The Central Department of Library and Information Science with the University Grant Commission had granted for the consortium making of repositories of Nepali universities in 2012-1014 (Pradhan, 2014). DSpace software was applied during the project. The version of DSpace is regularly updated. This study was conducted upon version 6.3. In addition, there are some features were added to localize the user interfaces of DSpace repositories, which was worth being tested.

2.3.1 Usability factors

Usability test and evaluative study has aimed for the development and adoption of any system. The beginning of users' adoption and use of new things is generally started with questions. Once users get satisfied and have the habits to use those new things, it is well adopted by users. DSpace is also new for librarians in Nepal. Nepali librarians are gradually using ICT for providing library services (Nyaichyai, Luitel, & Maharjan, 2021). Usability testing has been used for various systems to quantify user performance and subjective satisfaction. Even though usability testing was first used in the 1980s, it is still in use today (Wichansky, 2000). While testing the usability of digital applications, questionnaire methods have been widely used (Maramba, Chatterjee, & Newman, 2019). Alshamari and Mayhew (2009) technically reviewed the attributes of usability from 1991 to 1990 and came up with three major attributes: effectiveness, efficiency, and satisfaction. There was learnability, reliability, and speed of performance was also traced out as attribute. Similar to Alshamari and Mayhew (2009) review, Harrison, Flood, and Duce (2013) compared and contrasted various attributes of usability, where they found the additional attributes context, cognitive load, user, and time. However, they were specified for the mobile application usability test. The common definition for commonly measured usability attributes is as follows:

Ease of use: It means easiness while using the system.

Usefulness: Ability to fulfill meeting the goal.

Effectiveness: Effectiveness is the ability to complete specified tasks. It is judged whether a particular task was completed well or not.

Efficiency: Efficiency is the ability to complete specified tasks with speed and accuracy. The measurement of time to complete a task is applied for efficiency.

Satisfaction: Satisfaction is the pleasant situation reflected in using the software. To measure it, a qualitative or questionnaire method is used.

Learnability: Learnability is the ease of gaining proficiency with the software. How much time did it take to learn to apply for participation? It is measured by observing a participant's performance.

Memorability: Memorability is the ability to retain how to use the software effectively. It is measured by observing a participant operating an application without relearning it (Harrison et al., 2013). The attributes of usability as meant for the quality of use regarding the particular application. These characteristics are frequently evaluated as the elements that contribute to the system's usability, and the present study has also put these evaluations to the test. All these variables sounded resemblances though differs in some extend too (Burney, Ali, Ejaz, & Siddiqui, 2017).

Usability test was conducted to develop and evaluate the system (Chih-Chung, Liu, & Wang, 2017; Doesburg et al., 2017). Development and evaluations are circular tasks complemented for each other. In both cases, usability test was steered. However, the usability test led at development stage was termed as formative test and the usability test after development was called summative test. Summative test was more detailed than formative (Generosi, Villafan, Giraldi, Ceccacci, & Mengoni, 2022). Some study applied both questionnaire method and action method for testing usability (Ternauciuc & Vasiu, 2015). So, basically

usability test was required either to develop new features and evaluating the existing features of particular system.

In addition to focusing on system's feature, it can be appended with quality use too (Bevan, 1995). The quality of use denotes to the proclaimed and implied needs being fulfilled when the system is used under stated condition. The three metrics of measuring usability are given as below:

Table 2.2.

Brevan's metrics for usability test.

Effectiveness	Efficiency	Satisfaction
Quantity and quality use of system to the accuracy and completeness	Effectiveness achieved to the expenditure to resource	Comfort and acceptability of use

source: Bevan (1995)

The goal of usability test is to enhance users' ease of use. Usability test is related to human computer interaction (Ghasemifard et al., 2015). The given meaning has signified the users' quality use of the system. Ghasemifard et al. (2015) have described seven types of usability test methods and they also concluded that none of the method is superior to others. One of the methods they described is user-based testing method.

Usability factors are not confined to particular number. Each study has applied numbers of factors. The factors are evolving (Doesburg et al., 2017; Scholtz et al., 2016; Ternauciuc & Vasiu, 2015). However, usability factors that

are commonly found in numbers of study are: effectiveness, efficiency, and satisfaction. Effectiveness is the task accomplishing rate, efficiency is task accomplishing time, and satisfaction is the experiences of the users (Tristan, Woloszyn, & Kaden, 2018).

Another pattern found in usability testing is making compatibility with Technology Acceptance Model (TAM) factors. Usability was put under test for measuring the acceptance of system by users. So, the TAM factors are also equally relevant for usability.

Perceived usefulness (PU) and perceived ease of use (PEU) criteria, which were primarily examined in the Technological Acceptance Model (TAM), have been included in usability studies. Nonetheless, TAM factors also saw a lot of changes (Chih-Chung et al., 2017). Lin (2013) discovered that the TAM and usability test produced inconsistent results. Using TAM, the subjective perception was recorded, and usability testing revealed the objective behavior. He looked into the connection between TAM factors and the system's efficacy, efficiency, learnability, and memorability qualities. The study recommended combining TAM and usability testing. Burney et al. (2017) established an association between TAM and usability using a very similar research approach. They derived conclusions that the perceived ease of use and perceived usefulness increased the usability attributes of memorability and learnability.

Regular evaluative study would help improving system (Moreira, Gonçalves, Laender, & Fox, 2009). Moreira et al. (2009) has also pointed usability test is much possible as quantitative evaluating measures. However, usability test was not applied extended for qualitative tools like observation too. Usability was tested through operation of system.

A study on usability test on the DSpace installation and configuration was one among such. It observed operational tasks on DSpace installation by users (Körber & Suleman, 2008). Another study was made on usability of data uploading in DSpace, which had applied yet another observational tool (Boock, 2005). Usability studies revealed that DSpace terminologies like communities, collection, and metadata were strange for users. These terminologies are always difficult to understand for new users. The more frequent use can make it more familiar for users.

Factors like accessibility, significance, similarity, timeliness, completeness, conformance, efficiency and confidence were also measured in usability. Similarly, the specific terms coined in DSpace are also equally significant to test for the usability testing of DSpace.

2.4 Methodological literature review

" As yet there is no consensus on what the key criteria are for evaluating the usability of digital libraries"(Mittal, 2005, p. 12). However, reviewing different methods are helpful for this study. User-based usability testing involves real task performance, in which users are observed in actual operating conditions while performing either specific or general activities to run the provided system, and their input is based on their experiences. It does not represent 100% studied population. It is basically qualitative study. However, quantitative data could be generated through qualitative research tools (Beck & Manuel, 2008). Nonetheless, questionnaire method is considered as better choice for large scale qualitative data collection for usability (Ternauciuc & Vasiu, 2015).

Survey method was applied while investigating the challenges and barriers of institutional repositories in the USA, which find out 37 kinds of barriers and

interpreted from the librarians' perspectives who were working as institutional repository librarians (Joo et al., 2019). The combination of quantitative and qualitative research approaches to examine the adoption and use of institutional repositories in higher education. Another research technique used to determine the importance of institutional repositories for open archive projects at Nigerian universities was the explorative literature review (Ejikeme & Ezema, 2019).

The usability testing techniques used with DSpace software, an institutional repository program, are numerous. While measuring the usability of particular systems in DSpace, there has been applied ISO 9241-11 ergonomics of human-system interaction and System Usability Scale (SUS) propounded by John Brooke (Meyer, 2015; Tristan et al., 2018). The effectiveness, efficiency, and satisfaction are evaluated in accordance with ISO 9241-11, while the System Usability Scale (SUS) test uses a subjective evaluation of the system's usability to get a usability score (Meyer, 2015). ISO standard of usability test has been widely used, where effectiveness, efficiency and satisfactions were measured in objective way. While Nielsen's usability test has added learnability, memorability, error recovery as the variables (Aljohani & Blustein, 2015b; Nielsen, 1994). The variables reliability and flexibility was also found measured for system's usability test (Khoshnevis, 2021). Usability test has been developed to eliminate the subjective assessment of user-friendliness (Aljohani & Blustein, 2015a). Both subjective approach and objective approach has been utilized for the usability test.

Zhang, Maron, and Charles (2013) reported lab-based testing and questionnaire methods for evaluating usability in the college of Veterinary Medicine at Purdue University research repository. The usability was tested at article finding, article submission, addition of bibliographic information, and

designing interface of the repository. They have explained the problematic parts and satisfactory parts of the usability of the repository. They tested the usability of the research repository on seven graduate students.

2.5 Research gap

DSpace software is marching toward advancements with the largest DSpace community globally. From the comparative point, there are studies made for number of comparative studies among number of open-source digital library software (Abifarin & Imavah, 2019; Essien et al., 2022; Khan, 2019; Pyrounakis et al., 2014). Similarly, DSpace software is under study from different researchers from various countries (Boock, 2017; Chaudhari & Patel, 2019; Meyer, 2015; Ottaviani, 2006; Rajović et al., 2018; Yang et al., 2020). The growth of digital institutional repositories is increasing (Aljohani & Blustein, 2015b; Baudoin & Branschofsky, 2003; Gorton, 2011; Kulesz, 2011; Velmurugan, 2013); however, it is the lesser in quantity from Nepal. The Nepali study has not yet been discovered. There hasn't been any research done on how Nepali librarians and end users feel about DSpace's usability as an institutional repository. Nepal was not covered by other studies for the digital institutional repository.

In addition, the plug-in option of plagiarism checking software in DSpace was found unaccomplished task. It demanded for higher technical expertise. But it is possible to reveal how much institutional repositories were traced out by anti-plagiarism software. In Nepal, the awareness against unethical academic activities has been growing. In such context, this study has added a solid contribution for achieving academic integrity.

Chapter 3 : Research methodology

3.1 Philosophical perspective

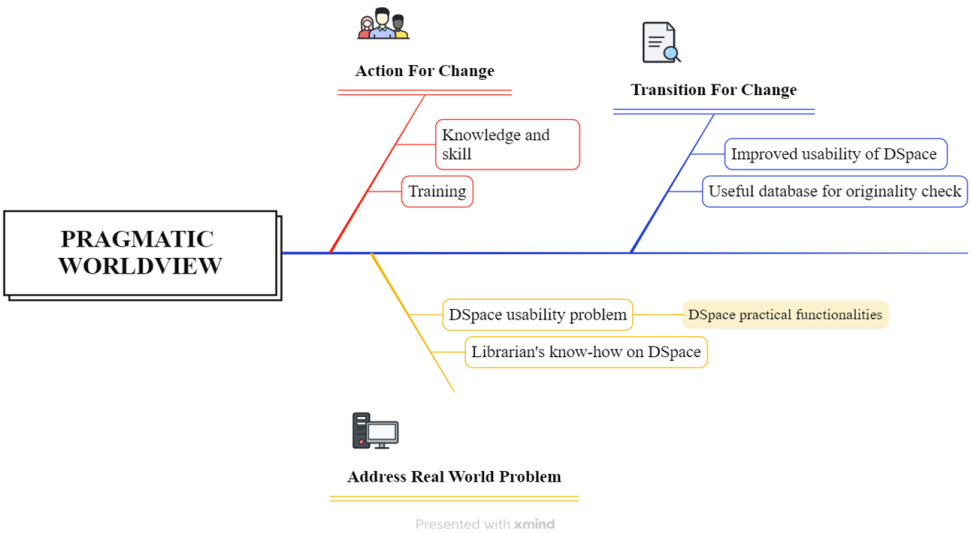
The study is based on pragmatic worldview (Creswell, 2009). The core of pragmatism is change; however, change does not mean simultaneous one, rather it is the action that led the change. Change is temporarily mediated difference (Koopman, 2009). The change in this study is implied as the more useful, the easier to use, the more effective, the more efficient, and the more satisfaction on DSpace were considered as causes of change. The change is the increased usability of DSpace for librarians and end-users. The actions implied for the change are: training, and orientation, that were conducted before testing the usability. It is because pragmatism has emphasized on knowledge as the major cause of transformation, the knowledge does not mean absolute truth (Godfrey-Smith, 2015). Rather than penetrating in the theory of pragmatism, the study has utilized the pragmatic view of research as described by Creswell, where the study is the problem centered, and real-world practice oriented (Creswell, 2009).

Besides the usability problem of DSpace repository, one more usefulness on DSpace repository is tracing original documents. It was studied with the cases of the Masters' level, Ph. D. level thesis on TUCL e-Library, one of the larger DSpace repository of Nepal. It has analyzed the usefulness of DSpace repository for checking plagiarism. This is how this study is focused on usability problem (Kaushik & Walsh, 2019) of DSpace. Descriptive and analytic statistical analysis for quantitative data and thematic analysis for qualitative data was employed for pragmatic approach of research methodology (Lehong, Biljon, & Sanders, 2019).

3.2 Conceptual framework of the study

As the pragmatic world-view has directed for addressing the real-world problem for the transition that was led by knowledge and action, the given figure 1 has depicted how it was implied for this study. The real-world problem for this study is DSpace usability problem, librarians' know-how on DSpace, and different practical functionalities of DSpace. While the action for the required change is the knowledge and skill, training and practices. The transition is the improved usability of DSpace, all constructs of usability are improved and the DSpace repository being one of the important repositories for checking plagiarism that helped the institutional repository being checked along with international repository.

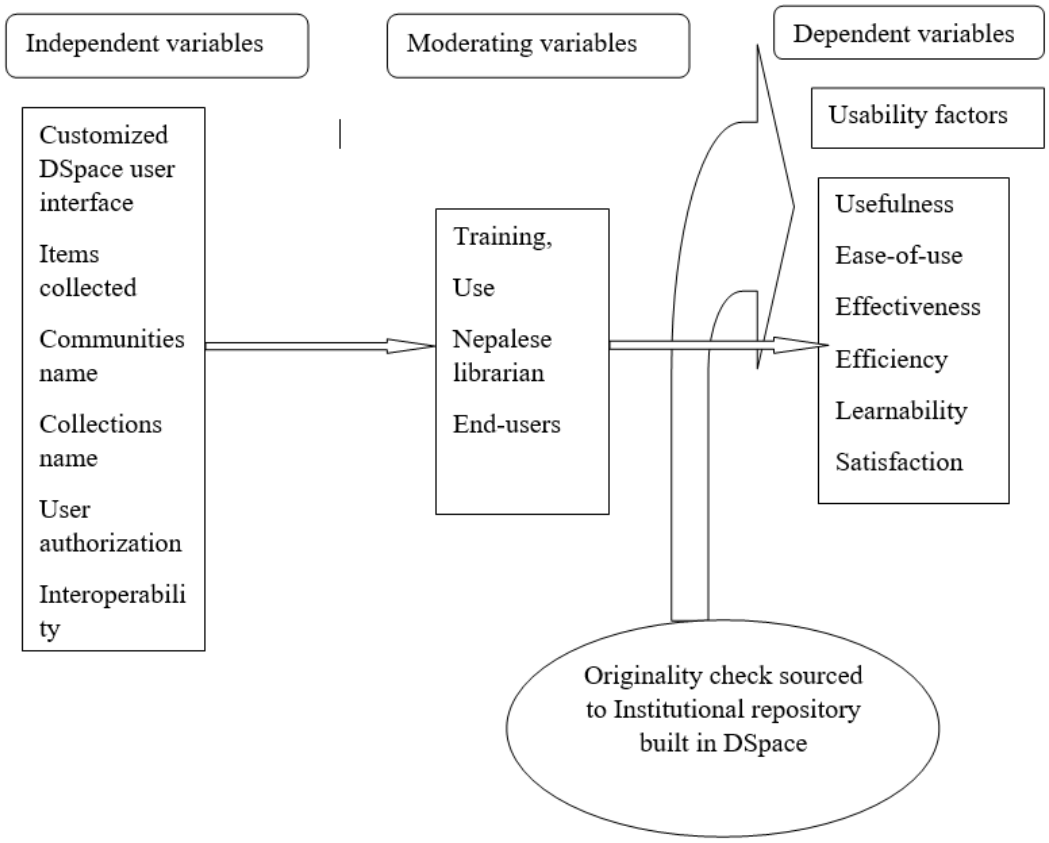
Figure 3.1. Implication of pragmatic worldview for the study.



Basically, the customized DSpace, which has included other default functionalities, were tested for their usability upon Nepali librarians and end-users. Hence, the independent variables for this study are the customized DSpace user interface, digital items collected in DSpace, the names and division of

communities and sub-communities, the name of collections, authorization, and interoperability. Within DSpace user interface, the identification of search bar, browsing options, color used, and instructions were included. The items mean digital collections kept in DSpace repository. Communities and collection names, and structure that each institutional repository has maintained was tested. The functions of user authorization and data interoperability through Open Archive Initiative – Protocol for Metadata Harvesting (OAI-PMH) was also put for usability test. For these usability test, the training, and orientation for Nepali librarians, and end-users was conducted because they are new for DSpace, and its use for institutional repository. So, training, orientation, and understanding capacity of Nepali librarians and end-users was taken as moderating variables for this study. Similarly, the capacity of librarians and end-users using digital institutional repositories are also included as moderating variables. The outcome of similarity or plagiarism checks found in the institutional repository is another independent variable included to this investigation. One of the significant and potential sources to be found for plagiarism checking is institutional repositories. The outcome of similarity or plagiarism checks found in the institutional repository is another independent variable included to this investigation. One of the significant and potential sources to be found for plagiarism checking is institutional repositories. While dependent variable is categorized as usability factors, as listed below in a Figure 3.2.

Figure 3.2. Conceptual framework of study



The customized user interface, varieties and number of collections, the communities and collection names, user authorization (permission given to users' access), and interoperability of DSpace are identified as independent variables because these can affect upon usability factors. Along with these independent factors, the training on DSpace operation can add-ons the usability. The moderating variable has indirect relation with both independent and dependent variable. Nepali context where the use of digital resources is just at the beginning stage, and Nepalese are initial users of DSpace repository. So, their training and the context has indirect influence over both independent and dependent variable. It was proved by the pre-test and post-test comparative evaluation.

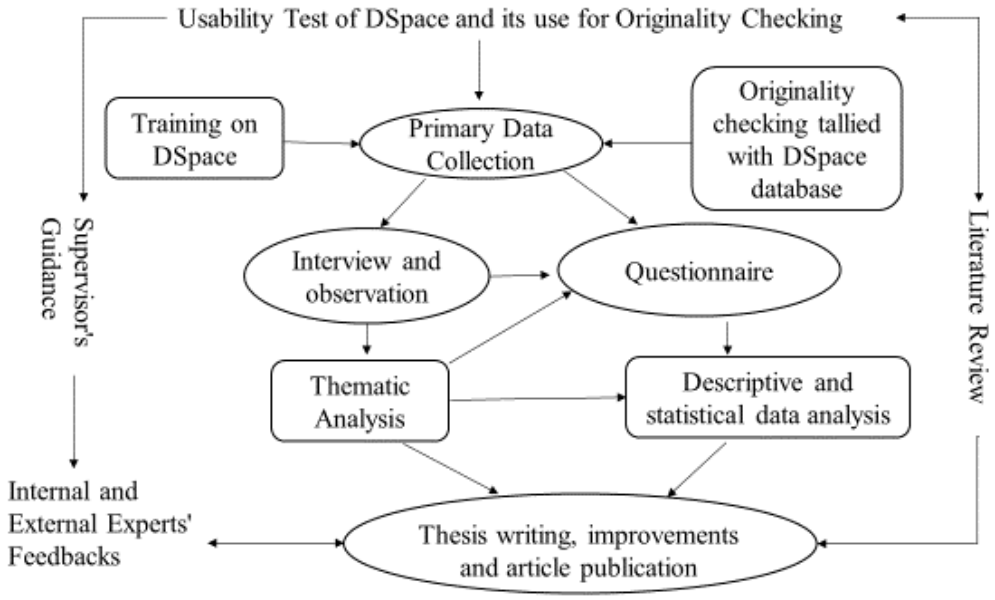
In addition, another feature of plagiarism tracing sourced to DSpace had the enhanced impact for the DSpace plagiarism.

3.3 Research methods

The sequential exploratory strategy was employed for this study. Nepali librarians were questioned about the usability of the DSpace installation during the first stage of the research strategy's qualitative data gathering instrument interview. The first phase of qualitative data collection and analysis was followed by the second phase of quantitative data collection and analysis that has built on the results of the first qualitative phase (Creswell, 2009, p. 211). Sequential exploratory strategy was utilized for usability studies (Nair et al., 2015). However, sequential exploratory strategy was applied only for the studied population of Nepali librarians, not for the end-users of DSpace institutional repository. In addition, the qualitative strategy was applied for DSpace installation process, while quantitative strategy was applied for other operational functionalities except installation. The description of customized DSpace user interface is also qualitative study, based on which quantitative questionnaire was designed. Nevertheless, the study has emphasized on quantitative method rather than qualitative method.

The quantitative approach was used for the end-user population. Additionally, the task performance of the DSpace operation and the plagiarism tracing issue were observed using a qualitative strategy tool. Data was extracted quantitatively from those qualitative instruments. Hence, the observation instrument has also turned to be quantitative means here.

Figure 3.3. Research design applied for the study



3.4 Data collection tools

Interview, observation, and questionnaire, these three tools for data collection were used for this study. Interview was conducted personally (K. Kumar, 1999) in either online mode and physical mode, while interviewees were all working on DSpace installation. Some of them have graduated Masters' degree in Library and Information Science, and some were graduated in Computer engineering. They were asked about their capability and experiences while installing DSpace. It was the purposive sampling (Seghal, 1998) for the interview of Nepali librarians.

3.4.1 Interview

This study investigated how freshmen, systems librarians, and librarians understood how to install DSpace. Whenever work on DSpace is scheduled, the installation process begins first. While the participants installed the DSpace software, the exploration was being done. Three of the seven participants were librarians, and the mentor assisted them at every step of the DSpace installation. The interview helped to dig out the human and social nature of information work

(Gorman, Clayton, Shep, & Clayton, 2005, p. 31). This study revealed the participants' views and experiences regarding DSpace installation.

For the three months from November 2020 to January 2021, a training program was held, including DSpace installation as one of the courses. A paper for installing DSpace was supplied to the students, and the instructor watched while it was done side by side. The backgrounds of the trainees were diverse; some were computer scientists, some were in the field of library science, and some were DSpace software newbies. The entire group of 7 trainees was questioned about their comprehension of and experiences with installing DSpace. To examine the common viewpoints of the interviewees, open-ended questions were used throughout the interview. The Zoom video conferencing program was used to conduct the interviews. Only one participant took part in the in-person interview.

3.4.2 Questionnaire

Multiple choice questionnaires were distributed through Google form for librarians for both pre-test and post-test usability testing (Table 3). In between pre-test and post-test questionnaire filling, respondents were trained online about the operation of DSpace.

While a brief introduction to utilizing DSpace was given to end users prior to filling out the questionnaire for the usability test. To end users, a single questionnaire was given. Likert scale was used for end users. Table 3 lists the questions that are pertinent to usability aspects. In contrast to the questions posed to librarians, the end users were given the option of five Likert points, ranging

from strongly disagree to strongly agree, for each of the six usability aspects. It used ordinal numerals to calculate. (R. Kumar, 2018).

Table 3.1.

Usability factors and related statements asked to end-users

Factors of Usability	Items	Measures
Usefulness (U)	U1	DSpace is useful for the library profession
	U2	Knowledge of data harvesting from others' DSpace repositories using OAI PMH is a useful feature
Ease of use (EU)	EU1	The Doblin core meta-data scheme is easy to understand and use in DSpace
	EU2	Data harvesting is easy to use in DSpace
Effective (EF1)	EF1	File format pdf and Docx are more feasible to upload files in DSpace
	EF2	I can install DSpace with the help of an expert, document, and self
Efficient (Eff)	Eff1	DSpace takes 5-10 minutes for the file-uploading process
	Eff2	The description for the file uploading process is self-understandable in DSpace
Learnability (LE)	LE1	The use of community, sub-community and collection is understandable by their name.
	LE2	The purpose of e-person is understandable in DSpace institutional repository.
Satisfaction (SA)	SA1	The most liked usage of DSpace is managing digital content
	SA2	I am satisfied with the process of file uploading

3.4.3 Observation

Through observation, Nepali librarians were observed operating DSpace. Before observation, they have participated training to operate DSpace, and had filled the questionnaire on DSpace usability. In addition to completing questionnaires, eight librarians chosen from the respondents had an observation session. They were chosen at random. They were required to log in, create communities and collections, upload files, and sign up as new DSpace members. OBS Studio was used to record their active screen. They received an invitation to

the TU Central Department of Library and Information Science's computer lab. For the sake of data analysis, the observation was quantified (Diah, Ismail, Ahmad, & Dahari, 2010).

3.5 Population frame and sampling

The population frame of this study is library professionals willing or using the DSpace software, and end-users of Nepal who were using the DSpace. The total population size was determined for quantitative data collection from Nepali librarians, whereas the number of end-users is not fixed population, hence, this study attempted to collect as much as possible.

Random sampling was applied. Nepali librarians were emailed to fill the pre-test questionnaires and those were requested to participate in the training and then they filled post-test questionnaire. Purposeful sampling was applied for applying qualitative means. In the case of end users, the DSpace repository holding institutions were selected. Respondents were randomly selected for those institution.

Nepali librarians were limited in number (118), however, the study required those who at least be familiar about DSpace software and its functionalities. So, the approach to librarians were made as per their academic qualification in Library and Information Science and their familiarity with DSpace.

The familiarity, and willingness of using DSpace software for librarians were set as the criteria of selection (Wildemuth, 2009). Whereas end-users are students of Bachelors, Masters, Masters of Philosophy (MPhil), and Doctor of Philosophy (Ph. D.), who required digital resources for their study purposes. Third type of population are Masters and Ph.D. thesis for checking the plagiarism traced

out from institutional repository using DSpace. They were randomly selected aiming to show the tracing parts from institutional repository. Institutional repositories on DSpace were selected from all academic institutions as cases. All of these DSpace had customized user interface, and customized browsing options.

For the qualitative data collection interview was conducted on seven librarians, among them three were systems' librarians and five were MLISc graduated. The Zoom platform was applied for the interview except for the one.

There was use of both qualitative and quantitative tools used for testing usability (Alshamari & Mayhew, 2009; Hughes, 1999). For the quantitative study on librarians, Masters' graduates were selected. In this study, the sample size was taken as per a statistical formula. Masters in Library and Information Science graduates, who were currently working as librarians are 118 in Nepal. With a confidence level of 95%, a margin of error of 10%, population proportion of 50%, the sample size was 54 librarians.

Before and after the DSpace training, the participants completed a structured multiple-choice questionnaire about the features for uploading files in DSpace, creating communities and collections, creating user groups and members, harvesting data in DSpace using the OAI PMH protocol, and installing and customizing DSpace. After the training, the post-test questionnaire was completed. The respondents were emailed the questionnaire in on the Google form. The responders initially answered the pre-test questions before being invited to a 2-hour online training session and receiving the same questionnaire to complete. Participants are all Nepali librarians with master's degrees in library and information science.

End-users were also oriented how to use DSpace for searching information. They were made to search information for them, then they were asked to provide their responses on given questionnaire with Likert scale. With pre-information end-users were invited in an orientation session, then were asked to fill the questionnaire.

For plagiarism checking, the documents were randomly selected, which were submitted for plagiarism checking at Tribhuvan University Central Library (TUCL), from the date when TUCL has subscribed iThenticate software. The author and the discipline were not revealing for plagiarism checked document for this study purpose.

3.6 Methods used to analyze data

Data for the study was primary data. Two types of questionnaires were prepared: one for multiple choice structured questions asked for Nepali librarians and another set of questions was in five-point scale Likert scale. In Likert scale, the respondents were asked with five-point scale to measure attitude as: they have retrieved needed information using DSpace institutional repository system, and the score was assigned as following:

Strongly agree (5)	The score 2 is given for this answer
Agree (4)	The score 1 is given for this answer
Neutral (3)	The score 0 is given for this answer
Disagree (2)	The score -1 is given for this answer
Strongly disagree (1)	The score -2 is given for this answer

The score was given for the multiple-choice questions as a percentage. A ranking was established. A score of 80% or higher was considered excellent, a

score between 60% and 80% was considered good, a score between 40% and 60% was considered fair, and a score below 20% was considered bad. It utilized Best-Worst Scale (BWS) (Louviere, Flynn, & Marley, 2015).

The descriptive statistical analysis, thematic analysis, and correlation statistical tools have been employed for usability test and reveal the relationship among variables as stated in research questions. The statistical analysis has used Excell and statistical package for social sciences (SPSS). Qualitative code analysis used Atlas.Ti 9 version. T-test, Chi square test, variations, and descriptive analysis were applied as per objectives.

3.7 Reliability and validity

The repeatability of the research is reliability whereas the correctness and the accuracy of answers given is validity (Gorman, G.E. and Clyton, 1997). Perfect validity would assure perfect reliability but in contrast, perfect reliability may not mean perfect validity. The qualitative data retrieved through interview was validated through consecutive process followed during the research (Hayashi, Abib, & Hoppen, 2019) , it was also triangulated with observation method and quantitative method (Golafshani, 2003). During the research, librarians who were asked about the usability of DSpace installation process were engaged in three-month long training that instructed installing DSpace 6.3 as one of the contents. Likewise, 54 librarians who were asked about the usability of DSpace operational functionalities were also oriented and had hands-on practice. The same model was conducted for end-users who were oriented for half and hours about the information searching mechanism of DSpace and made them practice. Only after their practical use, their feedback on usability test of DSpace was collected. These research process assured the reliability of research (Hayashi et al., 2019).

Nevertheless, the quantitative tools used were on the DSpace operational functions and librarians' experiences on usability, and the qualitative interview was focused on DSpace installation process. Though they are different functions, but carried same behavioral aspects while dealing with software (Franklin, Cody, & Ballan, 2010). For the quantitative data validation factor analysis was applied. The cut off value is 0.7 for factors that are valid for analysis. It was kept in 4.4 section too.

The reliability of end users' data for statistical analysis was determined by Cronbach Alpha (Cα) valued 0.914, which is higher than 0.7; it meant the collected data is reliable for statistical testing. Similarly, Cα for librarians' pre-test data is 0.907 and their post-test data Cα value was 0.924. Both values were higher than 0.7. It implicated the reliability for statistical analysis.

Before statistical analysis data were tested for reliability statistics analysis and Kaiser-Meyer-Olkin (KMO) that measured the sampling appropriateness ("KMO and Bartlett’s test of sphericity," 2020, May 9) and Bartlett's Test (Table 4.13). The value of KMO for librarians' pre-test and post-test data is 0.764 and 0.771. The data is average for sampling adequacy. The value of KMO for end users' data is 0.812, i.e., it is meritorious in sampling adequacy (Beavers et al., 2013). However, the p value is 0, which is less than 0.05, so, it is valid for further statistical analysis.

Chapter 4 : DSpace usability

4.1 Nepali institutional repositories in DSpace

For all institutional repositories in Nepal, DSpace 6.3 has been implemented. DSpace is used by the majority of academic institutions, and some non-governmental organizations have also embraced it. Table 4.1 provides a list of Nepali institutional repositories on DSpace.

Table 4.1.

List of Nepali institutional repositories in DSpace

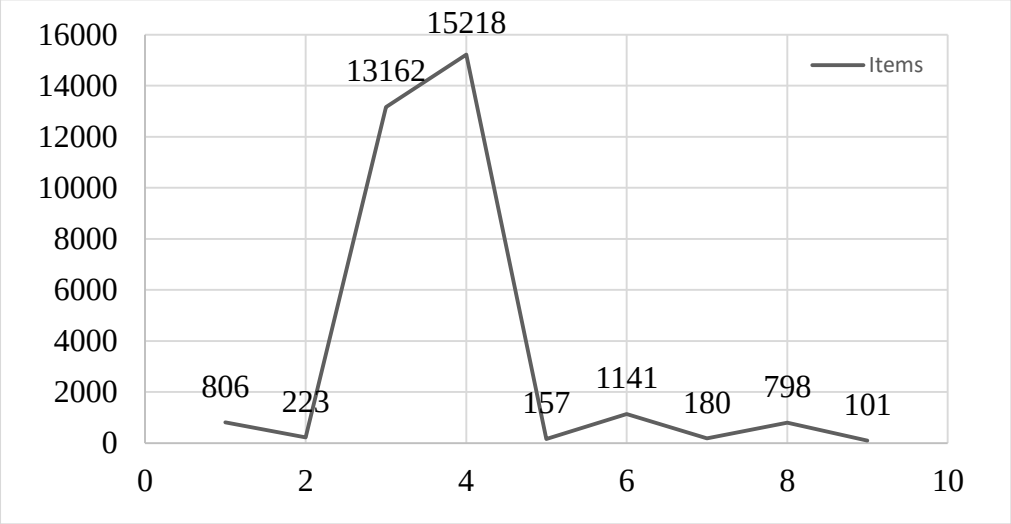
SN	Institution	URL	Items
1	NNL	http://archive.nnl.gov.np/	806
2	CCT, Dharan	http://202.45.146.37:8080/jspui/	223
3	TUCL	https://elibrary.tucl.edu.np/	13162
4	OLE Nepal	https://pustakalaya.org/en/	15218
5	CDLIS, TU	http://elibrary.tucdlis.edu.np/	157
6	GCI	http://elibrary.gci.edu.np/	1141
7	Khwopa	https://elibrary.khec.edu.np/	180
8	NHRC	http://elibrary.nhrc.gov.np/	798
9	CAAN	http://dspace-caan.healthnet.org.np:8080/caan/	101
10	Nepal Army	https://www.nepalarmy.mil.np/nawc/library	NA

Source: Related websites

With the greatest number of items (15, 218), the Open Learning Education (OLE) Nepal collection is devoted to children's educational materials and consists of text books, stories, novels, audio documents, and video documents. The Civil Aviation Authority Nepal (CAAN), which has uploaded documents pertaining to procedures, manuals, rules, and regulations, has the fewest collections, while the Tribhuvan University Central Library (TUCL) e-Library, which compiled master's, M. Phil., and doctoral theses and reports, has the second-highest collections (13,162). OLE Nepal is basically a digital children's library, TUCL e-Library is the university library and CAAN is the office library. These numbers of

collections represented the size of the related libraries. There is always more space for TUCL's electronic library to grow because there are more theses available.

Figure 4.1. Items collections of Nepali DSpace repositories



The quantity of institutional repositories in Nepal as of right now (2019–2022) has almost the same size as the India had from 2009–2012. But throughout the first ten years of the twenty-first century, Nepal had much fewer institutional repositories (IR) than India. With the exception of six, DSpace was utilized to build 31 institutional repositories (IR) in India (Kalbande, 2012; Kumar, 2009; Tripathi & Jeevan, 2011). In Nepal as well, DSpace is the most widely used IR software (Chaudhari & Patel, 2019).

Extensive Markup Language User Interface (XMLUI) was outperformed by JavaServer Pages User Interface (JSPU) for the Nepali IR user interface in DSpace. These are the two options that DSpace version 6.x offers. Both styles of user interface have been accepted equally by the users (Karki, 2022). While each of these IR has a distinct community structure. The functionalities of DSpace were made clearer by the descriptions of each IR.

Table 4.2.

Status of DSpace configuration, customization and resources types.

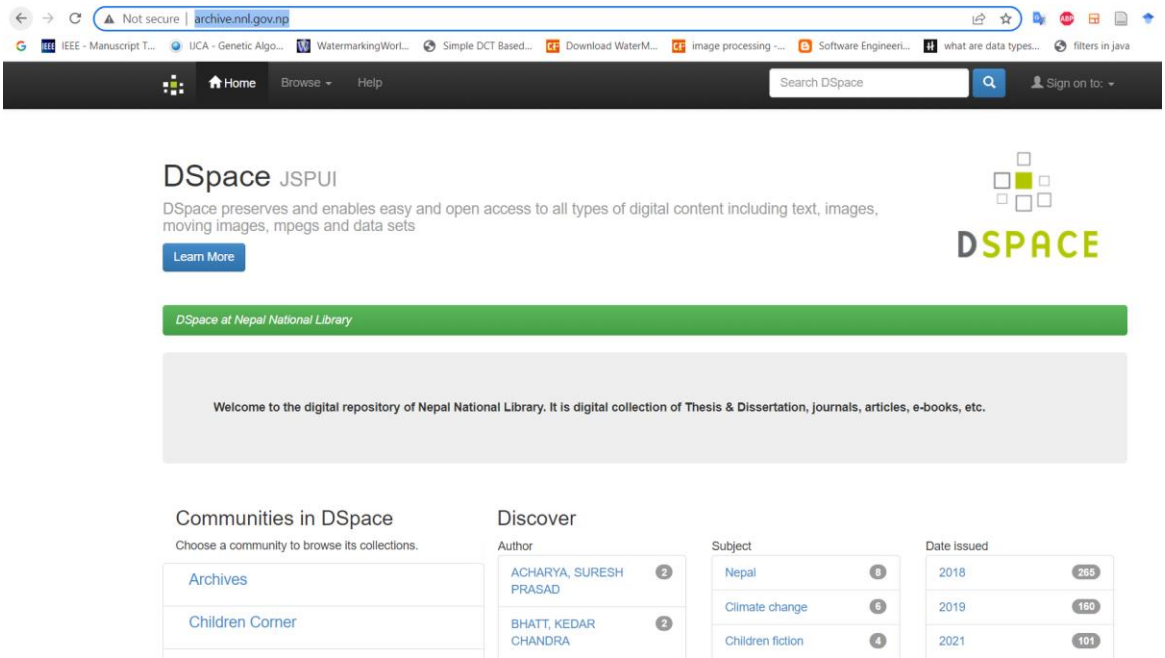
IR	Customization	Communities	Sub-communities	Collection types	Authorization
NNL	NA	5	12	Archival text in Sanskrit, Reports, Books, Thesis, Journals	Required for archives
CCT Dharan	NA	5	5	Thesis, and Journal articles	NA
TUCL e-Library	changed color, logo and name, added browsing filters	8	27	thesis, reports,	NA
TUCDLIS e-Library	changed color, logo and name	10	21	Thesis, reports, class presentation, bulletin, articles	NA
Khwopa e-Library	changed color, logo, and name	8	1	Thesis, reports, bulletin, journal	NA
OLE Nepal	added cover pages of books, icons of sources	6	NA	audio, video, text books, practice books	NA
NHRC	Changed logo and name	10	NA	Thesis, reports, journal articles, act, policy, guidelines	NA
Nepal Army e-Library	NA	NA	NA	NA	NA
GCI e-Library	Changed logo and name	7	NA	e-books	required
CAAN DSpace repository	NA	5	NA	Manual, procedures, reports	required

The types of collections, number of communities, and sub-communities are defined as per the local need of libraries. All customizations were made for the user interface on logo of library, and the corresponding colour use. Only NLA has kept the authorization provision for the archival materials.

4.1.1 Nepal National Library (NNL).

According to Sanjib Chaudhary (personal communication, January 27, 2023), the Nepal National Library began IR in DSpace in 2019 and has since uploaded 806 articles. The user interface of NNL IR is represented in the offered figure 1 by JSPU, which makes use of the DSpace 6.x version default. In total, five communities—Archives, Children's Corner, Depository Collection, Dissertation, and Serials—were categorized. Only the community serial is retained, which is a subcommunity called Journal. The communities were developed in response to the needs of the regional collection. The face of the document lacked the NNL name and logo. According to DSpace's default layout, the search bar is at the top.

Figure 4.2.User interface of NNL IR

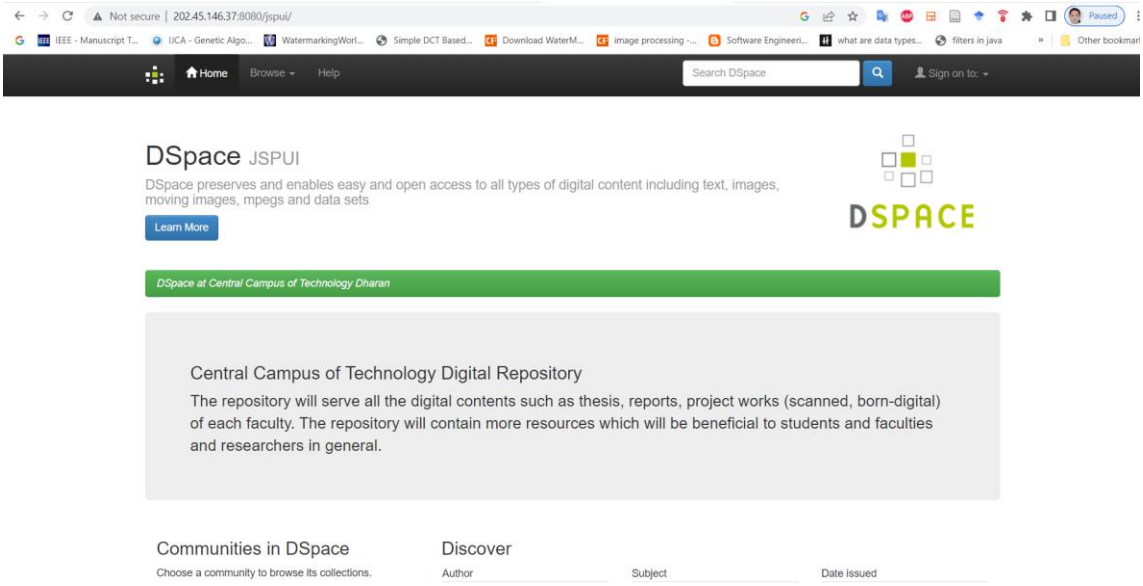


4.1.2 Central Campus of Technology (CCT) Dharan

With assistance from the Nepal Library and Information Consortium, CCT Dharan has maintained IR since 2018. (NeLIC) (Om Nath Khatiwada, personal communication, January 27, 2023). Since NeLIC is no longer providing support,

CCT IR is still operating with the assistance of local technicians but without a customized appearance. It comprises five departments, each with a single sub-community: Biology, Food Technology, Microbiology BSc and MSc, Nutrition and Dietetics, and Himalayan Journal of Science and Technology. Its DSpace JSPU interface is the standard version without any customizations.

Figure 4.3.CCT Dharan IR user interface



4.1.3. Tribhuvan University Central Library (TUCL) e-Library

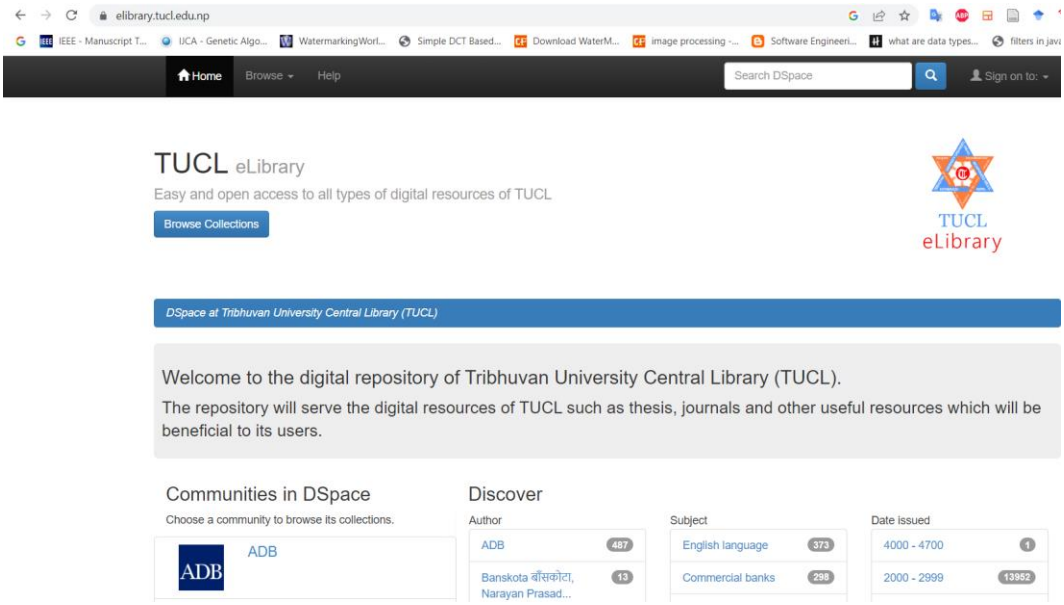
The second-largest collection (13,162) of Nepali IR, the TUCL e-Library provides free access to everyone. It has organized Asian Development Bank (ADB) papers and theses at the Masters, M. Phil., and Ph. D. levels. Reports from ADB have also been kept in NNL IR. It is a redundant task.

The interface has a localized appearance with the name and official emblem of TUCL. TUCL e-Library is the name of the IR. It has a blue color added that differs from the standard color. Submit date, institute name, level, and country have been added as browsing filters. It made it easier to find certain information. An excellent reason to choose IR is the information's high precision

ratio (Abifarin & Imavah, 2019). It is one of the IRs for which end-user usability testing was done.

There are eight communities created, and three of them—question papers, syllabus, and thesis—each have nine sub-groups depending on the TU departments.

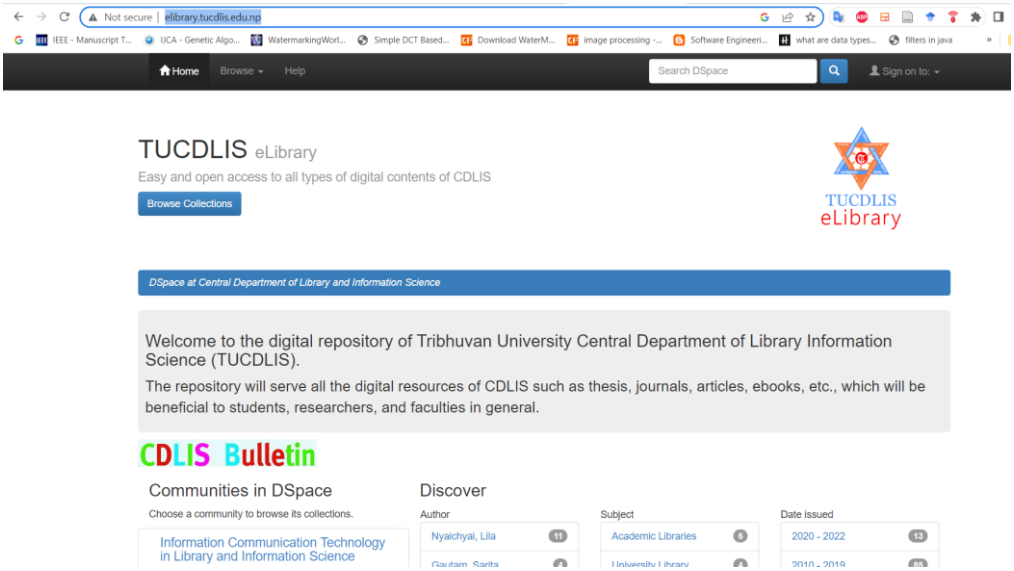
Figure 4.4.TUCL e-Library



4.1.4 Central Department of Library and Information Science, TU (TUCDLIS) e-Library

Starting in 2020, 157 things were uploaded, including theses, reports, bulletins, class presentations, and articles. The TUCDLIS e-Library used the color blue in its interface and displayed its unique name and logo. CDLIS publication, 'CDLIS Bulletin' has been highlighted at the front of the e-Library.

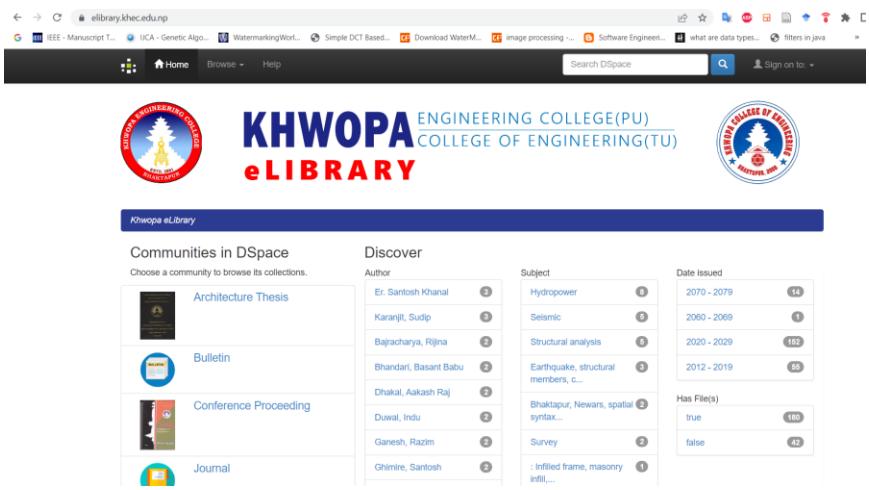
Figure 4.5. TUCDLIS e-Library



4.1.5 Khwopa Engineering College (Khwopa) e-Library

Khwopa e-Library, which was just established in 2022, has reports, conference proceedings, journals, and thesis (Dibyendra Hyoju, personal communication, January 27, 2023). It was a form of consortium since two logos stood in for two different institutions. It has only added 180 collections, though. As the official matched color for it, the dark blue and red color scheme was chosen. It includes eight communities, and the two communities for architecture theses and master's theses each housed a thesis.

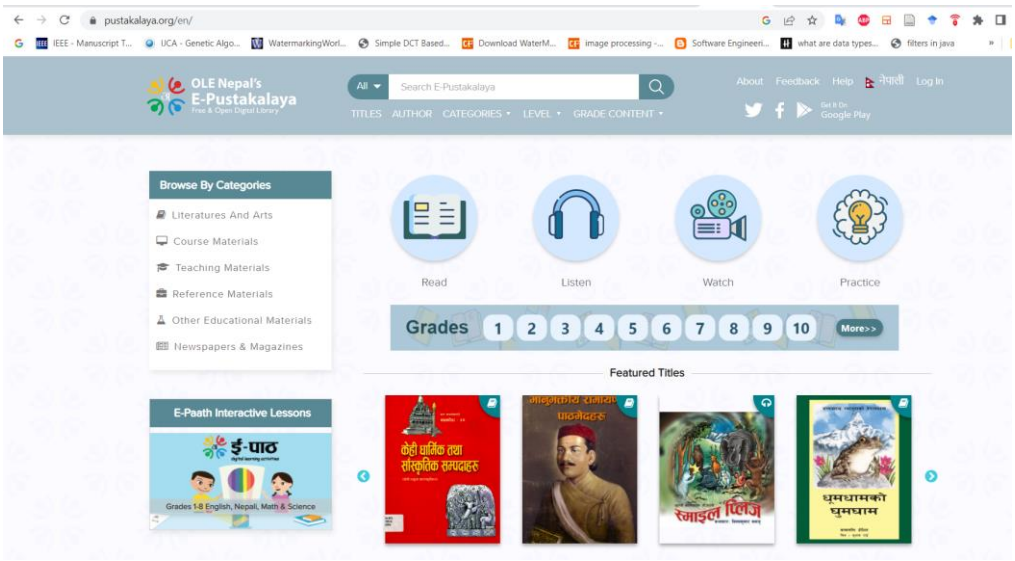
Figure 4.6. Khwopa e-Library



4.1.6 Open Learning Education (OLE) Nepal

A children's digital library with the largest selection is OLE Nepal (15,218). It is comparable to the educational digital publisher for kids. Its user interface had several different customizations. The six categories for browsing have undergone a complete overhaul. For various grades, it offers text books, audiobooks, and videos.

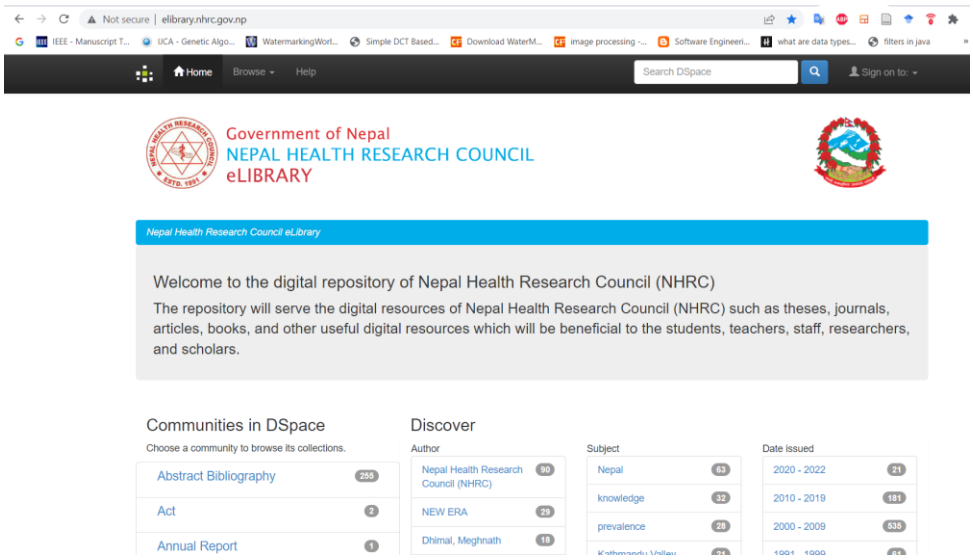
Figure 4.7. OLE Nepal user interface



4.1.7 Nepal Health Research Council (NHRC) e-Library

The value and utility of an e-library are greater in a special library that is geared toward research. Instead of using the usual hue of green, sky blue has been chosen, and both the institutional and parent organization logos have been utilised. It has 798 constructed collections.

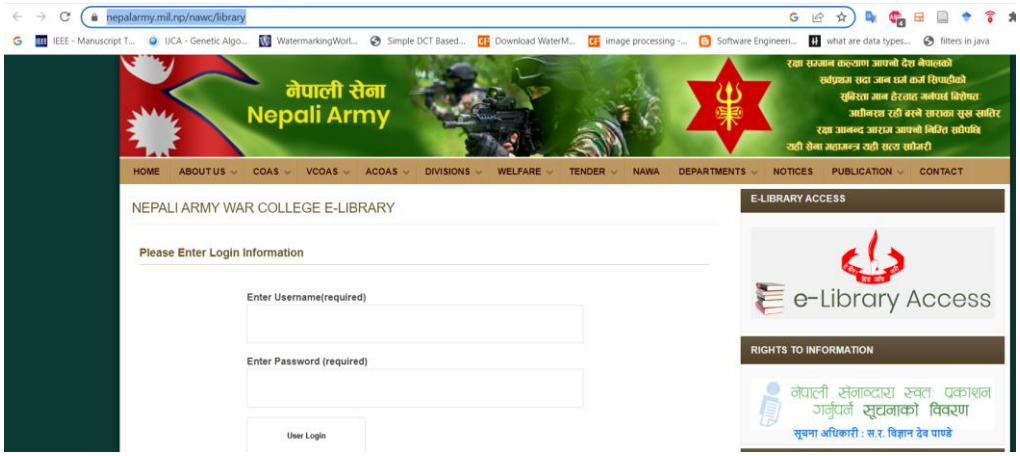
Figure 4.8. NHRC e-Library



4.1.8 Nepal Army e-Library

Due to compulsory authorization required to view the Nepal Army e-Library, any further information is unavailable.

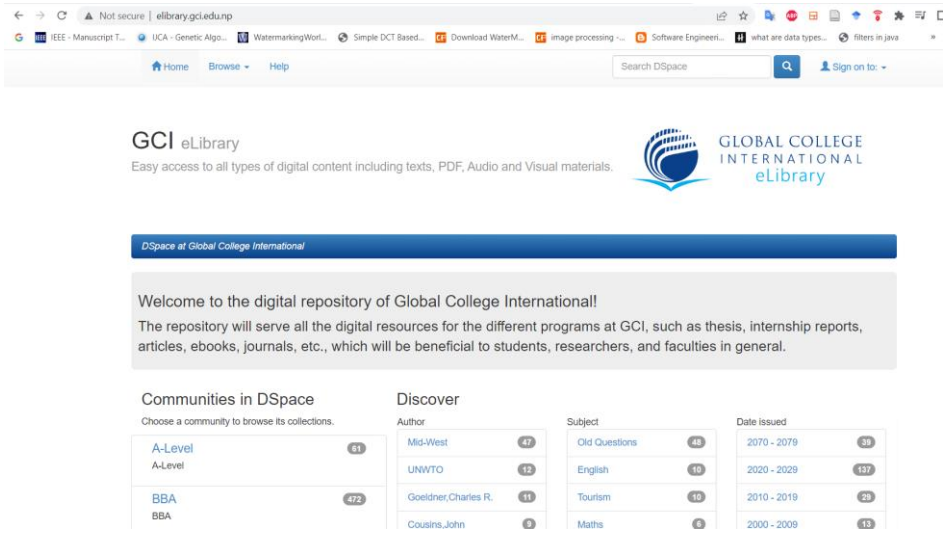
Figure 4.9.Nepal Army e-Library



4.1.9 Global College International (GCI) e-Library

It has overseen the management of e-books pertaining to the subjects covered in the college's curricula. In the GCI e-Library, the name and logo were localized. There are 1,141 built-in collections. For access, users are given their login and password. According to the program they are operating, there are 12 communities.

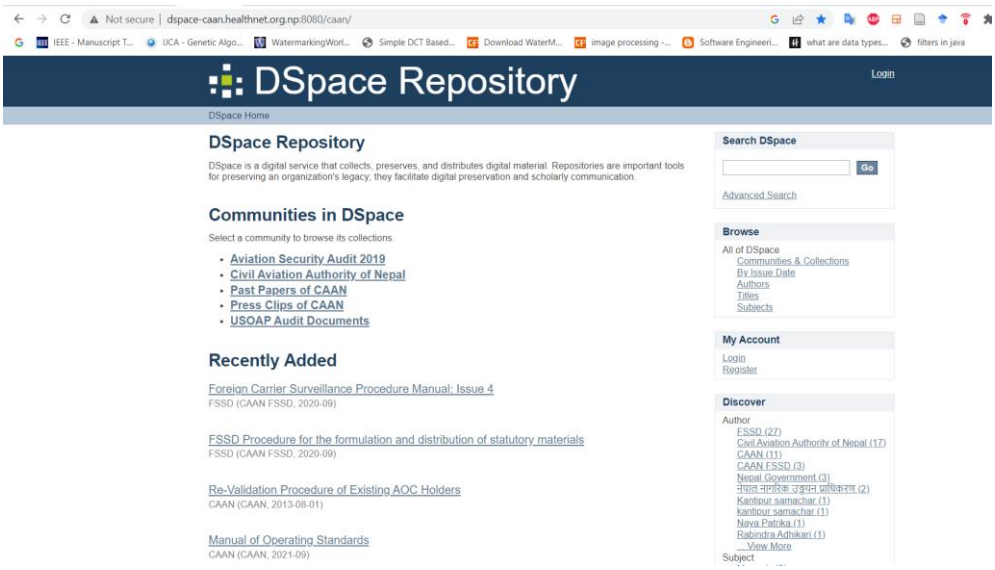
Figure 4.10. Global College International e-Library



4.1.10 Civil Aviation Authority DSpace repository

Five communities are set up according to the types of papers they include, and corresponding collections are submitted. The user interface has not been modified. It was created using the xmlui DSpace interface. It is the sole instance of IR using xmlui.

Figure 4.11. Civil Aviation Authority Nepal DSpace repository



All IR of Nepal, with the exception of OLE Nepal, can accommodate sources of information that are nearly identical. Such sources were noted by Kumar (2009) and held true for Nepali IR as well.

Even if there are few collections, IR has made institutions remotely accessible and digitally visible. It has made a considerable contribution to the gathering, arrangement, and preservation of institutionally generated information resources that would have gone unreported and useless otherwise. These IR are therefore crucial.4.2 DSpace 6.3 installation, configuration, and customization

DSpace installation need to provide proper instruction and it required other compatible third-party software run it. Here is given all steps to be followed in Ubuntu system.

4.2 DSpace 6.3 installation and configuration

DSpace installation at the real-time is one of the harder parts for librarians (Körber & Suleman, 2008), particularly those who are new for it. During the survey, it is viewed inability for self-installation by librarians. Without installation capacity, the usability of DSpace has no use.

Table 4.3.

DSpace installation skill of librarians

Installation skill	Opinion	Pre-test %	Post-test %
Installation skill	Need help from expert	50	56.5
	Unable to install	32	0
	Need installation document	16	23.9
	Self sufficient	0	8.7

Nepali librarians have clearly stated the inability to install by themselves, instead they sought for the help of expert (50% pretest, and 56.5 % Posttest), very few librarians (8.7%) have responded for the self-capability of installing DSpace (Table 4.3).

Although DSpace 6.3 has been provided here as the case to be examined, versions 7.3 and 7.4 are also available. The Linux operating system is needed to install DSpace. Linux distributions include Debian, Ubuntu, and Lubuntu, among others. Linus Torvalds created Linux and programmed it on Unix. He released the kernel code for Linux freely. It was created in 1991 (Hall & Sery, 2001). Kernel is the lowest level of operating system, that handles Central Processing Unit (CPU), and peripheral devices. Linux offers many high-quality software to install ("What Is Linux?," 2023). DSpace is one of the software that is installed in Linux operating system.

4.2.1 DSpace 6.3 customization process

Customized DSpace is a new creation. University of Huston has customized in workflow for uploading large batches of faculty research works in DSpace institutional repository (Davis-Van Atta, Washington, Dulek, & Ramirez, 2019). It is their innovative transformation made in their DSpace repository. Hazarika and Ravikumar (2019) have integrated between document viewer web-based software and DSpace. They have even customized for viewing medical images in DSpace (Hazarika et al., 2020). These efforts have generated a new creation in DSpace.

Because of a lack of expertise and advanced Java programming language abilities necessary to use DSpace. For librarians in Nepal, customization is a challenging aspect. The majority of them hold master's degrees in library and information science, which are heavily demanding in terms of manual labor. The installation procedure for library software and the practical are not covered in the MLISc course (Nira Manandhar, personal communication, 18 February, 2023).

Hence, Nepali libraries should take help from technical resource service institute and resource person. It is true for the cases studied here.

The three Nepali academic libraries TUCL, CDLIS, and GCI has contracted support service from Silverline Technology Pvt. Ltd. that has installed, configure and customized for their IR. These customizations are original to these DSpace database.

4.2.2 Customization of DSpace

Customization of the appearances of DSpace require creating a new theme or modification of stylesheet of the existing theme. There are two user interfaces in DSpace (XMLUI and JSPUI). The following sections discuss the customization of JSPUI. However, configuration, adding local metadata fields and customization of the input forms are common for both user interfaces (UIs).

[DSPACE_SRC] is the directory in which configurations and customizations are performed. We will have to configure DSpace configuration files (dspace.cfg or local.cfg) located in [DSPACE_SRC]/dspace/config. Apart from configuring URL, database connectivity and mail configurations, there are several other things that can be configured by modifying these files. For example, to create custom index and link of the field from which we can let user browse, we can configure the file as shown below.

webui.browse.link.[number] = programbatch:local.program.batch
webui.browse.link.[number] = advisor:dc.contributor.advisor

Here, the Doublin Core meta-data element 'contributor' has been changed into 'advisor'.

To modify the default display format of the item display, Dublin core and local metadata can be added to the “webui.itemdisplay.default” variable.

webui.itemdisplay.default = dc.title, \

dc.contributor.author, dc.contributor.advisor, \

dc.contributor.affiliation, \

dc.identifier.citation, \

dc.relation.ispartof, \

dc.citation.conference, \

dc.citation.journalTitle, \

dc.citation.issue, dc.citation.volume, \

dc.date.issued(date), dc.date.submitted(date), dc.publisher, \

local.program.batch, \

dc.identifier.doi, \

dc.subject.*, \

dc.format.pages, dc.format.extent, dc.citation.spage, dc.citation.epage, \

dc.relation.ispartofseries, \

dc.description.abstract, dc.description, \

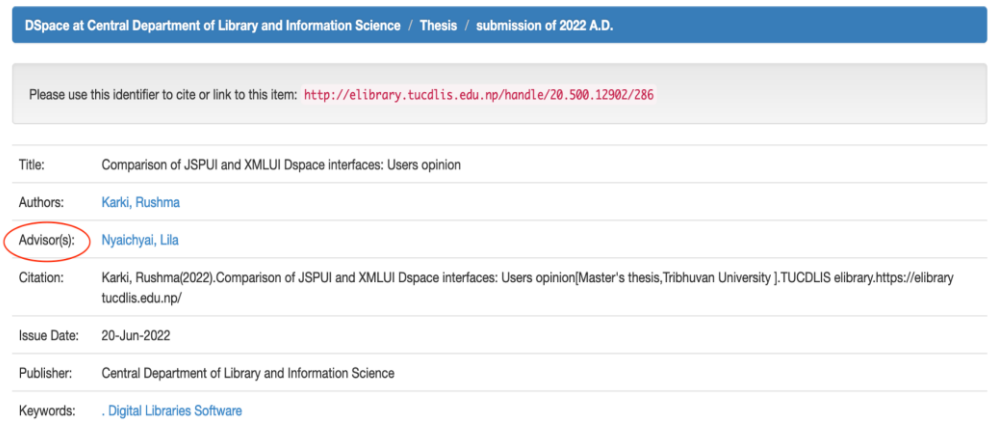
dc.identifier.uri(link), \

dc.identifier.isbn, dc.identifier.issn,

dc.relation.uri(link), \

dc.relation.references

Figure 4.12. Display of additional metadata in 'Thesis' community



4.2.3 Customization of input form

To customize field in the DSpace form, we have to edit “Input-forms.xml” located in [DSPACE_SRC]/dspace/config/input-forms.xml. Furthermore, fields other than already available in Dublin Core (dc) metadata need to be added manually from the local metadata. The following figure shows the element “program” with qualifier “batch” added to the local metadata.

Figure 4.13. Adding local field to the DSpace

In order to add “batch” field to the input form, it can be done by editing the “input-forms.xml” in the following way.

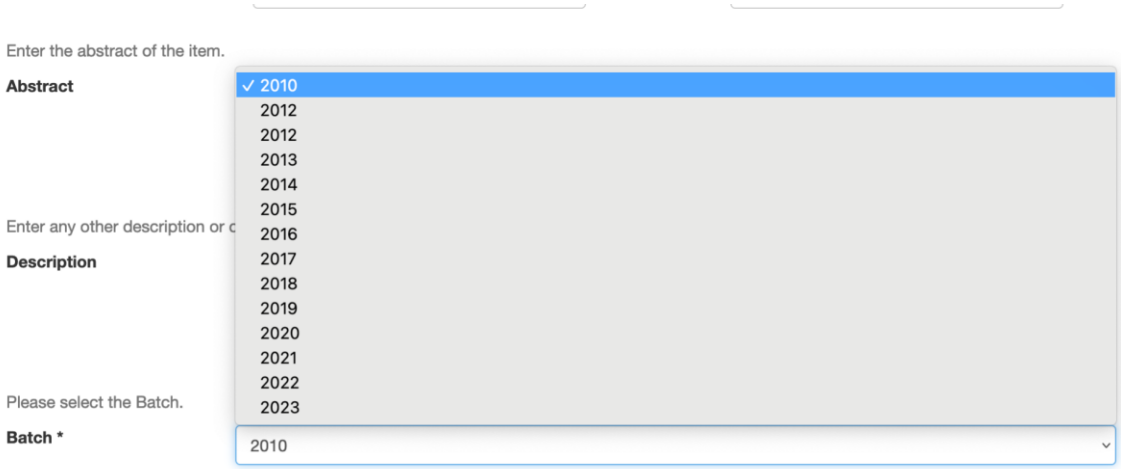
```
<field>
    <dc-schema>local</dc-schema>
    <dc-element>program</dc-element>
    <dc-qualifier>batch</dc-qualifier>
    <!-- An input-type of twobox MUST be marked as repeatable -->
    <repeatable>false</repeatable>
    <label>Batch</label>
    <input-type value-pairs-name="program-batches">dropdown</input-type>
    <hint>Please select the Batch.</hint>
    <required>Batch is required.</required>
</field>
```

To display the drop-down list in the input form for the “batch” field, the same file requires <value-pairs value-pairs-name="program-batches">...</value-pairs> code segment as shown below.

```
<value-pairs value-pairs-name="program-batches">
```

```
        <pair>
        <displayed-value>2020</displayed-value>
        <stored-value>2020</stored-value>
        </pair>
        <pair>
        <displayed-value>2021</displayed-value>
        <stored-value>2021</stored-value>
        </pair>
        <pair>
        <displayed-value>2022</displayed-value>
        <stored-value>2022</stored-value>
        </pair>
        <pair>
        <displayed-value>2023</displayed-value>
        <stored-value>2023</stored-value>
        </pair>
  </value-pairs>
```

Figure 4.14. Display of drop-down list in the input form



Similarly, to add the advisor field in the input form, the following modification can be done in the same file.

```
        <field>
```

```
<dc-schema>dc</dc-schema>
<dc-element>contributor</dc-element>
<dc-qualifier>advisor</dc-qualifier>
<repeatable>true</repeatable>
<label>Advisor</label>
<input-type>name</input-type>
<hint>Enter the names of the advisor of this item.</hint>
<required></required>
</field>
```

The field will be displayed in the input form as follows after rebuilding the DSpace.

Figure 4.15. Adding "advisor" field to input form

4.2.4 Localization of JSPUI

Text in the DSpace JSPUI interface can be localized/modified by adding/modifying the keys in/to the message catalog or changing the particular wording “phrases” of DSpace concepts in the “Messages.properties” located in [DSPACE_SRC]/dspace-api/src/main/resources/Messages.properties. In order to display the advisor separately instead of displaying along with author as “author(s)”, the following keys have to be added to the Messages.properties file.

```
itemlist.dc.contributor.advisor = Advisor(s)
browse.type.metadata.advisor = Advisor
browse.menu.advisor = Advisor
metadata.dc.contributor.advisor  = Advisor(s)
```

Similarly, to display local metadata element “program.batch”, we need to define the values to the following keys.

metadata.local.program.batch = Batch

browse.type.metadata.programbatch = Batch

browse.menu.programbatch = Batch

The changes are made adding the new keys to the Messages.properties file.

4.2.5 Adding discovery options

By default, only a few facets such as Author, Subject and Issue Date are created for faceted searching & browsing of the repository. If we want to create facet such as 'Advisor' from which users can search and browse the repository, we can modify the “discovery.xml” file located in [DSPACE_SRC]/dspace/config/spring/api/discovery.xml as follows.

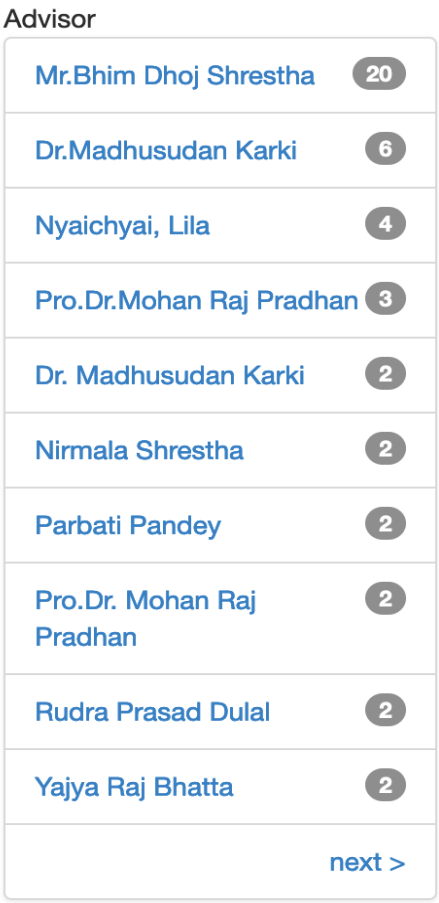
```
<property name="sidebarFacets">
        <list>
                <ref bean="searchFilterAuthor" />
                <ref bean="searchFilterAdvisor" />
                …
               …
                …
        </list>
 </property>

<property name="searchFilters">
        <list>
                <ref bean="searchFilterTitle" />
                <ref bean="searchFilterAuthor" />
                <ref bean="searchFilterAdvisor" />
                …
               …
                …
        </list>
        </property>
```

```
<bean id="searchFilterAdvisor"
class="org.dspace.discovery.configuration.DiscoverySearchFilterFacet">
        <property name="indexFieldName" value="advisor"/>
        <property name="metadataFields">
        <list>
                <value>dc.contributor.advisor</value>
        </list>
        </property>
        <property name="facetLimit" value="10"/>
        <property name="sortOrderSidebar" value="COUNT"/>
        <property name="sortOrderFilterPage" value="COUNT"/>
</bean>
```

After rebuilding the DSpace, we can obtain the following facet in the DSpace discovery.

Figure 4.16. Display of new facet in DSpace discovery

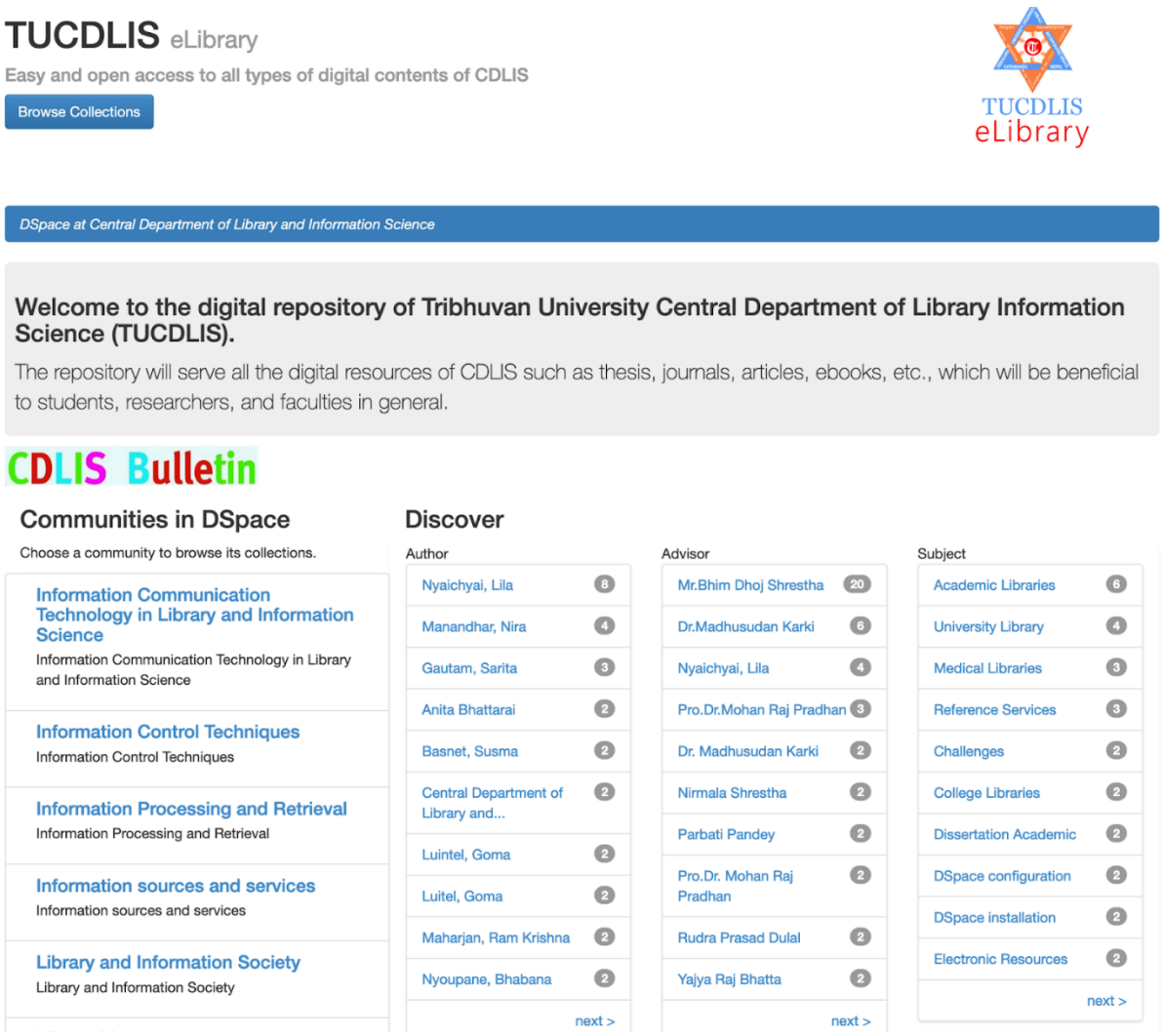


4.2.6 Customization of DSpace JSPUI interface

The different parts of the JSPUI interface can be modified according to our requirements by editing files such as “header-default.jsp”, “community-list.jsp”, “community-home.jsp”, “collection-home.jsp”, “dspace-theme.css”, etc. located under “[dspace-src]/dspace-jspui/src/main/webapp/” directory.

The top and side news section can also be modified by editing the “news-top.html” and “news-side.html” files located in “[dspace-src]/dspace/config” directory.

Figure 4.17. Customization of DSpace JSPUI interface



4.2.7 Rebuilding DSpace from source

From the Linux terminal, we can rebuild the DSpace from the source to apply the changes made to the source code as shown below. It helps to work out all changes made in DSpace.

```
$cd [dspace-src]
$mvn -U clean package
$cd [dspace-src]/dspace/target/dspace-installer
$ant update
```

4.3 Describing the skill and knowledge on DSpace in Nepal

4.3.1 Installation process: easy, effective and satisfied

During the installation process, the ease of use was basically expressed by the participants who were serving in library's system, while the librarians experienced confusions, obliviousness, and difficulties. The challenges for Nepali librarians is the lack of prior knowledge about open source software installation packages, and commands. One of the newly acquaintance Information Technology graduate has experienced the comfortable feelings while installing DSpace by herself during a training. She expressed:

> While working in a Linux operating system for a year, where I finally installed different software, I learned how to assign and change passwords as well as install different packages, among other things, which I used when installing DSpace, even though it was my first time doing so. (Divya Agrawal, Personal communication, January 29, 2021).

For her, it was the first time to install DSpace. She has experienced of installing other software using similar command line and understand using Linux operating system. She knew the standard command lines. In addition, she studied

Information Technology too. Similar work experiences have made DSpace installation easier for her.

During the training session, she performed installation processes instantly after the mentor provided the relevant document and instructions. The ease of use was resonated by another experienced librarians too.

> I've been using DSpace for the past two years. Additionally, I took part in DSpace training courses. Additionally, I had studied MS-DOS commands, which greatly aided in my understanding of Linux commands and helped me gain comfort in working in the Linux environment—the foundation for the installation of DSpace (Goma Banjade, personal communication, July 2, 2021).

The resemblance of command codes between MS-DOS and Linux aided her for the ease of DSpace installation. It is not the awareness about DSpace that made easier, it is the skill of practical use of Linux commands that made easier.

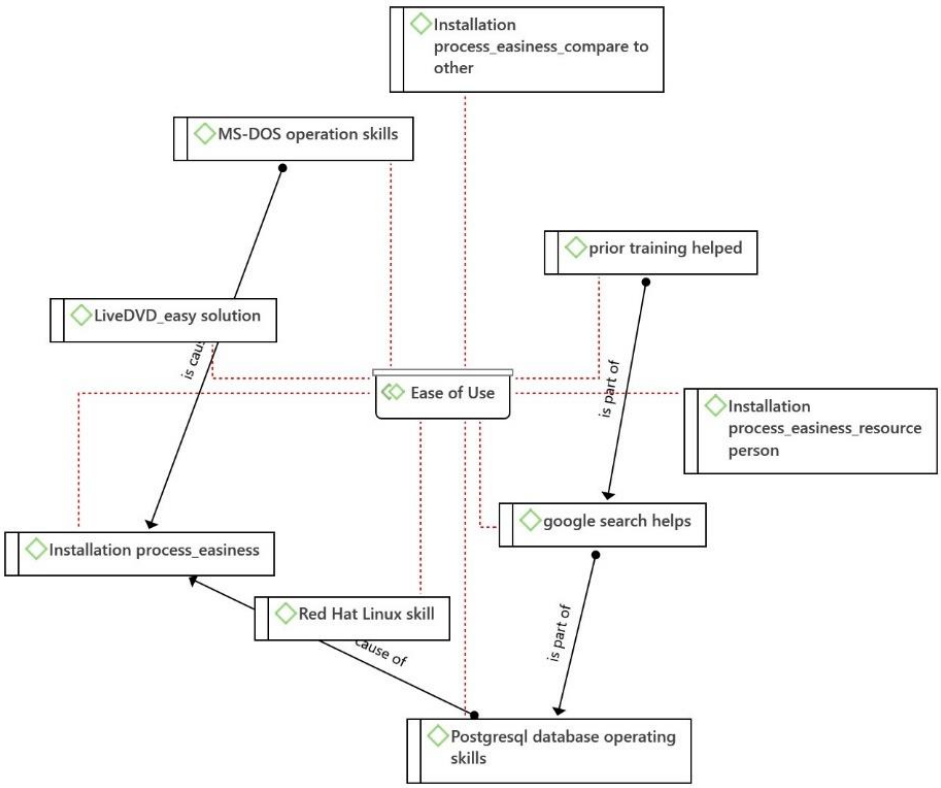
> Before 6 years, I knew about DSpace software that is very useful for the full-text database, but I did not know the installation process. However, the 6 months course I did on Red Hat Linux helped me to understand the DSpace installation (Sajib Chaudhary, Personal Communication, July 2, 2021).

The course that he did on Red Hat Linux was the relevant skill for DSpace installation process that made him easier. The Linux commands are very important for DSpace installation.

One of the experienced system's librarians clearly argued for 'the need of persistent effort, hardworking, continuity and dedication, in addition to the basic

IT knowledge. ' (Jaya Mariapillai, Personal Communication, July 24, 2021). The continuous search and practice have the capacity to learn. Another aspect of ease of use is the learnability of DSpace installation. Some interviewees experienced about the relevant and possible problem solution information in Google searching.

Figure 4.18. Interviewees' perceptions on reasons for easy installation process of DSpace



In Figure 4.18, the skills on Linux commands, MS-DOS commands, Postgresql database, and the provision of LiveDVD have made the DSpace installation process easier. These reasons are inapplicable for the interviewees who lacks such skills.

Additionally, there are blogposts, frequently asked questions answers, websites and many others retrievable documents through searching on web browsers, for instance, Google.

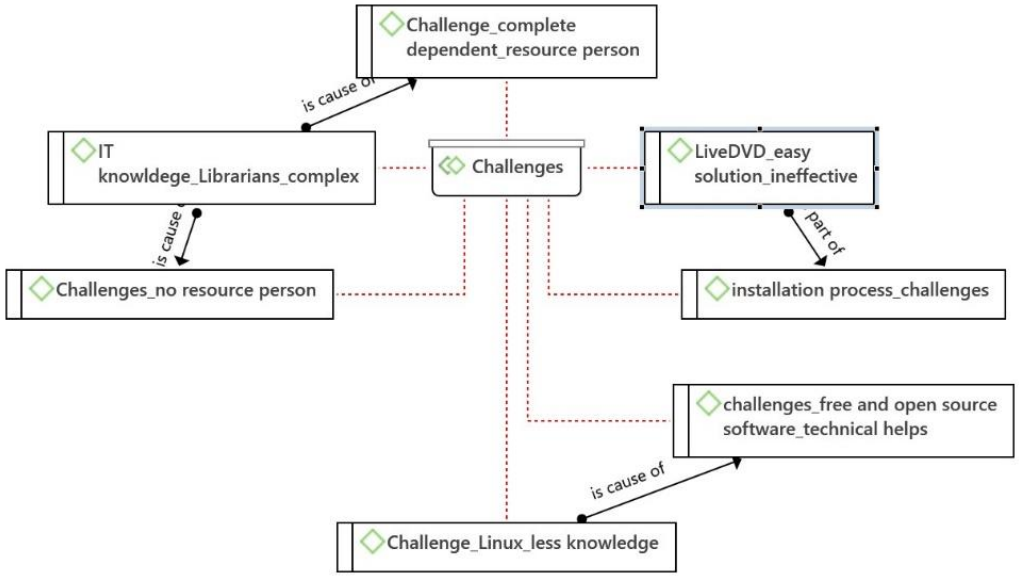
> Everything is possible to find in Google and I know which site may provide for particular problem. So, it helps proper troubleshooting. The error code could be searched in Google that will bring us to right solution. Note down the steps while installing DSpace. It will help to identify the problem if some occurs (Divya Agrawal, Personal communication, January 29, 2021)

There is possibility of searching solutions of problem. It is the mark of effective provisions about the availability solutions for DSpace installation. Another solution is the reuse of configuration files of DSpace availability, "I tried to solve with the backup configuration files, if not solved, I will reinstall DSpace" (Sajib Chaudhary, Personal Communication, July 2, 2021). "The sample of configuration files are kept in various packages of DSpace. If any mistakes took place during configuration, it could be retrieved easily" (Divya Agrawal, Personal communication, January 29, 2021). They were confident of finding solutions if problem occurred. Yet, it was not the case for all librarians, particularly to those who lack the basic know-how of commands.

Kishor Poudel explained his problem "I don’t have proper knowledge on solving problems, if occurs while installing DSpace. I can just follow the steps given in the document of DSpace installation” (Personal Communication, July 2, 2021). Parbati Pandey has also reflected the possible hindrances that "as a student of library science, I know what a DSpace can do, but I don’t know that there are so many technical things to know to be able to install DSpace" (Personal Communication, July 2, 2021).

The limited technical knowledge of librarians caused them unknow to the reasons behind particular commands. They can memorize it, but difficult to understand the reason and meaning of applied commands. In this context, library system's librarians and computer engineer Dibyendra Hyoju (personal communication, July 26, 2021) suggested hiring proper technical persons for DSpace installation, configuration, and customization.

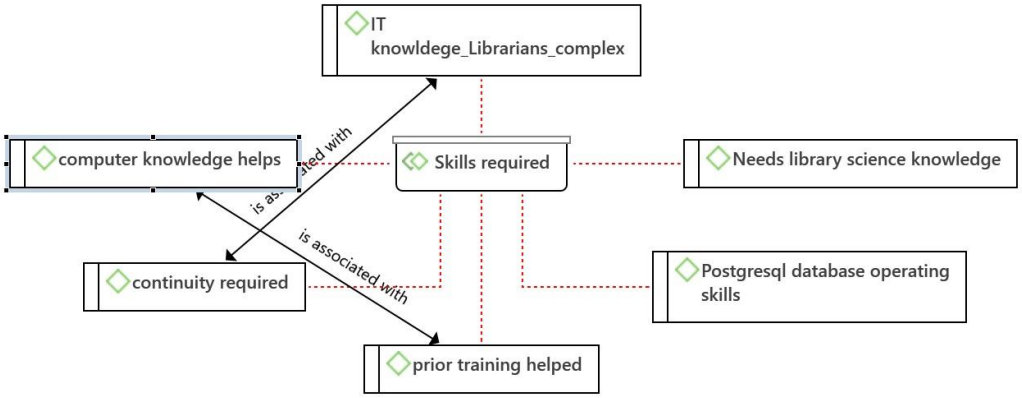
Figure 4.19. Challenges faced for installation of DSpace



In Figure 4.19, the challenges faced for the installation of DSpace were identified as lack of IT knowledge on librarians, lack of resource persons, lack of Linux knowledge, and the nature of free and open source software that requires keen technical help for a librarian.

There are numbers of ways for finding solutions for problem, but the most required thing is the consistent effort from the seekers. Even in the YouTube video, people were found sharing troubleshooting issues on DSpace (Deori, Kumar, & Verma, 2021). But the need of continuity and required longer time has decreased the efficiency of DSpace installation.

Figure 4.20. Required skills for the installation process of DSpace



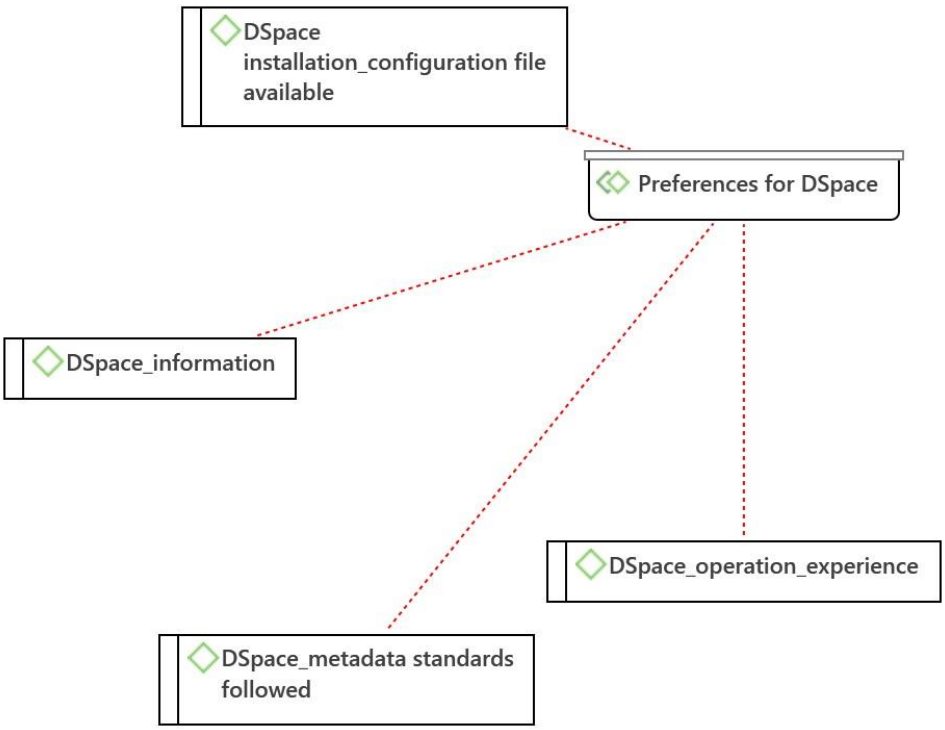
Instead of such real-time installation process, there is the provision of Live DVD installation, but Live DVD installation was least preferred by the interviewees: " Real-time installation is better than Live-DVD installation" (Divya Agrawal, Personal communication, January 29, 2021). Similarly, an interviewee properly explained the reason for the selection of LiveDVD and real-time installation process as follows:

“Small sized library can install from Live DVD but large sized library should follow real-time installation. The real-time installation of DSpace facilitated lots of flexibility and changes as well" (Dibyendra Hyoju, Personal communication, July 26, 2021).

"I prefer DSpace due to the easy interference of it” (Goma Banjade, personal communication, July 2, 2021). “I have installed DSpace in many libraries, they are performing well in various libraries. So, I would prefer it to use” (Sajib Chaudhary, Personal Communication, July 2, 2021). There are all the configurations' files available while installing, which is yet another potentiality of having reuse of those files if problems occurred. In this way, the interviewees were satisfied of installing DSpace in real time.

Kumar V and Jasimudeen (2012) observed that the difficulty of the open-source system's installation process caused librarians to be hesitant about implementing it. However, the interviews have one thing in common with both types of respondents: they felt confidence that the installation process could be implemented in their own workplace. The ease of use for installing DSpace is higher for librarians who work for systems, which entails routine use of Linux commands and consistent effort for successful installation, but manual library service providers felt less usable due to the challenging technical details they had to remember and their inability to comprehend the provided Internet solution. (Choi, 2021). Library education required courses on Linux operating system and command lines (Choi & Pruett, 2019). When librarians are experienced on Linux command, their confidence of installing, configuring, and customizing Open-Source Software, DSpace.

Figure 4.21. Reasons preferring for DSpace

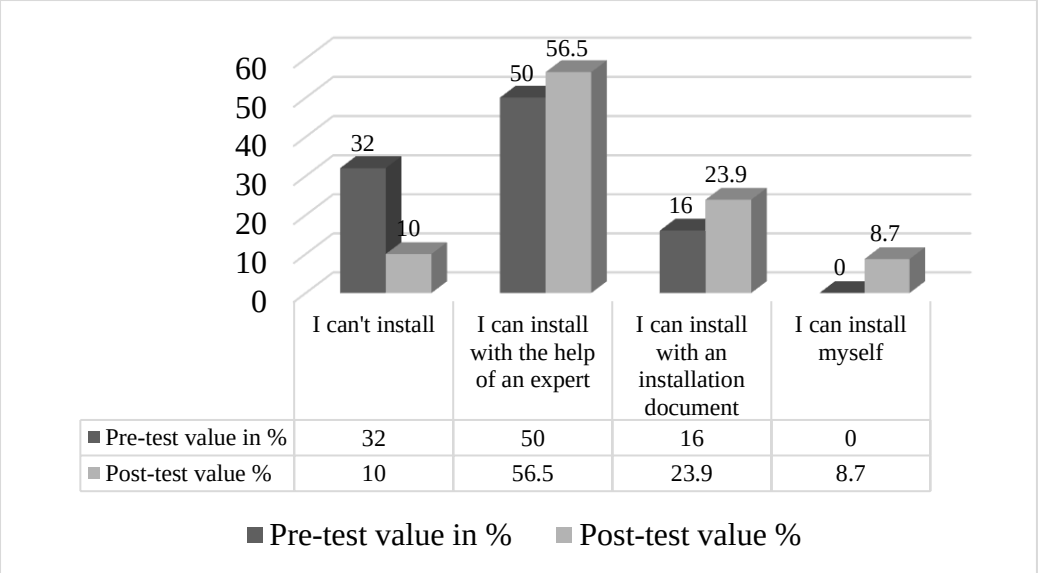


In Figure 4.21, the reasons for preferring the choice of DSpace are availability of metadata standards followed, availability of configuration files ready-made, and librarian's prior information, and experience regarding DSpace. Two reasons are basically technical, two are related to awareness about DSpace.

DSpace has been the most applied software for developing digital repository, as the statistics of Open Access Repositories (OpenDOAR) revealed the highest 39% was occupied by DSpace. Other software, namely, EPrint, Weko, Digital Commons, Inslandora, CONTENT dm have secured below 15% share of the total (Formanek, 2023).

Besides the feeling and experience shared by librarians, a quantitative measurement of perception of Nepali librarians were also collected. Those respondents did not participate months long training, as the above-mentioned interviewees did, but they were oriented about the installation and operation process of DSpace in the online mode. Regarding DSpace installation, the questionnaire survey results were also insightful in Figure 4.22.

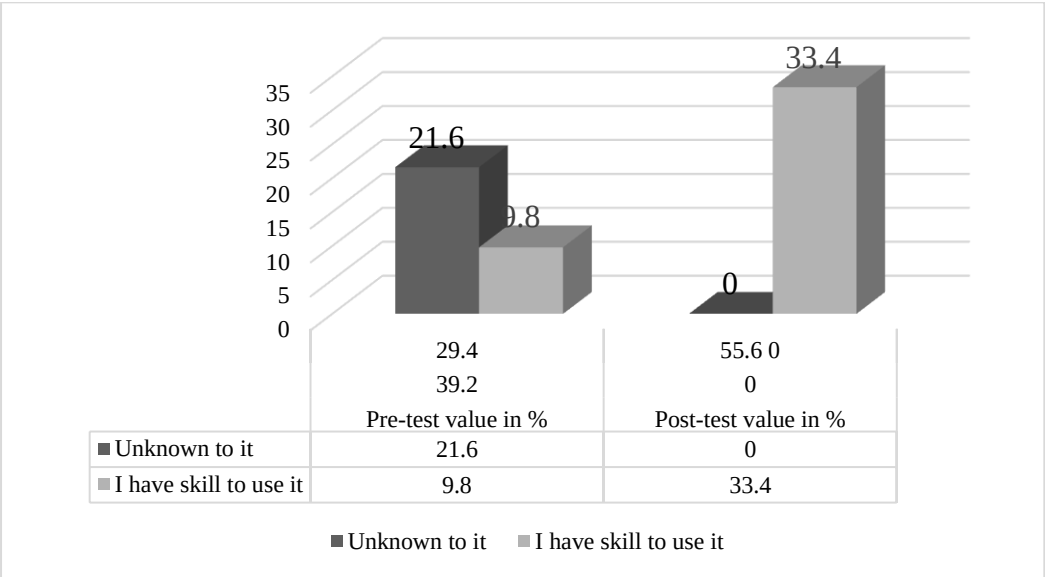
Figure 4.22. Librarians' capacity of DSpace installation



Though the independent installation capability was reflected the least (8.7%), the confident of installation with the help of an expert resource person, and an installation document has been improved to 56.5% and 23.9% after the training (Figure 4.22). However, the training on Linux command have larger share for the confidence on librarians while installing DSpace.

After the installation, configuration and customization of DSpace, it is operable for organizing digital collections. The more librarians are educated about all the operating functionalities of DSpace, the more usable it is for them. Among the studied population, there were 9.8% librarians skilled operating DSpace. The lesser skilled librarians, the more unusable DSpace software is for them.

Figure 4.23. Librarians' familiarity about DSpace



The two choices, 'heard about it', and 'unknown to it' in combined denoted the inability of operating DSpace, while the option 'literate about it' was the general know-how about the tasks of DSpace, and the last choice is the ability to work on DSpace, which is the least (9.8%) before the training was provided to them. Hence, two hours of orientation and hands-on practice were conducted for

this study. After the training, the two choices denoting inability were turned zero, yet, the highest (55.6%) were only literate about it, and the skilled librarians were increased by 23.6% (Figure 4.23). As per the increasement of skill, the usability factor indicators' value has also been improved.

4.3.2 The positive effect of training on usability

Among numerous operations of DSpace, measuring factors of usability were on data harvesting, Doublin core-metadata, file format, installation, file uploading, features, and experiences of librarians (Table 4.4). These functionalities are basically related to digital document organizations in DSpace.

All five factors (usefulness (U), ease of use (EoU), effectiveness (EF), efficiency (Eff), learnability (LE), and satisfaction (SA)) have improved value in post-test, that was after the training provided to librarians (Table 4.4), that was also equally visible in figure 70.

Table 4.4.

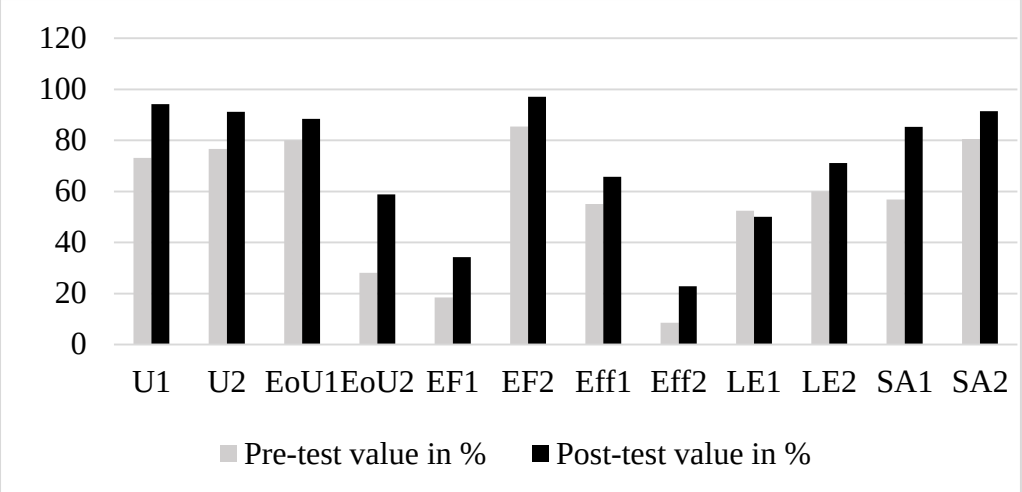
Pre-test and post-test differences of usability factors

Usability factors	Items	Pre-test value in %	Post-test value in %
Usefulness (U)	U1	73.2	94.2
	U2	76.6	91.2
Ease of Use (EoU)	EoU1	80	88.5
	EoU2	28.1	58.9
Effectiveness (EF)	EF1	18.4	34.3
	EF2	85.4	97.1
Efficency (Eff)	Eff1	55.1	65.7
	Eff2	8.6	22.9
Learnable (LE)	LE1	52.4	50
	LE2	60	71.1
Satisfaction (SA)	SA1	56.8	85.3
	SA2	80.5	91.5

P = 0.1703 d.f. = 11 (n-1)

The p value (p = 0.1703) is greater than the alpha value of p (0.05), hence, it expressed the positive effect of training for the improved usability of DSpace in post-test after the training. The improved skills of librarians were the reason behind this more positive usability value (Table 4.4).

Figure 4.24. Pre-test and post-test differences of usability factors



All factors have upgraded values in post-test usability test, which reflected the improved usability of DSpace for librarians. Librarians' skill and knowledge upgradation has impacted upon the improved usability of DSpace.

4.3.3 Perception of librarians for DSpace

The survey on the existing status of Nepali librarians about DSpace expressed the very less skillful librarians (9.8%) on DSpace, however, they have at least 'heard' about it and 'literate' on it. It is the general awareness of librarians on DSpace. They have high desire 'wish to learn' (64.7%), that was fulfilled through the two hours training in some extend: 'wish to learn' (44.4%) in Post-test.

There are fewer skilled on DSpace librarians available. Nepali librarians have greater desire to learn about DSpace. They have already heard (39.2%) and literate (29.4% in Pre-test, and 33.3 % in Post-test) about DSpace in some extend. The higher desire of learning is good sign for improving usability.

Table 4.5.

Familiarity and learning desire of librarians about DSpace

Category	Opinion	Pre-test %	Post-test %
Familiarity	Heard	39.2	0
	Literate	29.4	55.6
	Unknown	21.6	0
	Skillful	9.8	33.3
Attitude on DSpace Learning	Wish to learn	64.7	44.4
	Learning	19.6	26.7
	Have learnt	15.7	26.7
	Dislike to learn	0	0

The view on the effectivity of DSpace software has also significant implication for the usability of DSpace for Nepali librarians. At first, librarians viewed DSpace as the 'tool for information service' (44%), while in the post-test, librarians responded it as the 'essential tool' in the highest number (41.3%). It is presented in Table 4.6

Table 4.6.

Effectivity and usage of DSpace for a library

Category	Opinion	Pre-test %	Post-test %
Effectivity	Tool for information service	44	30
	Important tool	32	28
	Essential tool	24	41.3
	Ineffective	0	0
Usage	Manage digital content	30	39.1
	Manage institutional repository	28	39.1
	Disseminate information	22	10.9
	Archive digital content	20	10.9
Professional use	Essential for profession	42	54.3
	Improve profession	30	30.4
	Manage information	24	13
	Optional for profession	0	0

According to the opinion of respondents, the majority 44% viewed DSpace as a tool for information service, while after the training, the majority of respondents 41.3% viewed as the 'essential tool'. Similarly, the highest number of

librarians (54.3%) agreed that DSpace is 'essential for profession'. The training made them realize the effective use of DSpace, hence, more respondents responded it as 'essential tool'. They expressed the use of DSpace to 'manage digtial content' (30% in pre-test, and 39.1% in post-test), and 'manage institutional repository' (28% in pre-test, and 39.1% in posttest). The difference between digital content and instituational repository is related to the scope of documents, that means the digital content denotes to all sort of digital content, and institutional repository denotes to those digital content that was born within the institution. The highest number of respondents viewed DSpace as a tool for managing instituational repository. However, both opinion carries similar tasks to some extent.

4.3.4 Opinon on DSpace customization

DSpace software has the potentiality of localization (Yang et al., 2020), which has addressed the local need of a library. So, in relation to the customization, respondents viewed following opinions:

Table 4.7.

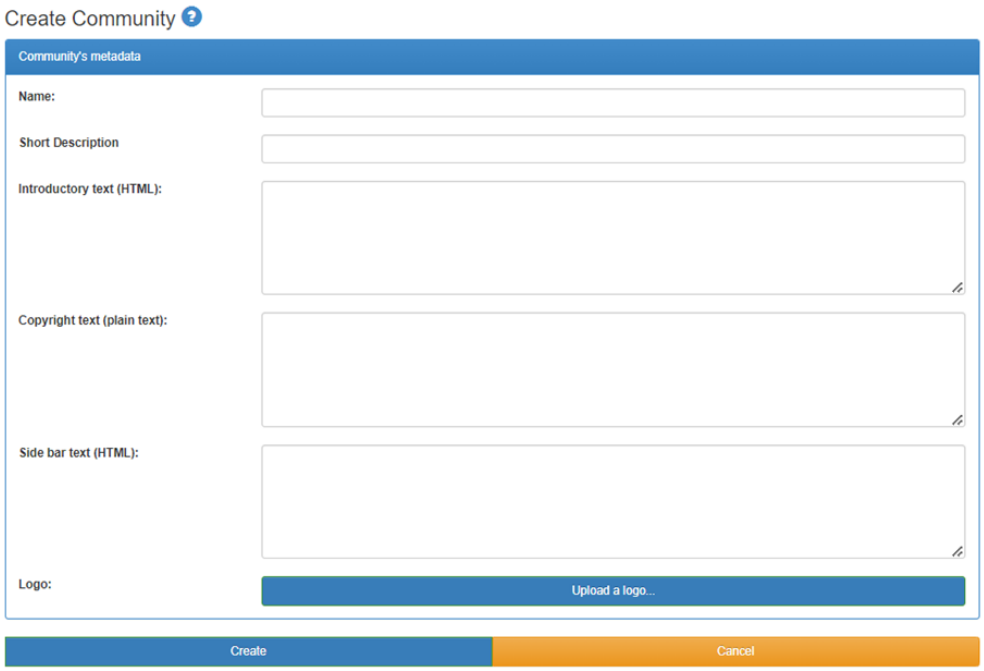
Opinions on DSpace customization

Categories	Opinion	Pre-test %	Post- test%
Attitude on Customization	Looks and name	26.8	20
	Metadata names	26.8	17.8
	community file	26.8	48.9
	Search history display	19.5	13.3
Ability to customize	Need expert	44	40
	Need training	30	31.1
	Unable	18	0
	Need document	8	24.4

During pre-test survey, respondents gave equal emphasize (26.8%) on three sorts of options: customize for 'looks and name', 'metadata names', and

'community file' during pre-test. But in the post-test, they focused on customizing community forming file (48.9%). There are 'name, 'introductory text (HTML)', 'copyright text', 'side bar text', and 'logo' to be kept. All these are not mandatory field to be filled. However, they are much possible being confused for what particular information to be filled in. Fields for community formation is given in Figure 4.25 below:

Figure 4.25. Community form in DSpace



It was recorded that the looks and name was the only thing that was customized. Only TUCL e-Library has added browsing options: 'institution', 'level', and 'country'. Other changes for administrative tasks were not conducted.

The realization of the need of customization arises after use. Since few of librarians (9.8%) have skilled to operate it, they were at first unaware about the need of changes to be made. Later on, they indicated to change in the community

form. The requirement of changes has potentiality to increased once, they started using it.

4.3.5 Understanding meta-data and file uploading process

Meta-data are similar to language for describing resources fully. DSpace utilizes Doublin core metadata. There are 15 elements or qualifiers of Doublin core: title, creator, subject, description, publisher, contributor, date, type, format, identifier, source, language, relation, coverage, and rights (Baker, 2000). These meta-data are filled during file uploading process. Hence, it is important for librarians who upload resources in DSpace of their libraries.

Table 4.8.

Opinion on meta-data

Categories	Opinion	Pre-test %	Post-test %
Sufficient meta-data	Sufficient	51.2	47.8
	Need change	39.5	43.5
	Insufficient	0	0
	Perfectly sufficient	0	0
Easy meta-data	Easy	32.6	34.8
	Effective	25.6	19.6
	Useful	20.9	37
	Difficult	20.9	8.7

Initially librarians viewed the meta-data of DSpace is sufficient (51.2%), as displayed in Table 4.8, while later after training and use, their view altered, hence, increased their opinion on 'need change' (43.5%). But non-of them viewed as 'insufficient' and 'perfectly sufficient'. Regarding the 'easy meta-data', their views switched for 'easy' (32.6% in pre-test and 34.8 % in post-test), rather than 'effective' (25.6 % in pre-test and 19.6 % in post-test). Effective means the success to produce desired and intended result (Batagoda, 2020; Brown, 2020). Useful means 'helpful for achieving some results'.

Table 4.9.

Opinion on file uploading process

Categories	Opinions	Pre-test %	Post-test %
File uploading time	Takes 10 min less.	42.1	25
	Takes 5 min. less	31.6	40.9
	Takes 5 min. more	13.2	25
	Takes 10 min. more	13.2	9.1
File uploading Process	Clear process	52.4	50
	Need guidance	31	30.4
	Self-understanding	9.5	17.4
	Unclear	7.1	0
File uploading	Satisfied	52.3	56.8
	Unknown	38.6	18.2
	Very satisfied	0	22.7
	Unsatisfied	0	0

Task performing time is one of the important elements for usability (Batagoda, 2020). The majority of librarians (40.9% in the post-test) concurred that it "takes less than 5 min." However, 42.1% of them in the pre-test believed that it "takes more than 10 min." (Table 4.9). The time needed to upload a file has reduced after they completed the training and some practice.

Table 4.10.

Task performance of librarians

Task	Frequency of error	Average time in minute
Making Community	1	4.25
Making collection	6	5.75
Filling metadata and uploading document	0	8.37
Making e-people	1	1.62
Harvesting Data from MIT DSpace repository	6	8.37

The above (Table 4.10) expressed the consumed time 8.37 min without any error. The task performance observation differed from questionnaire

responses where 42.1% of librarians responded of consuming less than 5 minutes, while observing some librarians (8), they required 8.37 min in average.

Similarly, they got the file uploading process 'clear' (52.4% pre-test and 50% post-test), and 'self-understood' (9.5% pretest and 17.4% in posttest). However, few librarians (22.7% posttest) are 'very satisfied'; majority (52.3% pre-test and 56.8% post-test) viewed 'satisfied' for file uploading.

File uploading task is the most crucial stage for librarians, because it is the time when they describe resources in detail. The more correct representation of subjects in the meta-data element 'subjects', the more possible to retrieve resources. Similarly, providing contributors name, rights, title, publishers are significant job for librarians. It is a modern type of catalogue for resources (Baker, 2000).

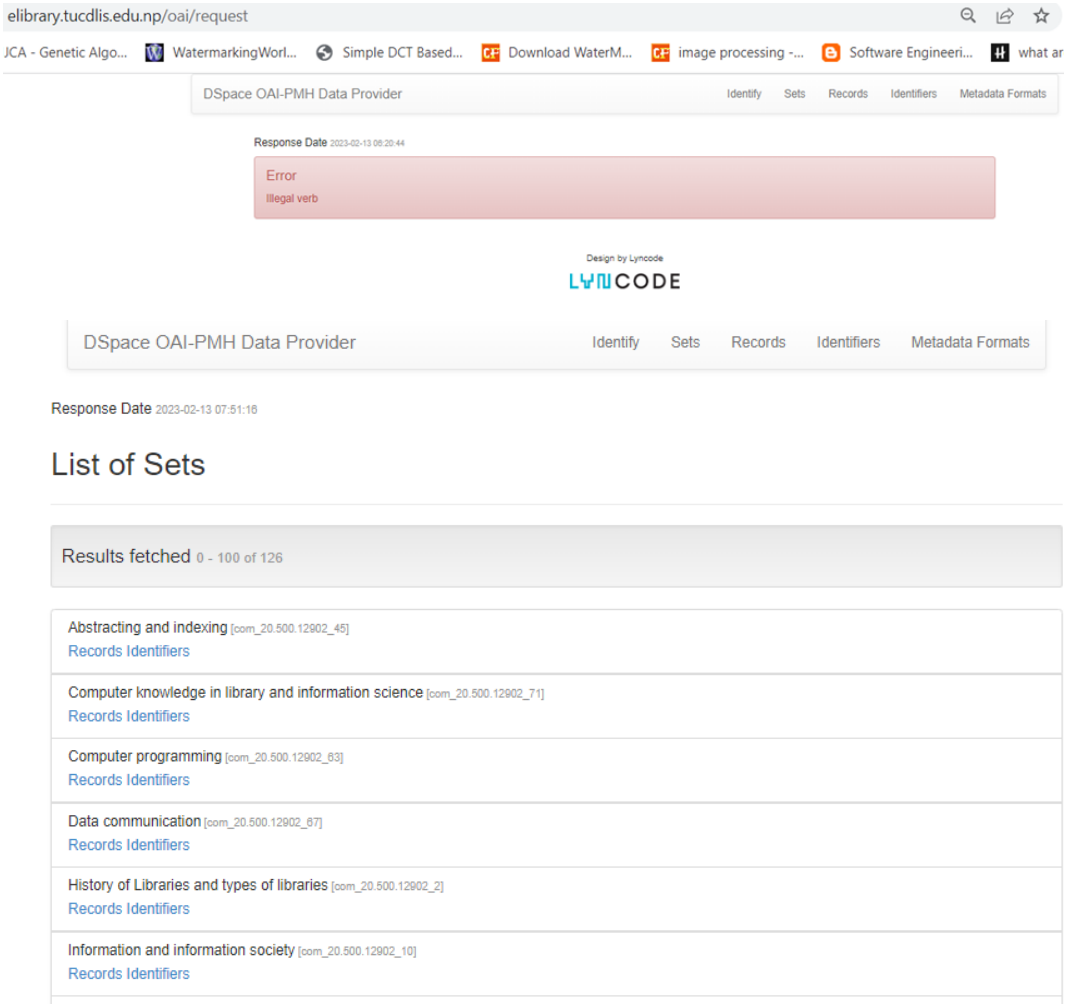
4.3.6 Coping DSpace feature of data harvesting

Libraries are still building up the crucial component for enhancing interoperability despite the creation of institutional repositories in DSpace (Masinde & Sanya, 2022). The ability to import and export full-text documents and meta-data to another institutional repository is known as interoperability. Such a characteristic creates the possibility for global information sharing and catering. The more advanced a feature, the more difficult it is to use. Nevertheless, complexity can be lessened with practice and instruction.

In Nepali institutional repositories, the interoperability was not set up at the time of data collection. During the training, it was experienced using MIT DSpace institutional repository to export their data (MIT Libraries, 2023).

Figure 4.26. Use of request verb 'oai/request' interoperability feature in TUCDLIS e- Library

Figure 4.27. Availability of data sets for data harvest



Below are the steps of data harvesting was presented. The data was harvested from DRTC India's institutional repository ("LDL: librarian's digital library," 2002). These steps wise presentation of data harvesting process made to understand the exact process for data harvesting process in DSpace. 'oai/request' verb is the standard for all open-source software that are used for institutional repository including DSpace.

Figure 4.28. Step 1 for importing data from others repository

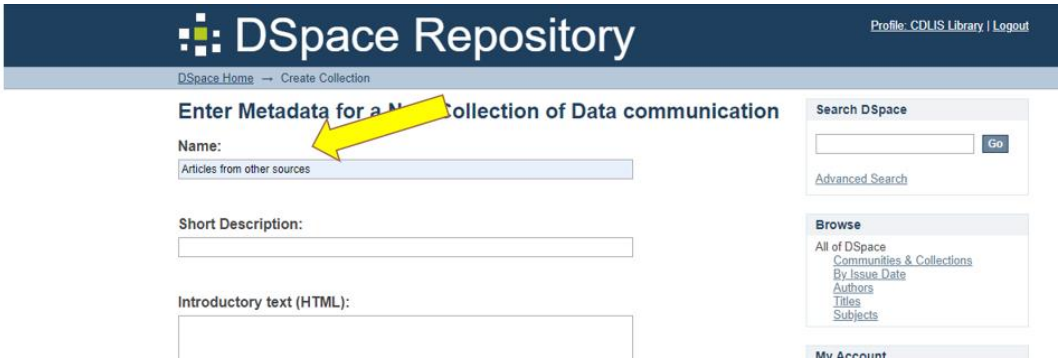


Figure 4.29. Step 2 for data import, assigning content source

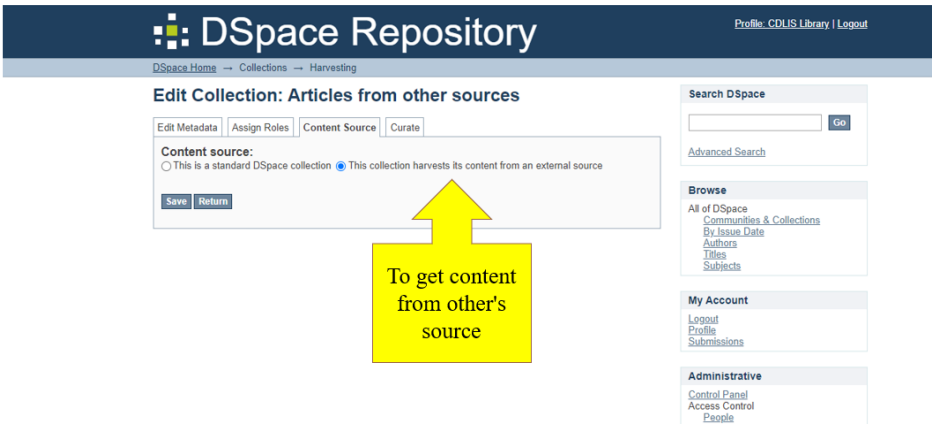


Figure 4.30. Step 3 gives the collection location to harvest in it.

Figure 4.31. Step 4 the notice for valid setting for harvesting

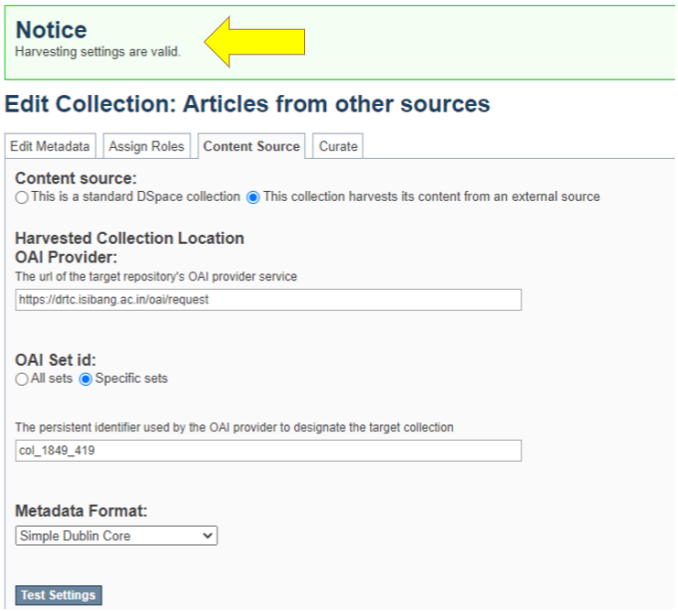
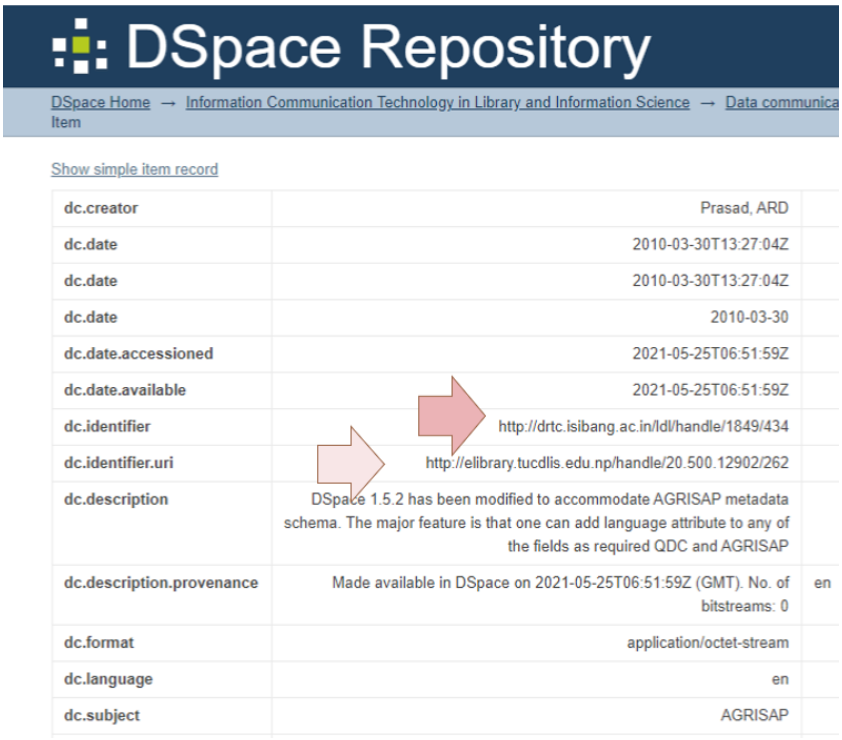


Figure 4.32. Step 5 harvested data

Figure 4.33. Details of harvested data



Following all above steps Nepali librarians have experienced in during the training program aimed for data harvest. The table 17 specified on the learnability, easiness, and over all view about data harvesting.

Table 4.11.

Opinions on data harvesting feature of DSpace

Categories	Opinions	Pre-test %	Post-test %
Data Harvest learnability	learnable	60	71.1
	easy to learn	20	20
	Expert required	17.1	8.9
	Unable to learn	0	0
Data Harvest easiness	Need to learn	71.1	40
	easy with instruction	26.3	46.7
	Very easy	0	13.3
	Difficult to use	0	0
Data Harvest	Effective and useful	56.4	47.7

Categories	Opinions	Pre-test %	Post-test %
	Accessed to others data	20.5	0
	Effective and Useful for open access	17.9	45.5
	ineffective and useless	0	0

Though Nepali librarians' have newly experienced, they (60% in pre- test and 71.1% in post- test) viewed it as the 'learnable', and stated for the 'need to learn' (71.1% in pre-test and 40% in post-test); the view has been increased (26.3% for pre-test and 46.7% for post-test) for 'easy with instruction'. However, they (56.4% for pre-test and 47.7% for post-test) viewed the data harvesting less 'effective and useful' in post-test in compare to pre-test view. Interoperability is the two-way exchange. Nepali librarians are less attractive in the effective and useful use of data harvesting feature of DSpace.

The descriptive analysis was conducted for usability test analysis (Subiyakto et al., 2021). It has provided the picture of DSpace usability on usefulness, ease of use, effectivity, efficiency, learnability, and satisfaction related to various tasks in DSpace for librarians. As shown in tables 7-15, librarians responded mostly for willingness to learn more about DSpace, either for data harvest in DSpace, 'need to learn' (71.1% in pre-test and 40% in post-test), data harvest in DSpace was viewed 'easy with instruction' (26.3 % in pre-test and 46.7% in post-test); librarians opined 'need expert' (44% in pre-test and 40% in post-test), they said they 'need training' (30% pre-test and 31.1% post-test), and they 'wish to learn' (64.7% pre-test and 44.4% post-test) for DSpace customization. In this way, for the enhanced usability, librarians either sought for expert, or for instructive documents, or for the training before performing by themselves.

4.4 Analyzing DSpace usability factors and relationships

The statistical analysis was conducted for the data collected from librarians and end-users. The five-point Likert questionnaire was applied for the usability test. The System Usability Scale (SUS) (Colter, 2016) has been employed for evaluating the usability of DSapce based on their experiences. SUS is applied for subjective evaluation of system usability. Institutional repository has been the new thing for both sort of users. For usability test such newness to users has been considered as a sort of problems (Jeffcoat King & Jannik, 2005). However, the study considered it as the special condition of DSpace usability test.

4.4.1 Reliability and validity test of data

Reliability and validity test make sure of correct start of research question, the correct population to be asked for the data, and the right time for asking questions (Roberts & Priest, 2006). Cronbach Alpha provided the reliability index for data (Table 4.12). It has increased the statistical power (Heo, Kim, & Faith, 2015).

Table 4.12.

Statistics analysis for the reliability test

Reliability Statistics		
Type of users	Cronbach's Alpha	No. of Items
End Users	.914	24
Librarians (pre-test)	.907	16
Librarians (post-test)	.924	16

The reliability of end users' data for statistical analysis was determined by Cronbach Alpha (Cα) valued 0.914, which is higher than 0.7; it meant the collected data is reliable for statistical testing. Similarly, Cα for librarians' pre-test

data is 0.907 and their post-test data Cα value was 0.924. Both values were higher than 0.7. It implicated the reliability for statistical analysis.

Before statistical analysis data were tested for reliability statistics analysis and Kaiser-Meyer-Olkin (KMO) that measured the sampling appropriateness ("KMO and Bartlett's test of sphericity," 2020, May 9) and Bartlett's Test (Table 4.13). The value of KMO for librarians' pre-test and post-test data is 0.764 and 0.771. The data is average for sampling adequacy. The value of KMO for end users' data is 0.812, i.e., it is meritorious in sampling adequacy (Beavers et al., 2013). The Bartlett's Test of Sphericity is meant for checking if the correlation coefficients (here in the Table 4.13 Sig.) are all zero or not. It signifies the validity for further statistical analysis (basically factor analysis).

Table 4.13.
KMO and Bartlett's test

Type of tests		End users	Librarians (pre-test)	Librarians (post-test)
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.812	0.764	0.771
Bartlett's Test of Sphericity	Approx. Chi-Square	1007.846	384.452	451.550
	Df	276	120	120
	Sig.	0.000	0.000	0.000

4.4.2 DSpace usability for librarians: pre-test and post-test survey analysis

The factor analysis (Principal component analysis) among 16 factors was assessed for librarians. Here 'L' is denoted for labels in data analysis. The first four usability components:

L1. DSpace configuration and customization comes under Librarian's job;
L2. It is essential for presenting institutional repository as its own;
L3. All the information to be filled in the community, sub-community and collection are useful and essential;

L4. The categorizations of e-groups with particular authorization are useful for DSpace institutional repository building;

have weighted the highest value with the total variation of 70.251% and 73.237 % respectively for pre-test and post-test (Table 4.14 and Figure 4.34). Among these components L1 has 42.773% variance for pre- test and 48.190 % for post-test, component L2 had 13.566% and 10.534 %, component L3 has 7.362%, and 7.887 % and component L4 has 6.550%, and 6.625% respectively for pre-test and post-tests. The factors L1, L2, L13 and L15 had weightage of 42.773% impacts in usability of DSpace before training but they were changed in post-test, hence those factors L1, L2, L4, L9, L13, L15 and L16 had weightage to 48.190% after the training.

Table 4.14.

Characteristics value for each component of usability using Eigen values

	Initial Eigenvalues (Pretest)			Initial Eigenvalues (Posttest)		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.844	42.773	42.773	7.710	48.190	48.190
2	2.171	13.566	56.339	1.686	10.534	58.724
3	1.178	7.362	63.701	1.262	7.887	66.612
4	1.048	6.550	70.251	1.060	6.625	73.237
5	.916	5.728	75.978	.841	5.259	78.496
6	.799	4.996	80.974	.622	3.885	82.381
7	.698	4.360	85.334	.583	3.646	86.027
8	.559	3.494	88.828	.484	3.027	89.054
9	.417	2.604	91.432	.430	2.689	91.743
10	.325	2.030	93.461	.368	2.302	94.045
11	.284	1.774	95.235	.298	1.861	95.905
12	.236	1.478	96.713	.212	1.325	97.231
13	.192	1.201	97.913	.147	.918	98.148
14	.142	.885	98.798	.128	.798	98.947
15	.112	.702	99.500	.095	.593	99.540
16	.080	.500	100.000	.074	.460	100.000

The importance of components was different for librarians before and after training of DSpace (Table 4.15 and

Table 4.16). Their preferences of choice have altered after they knew more about DSpace operation. The figure 80 is the scree plot that expressed the major four components having more than 0.5 eigen value. Those major four usability components included the factors mention in Table 4.15.

Figure 4.34. Principal components for usability in pre-test and post-test data.

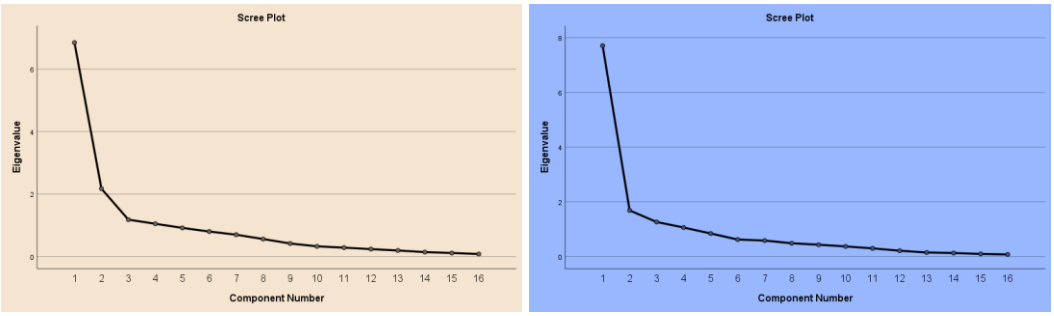


Table 4.15.

Principal components for usability in pre-test

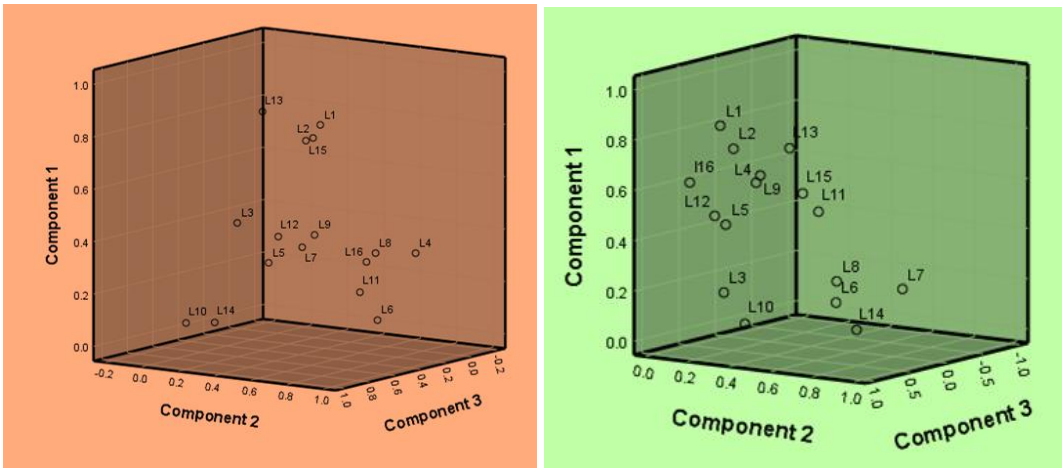
Usability factors	Components	1	2	3	4
U1	L1	0.79	0.36	0.17	
U2	L2	0.74	0.32	0.18	0.22
U3	L3	0.46	0.22	0.64	-0.13
U4	L4	0.33	0.81		0.17
U5	L5	0.32	0.37	0.60	0.35
EoU1	L6	0.71	0.24	0.42	
EoU2	L7	0.29	0.14		0.76
EoU3	L8	0.34	0.69	0.22	0.35
EF1	L9	0.40	0.44	0.34	0.46
EF2	L10	0.11	0.14	0.92	
EF3	L11	0.11	0.33	-0.17	0.71
LE1	L12	0.41	0.39	0.56	0.11
LE2	L13	0.82	0.19	0.31	
LE3	L14	0.46	0.74		
SA1	L15	0.73	0.29	0.19	0.19
SA2	L16	0.31	0.71	0.31	

Table 4.16.

Principal components for usability in post-test

Usability factors	Components	1	2	3
U1	L1	0.81		0.23
U2	L2	0.72	0.10	0.20
U3	L3	0.20	0.26	0.77
U4	L4	0.61	0.28	0.40
U5	L5	0.45	0.20	0.59
EoU1	L6	0.16	0.63	0.31
EoU2	L7	0.22	0.85	
EoU3	L8	0.26	0.67	0.41
EF1	L9	0.64	0.27	0.32
EF2	L10	0.36	0.77	
EF3	L11	0.49	0.46	
LE1	L12	0.48	0.13	0.54
LE2	L13	0.72	0.30	
LE3	L14	0.72	0.29	
SA1	L15	0.57	0.44	0.20
SA2	L16	0.60		0.52

Figure 4.35. Principal components analysis (PCA) for usability factors in pre-test(left) and post-test (right)



As in Figure 4.35 the principal components (1) have been varied in pre-test and post-test. In pre-test the principal components (1) were L1, and L2, that are

usefulness (U) factors. Similarly, L13 Learnability (LE) factor, and L15 Satisfaction (SA) are principal components. While the post-test principal component (1) is U factors L1, L2, and L4, Ef factor L9, LE factor L13, and SA factor L15 and L16. These factors are also clearly seen in Figure 4.36 and Figure 4.37, where above mentioned components were above the value 1. It shows the empirical relation between Egen value and Principal Component one.

Figure 4.36. Empirical relation between Egen Value and Principal Component one in pre-test.

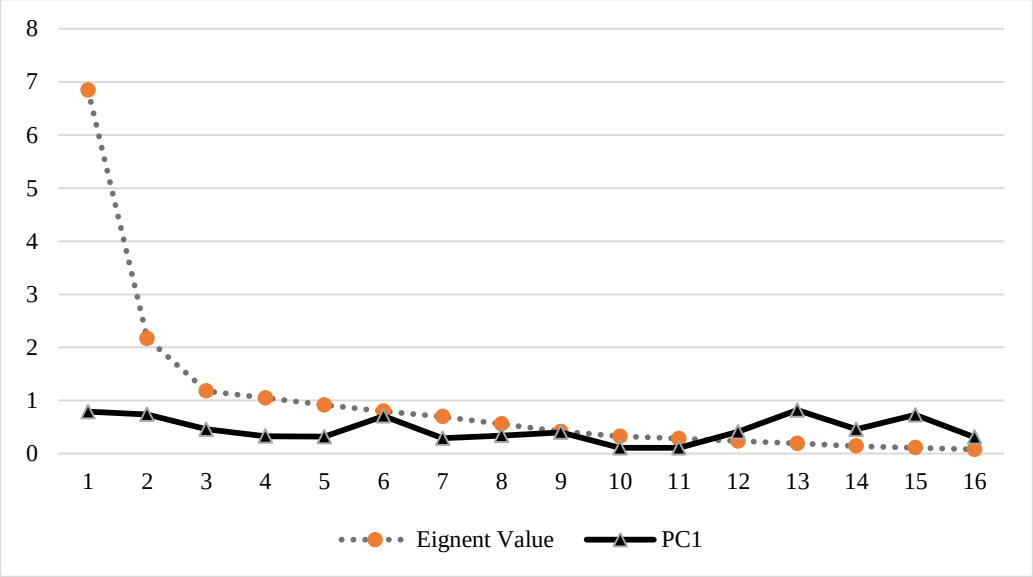
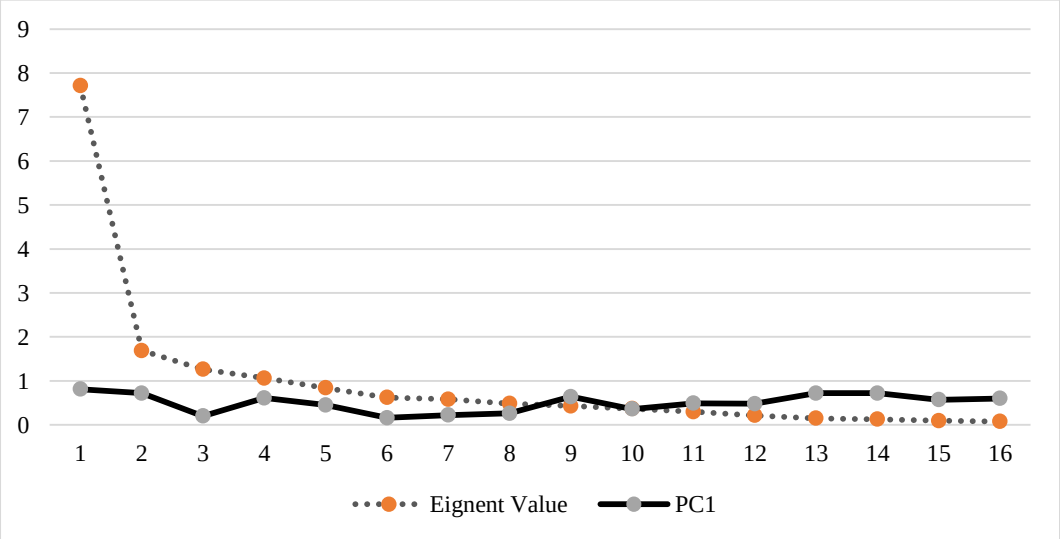


Figure 4.37. Empirical relations between Egen Value and Principal Component one in Post-test



For librarians the first principal components (PC) were presented in Table 4.15 and

Table 4.16, those Eignent values were presented in empirical relationship with PC1 in Figure 4.36 and Figure 4.37. According to these tables and figures, during pre-test, U factor's two items, EF factors' one item, EoU factors' one item, ELE factors' one item, and SA factors' one item was the most principal factors. After the post test, the emphasis changed. It became as U factor's three items, EF factor one item, LA's two factors, and SA's two factors are the most principal factors. The shift in principal factors have been achieved.

4.4.3 The most influential factor of DSpace usability

While having the descriptive analysis the fifty librarians suggested that all factors except Ease of Use (EoU) had high impact in usability of DSpace before training but after training the perception has changed, and has suggested all components are highly important for better use of DSpace (Table 4.17).

Table 4.17.

Descriptive analysis for impact of usability factors

	Pre-test			Post-test		
Variables	High	Medium	low	High	Medium	low
usefulness	**54.0**	38.0	8.0	**67.4**	30.4	2.2
Ease of use	38.0	**52.0**	10.0	**69.6**	26.1	4.3
Effectiveness	**52.0**	38.0	10.0	**71.7**	26.1	2.2
Efficient	**50.0**	38.0	12.0	**56.5**	39.1	4.3
Learnability	**58.0**	38.0	4.0	**78.3**	19.6	2.2
Satisfaction	**52.0**	38.0	10.0	**80.4**	13.0	6.5

4.4.4 The impact of DSpace usability factors to each other

To analyze the impact of DSpace usability factors to each other, the Pearson Chi-Square test between all six factors of usability to librarians before training shows that usefulness (U) and Effectiveness (EF) has significance relation

with all factors expect Efficient (Eff). The ease of use (EoU) factor has significance relation only with Usefulness (U), Learnability (LE) and satisfaction (SA); similarly, the factor learnability (LE) and satisfaction (SA) have significant relation with all other factors (Table 4.18).

After training of DSpace to all participant librarian were provided the same questionnaire set. During post-test, the Pearson Chi-Square test between all six components category to librarians have significant relation with each other. It has suggested that the change in one component could change the usability of the DSpace.

Table 4.18.

Pearson chi-square test for analysing impact of usability factors to each other (Pre-test data).

Usability factors	U	EoU	EF	Eff	LE	SA
Usefulness (U)		0.08	0.02	0.26	0.06	0.01
ease of use (EoU)	0.08		0.506	0.137	0.011	0.007
Effectiveness (EF)	0.02	0.506		0.086	0	0
Efficient (Eff)	0.26	0.137	0.086		0	0.02
Learnability (LE)	0.06	0.011	0	0		0
Satisfaction (SA)	0.01	0.007	0	0.02	0	

P<=0.05 (significant relations) and P>=0.05 (non-significant relations), degree of freedom (d.f.) = 5 (n-1)

This table is dedicated to present the relationship among usability factors. The listed usability factors in the first column and their relations with remaining factors have been presented with their corresponding P values. Factors having the value of higher than 0.05 have indicated the insignificant relationships. It means there is no significant relation between **U** and EF, **EoU** and Eff, **EF** and EoU, Eff,

Eff and EoU, EF in pre-test (Table 4.18). But those factors having the value of less than 0.05 have shown the significant relationship among factors.

Table 4.19.

Pearson chi-square test for analysing impact of usability factors to each other (Post-test data)

Usability factors	U	EoU	EF	Eff	LE	SA
Usefulness (U)		0	0	0	0.01	0
ease of use (EoU)	0		0	0.001	0	0.001
Effectiveness (EF)	0	0		0	0	0.001
Efficient (Eff)	0	0.001	0		0	0.02
Learnability (LE)	0.001	0	0	0		0.002
Satisfaction (SA)	0	0.001	0.001	0.02	0.002	

In contrary to pre-test result, all usability factors have significant relation among each other in the post-test, which is proved by the values less than 0.05. Hence, the post-test is resulted with the significant relationship among usability factors (

Table 4.19).

4.4.5 Statistical test for the relationships among DSpace usability factors

4.4.5.1 Total variance explained

The factor analysis (Principal component analysis) among 24 factors assessed for end users suggested that total six factors resulted with the total variation of 62.932% (Table 4.20 and Figure 4.38). Among them factor 1 has 34.7% variance, factor 2 has 7.489%, factor 3 has 6.33%, factor 4 has 5.154%, factor 5 has 4.679% and factor 6 has 4.577% of variance. The factors F1-F7 had weightage of 34.7% impacts in usability of DSpace. Similarly, F8-F13 and F15 7.489% and F14, F16 and F17 had 6.33% impacts in usability of DSpace (Table 4.20 and Figure 4.38).

Table 4.20.

Total variance explained of PCA analysis of end users' group

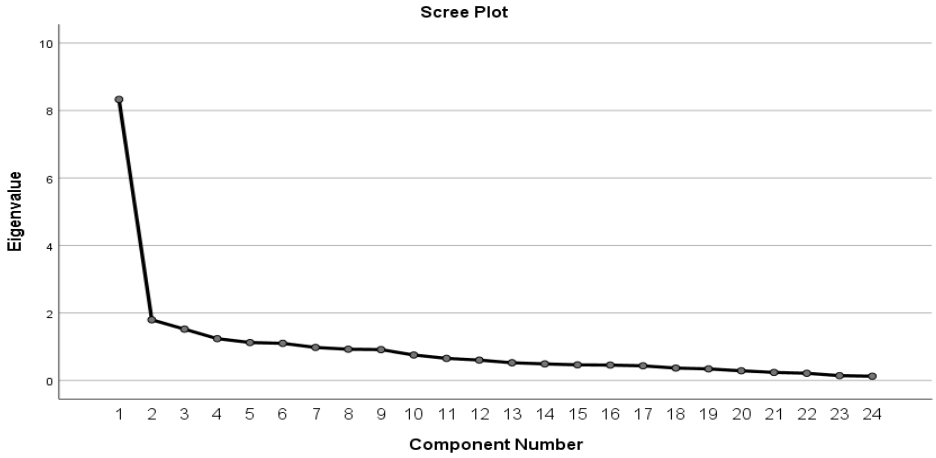
Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factors	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.328	34.701	34.701	8.328	34.701	34.701	3.715	15.481	15.481
2	1.797	7.488	42.190	1.797	7.488	42.190	3.290	13.710	29.191
3	1.520	6.333	48.523	1.520	6.333	48.523	2.312	9.634	38.824
4	1.237	5.154	53.676	1.237	5.154	53.676	1.979	8.248	47.072
5	1.123	4.679	58.355	1.123	4.679	58.355	1.932	8.050	55.122
6	1.099	4.577	62.932	1.099	4.577	62.932	1.874	7.810	62.932
7	.978	4.074	67.006						
8	.924	3.851	70.857						
9	.913	3.804	74.661						
10	.754	3.141	77.802						
11	.653	2.721	80.524						
12	.603	2.512	83.036						
13	.523	2.180	85.216						
14	.489	2.037	87.253						
15	.461	1.921	89.175						
16	.455	1.896	91.071						
17	.433	1.802	92.874						
18	.367	1.531	94.404						
19	.341	1.423	95.827						
20	.286	1.190	97.017						
21	.237	.989	98.006						
22	.212	.882	98.888						
23	.142	.590	99.478						
24	.125	.522	100.000						

Extraction Method: Principal Component Analysis.

Usability factors of all 24 items were categories into six factors EoU, U, EF, Eff, LE, and SA, each comprising 4 from 1-24. EoU, U, and EF factors have greater impact on DSpace usability for end users in compare to Eff, LE, and SA factors (Table 4.20 and Figure 4.38). Factors that have above 0.5 value are significant for the usability for end-users. The second item of EoU has scored 62.9 % contribution for the usability. It is the factor that impacted the most on usability.

Figure 4.38. Scree plot Total Variance Explained for PCA analysis of end users' group



The Principal Component Analysis (PCA) has also depicted the important factors in DSpace usability for end users. The 4 factors of EoU, 3 factors of U have stood as the first positioned component to impact on DSpace usability (Table 4.21 and Figure 4.39). The scree plot is the figure presentation of the table.

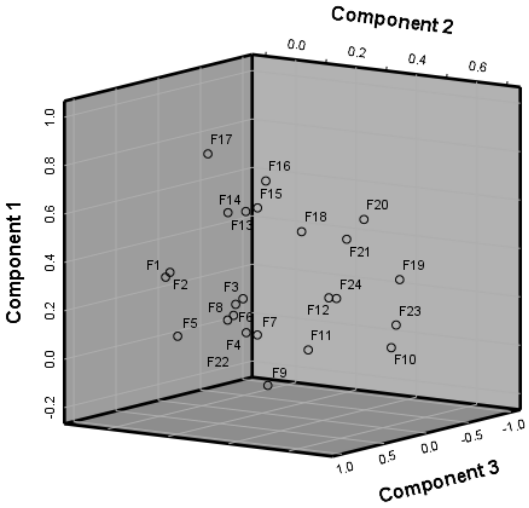
Table 4.21.

Rotated Component Matrix of PCA analysis of end user groups

Factors		statements	1	2	3
EoU	F1	The given name to the community and collection is expressive to locate needed document.	**0.81**		0.22
	F2	Browsing options Title, Author, Issue Date,	**0.71**	0.26	0.16

Factors		statements	1	2	3
		and Subject are easy to use.			
	F3	Searching bar in DSpace at the top is easy to locate in user interface.	**0.6**	0.23	0.17
	F4	The provisions of searching filters (author, title, date,) are easy to use.	**0.57**	0.51	
U	F5	The retrieved documents from DSpace collections are relevant to my information need	**0.57**	0.17	
	F6	I find relevant information sources in DSpace repository of my institution	**0.54**		
	F7	DSpace repository help me solving my professional problems	**0.53**	0.39	0.22
	F8	The use of DSpace repository improved my information literacy (skill to retrieve needed information).		**0.68**	0.19
EF	F9	Your keywords fed to DSpace repository give relevant document to you.	0.17	**0.66**	
	F10	The full information about the document and the abstract of documents help to decide the relevancy of document.	0.35	**0.65**	
	F11	The login user name and password protection for users of DSpace helps for authorized use of DSpace.	0.52	**0.55**	0.24
	F12	The display of recently submitted documents helpful	0.28	**0.51**	0.32
Eff	F13	Identifying the name of DSpace repository is a quick task	0.27	**0.51**	0.23
	F14	Browsing information through community name takes in an instant	0.11	0.15	**0.83**
	F15	Displaying of the relevant documents in DSpace takes in an instant.	0.32	**0.57**	
	F16	Download for the full-text of relevant document takes in an instant.	0.24	0.26	**0.51**
LE	F17	Finding a search bar in DSpace takes place in an instant		0.49	**0.5**
	F18	A search filter in DSpace is in an instant.		0.19	
	F19	Viewing the relevant document takes in an instant	0.12	0.14	0.18
	F20	Given instructions are clear for downloading document		0.15	
SA	F21	The given instructions are helpful to use DSpace.	0.24	0.23	0.32
	F22	The visual appearance of user interfaces is attractive to me.	0.12	0.1	
	F23	The display of issue date, title and author at the front page is helpful.	0.31		0.33
	F24	I am satisfied with using DSpace repository	-0.1	0.32	0.35

Figure 4.39. Graphical structure of PCA analysis of end user groups



4.4.5.1 Impact rank of the usability factors

The six factors of the DSpace usability were ranked to three categories based on the Likert scale. The Likert score above 80% is categorized as high, 60-80% to moderate and below 60% low. On the basis of this ranking the factors related to Ease of use, Effectiveness, Efficiency, Learnability and Satisfactory has high ranked for better usability of the DSpace but its usefulness category is ranked moderately important (Table 4.22).

Table 4.22.

Usability factors' impact ranks on DSpace usability

Components	High (n)	Moderate (n)	Low (n)
Ease of use	**68.4 (65)**	28.4 (27)	3.2 (3)
Usefulness	40 (38)	**50.5 (48)**	9.5 (9)
Effectiveness	**52.6 (50)**	42.1 (40)	5.3 (5)
Efficiency	**56.8 (54)**	37.9 (36)	5.3 (5)
Learnability	**54.7 (23)**	40 (38)	5.3 (5)
Satisfactory	**52.6(50)**	41.1 (39)	6.3 (5)

4.4.5.3 Co-relations among DSpace usability factors

The Pearson Chi-Square test (co-relation test) between all six factors and those factors with institute and education level of end users shows that all six

factors have Pearson Chi-Square value less than 0.05. It suggested that all factors have significant relationship with each other. Any of the component change will change the usability of the DSpace.

Similarly, the Pearson Chi-Square test between affiliated institute with these six factors showed the factor EoU is changed as the institute is changed since they have significant relation (p=0.043) but remaining other five factors U, EF, Eff, LE, and SA have p value higher than 0.05 that suggested end users' affiliated institute has no impact in usability of DSpace on respective components. Moreover, the education level of the end users has significant relation with all six factors showing the education level will impact the usability of DSpace in all components (Table 4.23).

Table 4.23.

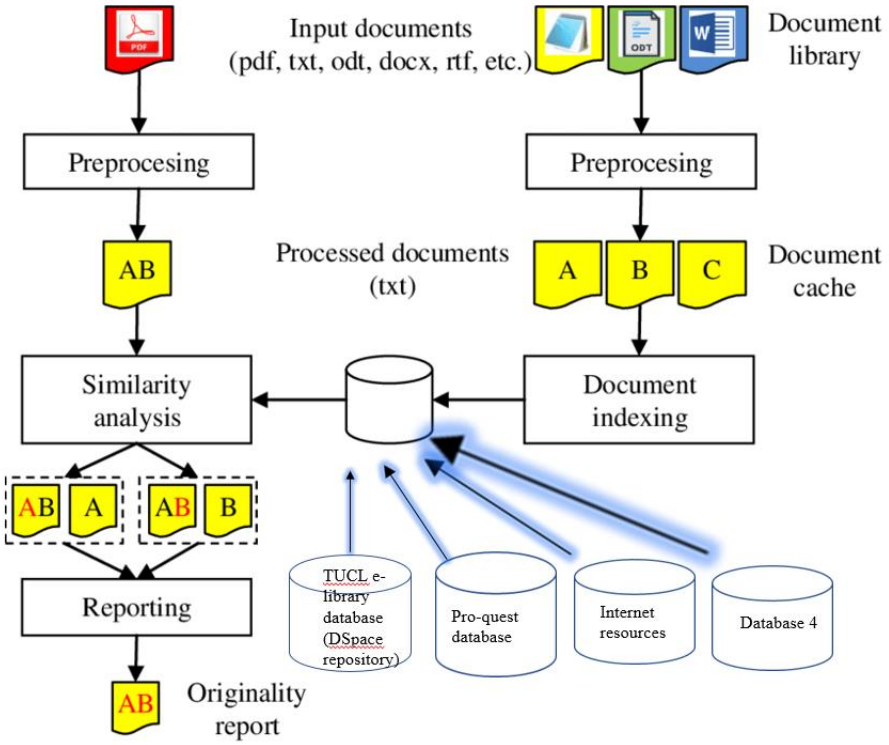
Correlation with six usability factors to each other

Factors	Ease of use	Usefulness	Effectiveness	Efficiency	Learnability	Satisfactory
Ease of use (EoU)	NA	0.00	0.01	0.00	0.00	0.00
Usefulness (U)	0.00	NA	0.00	0.03	0.00	0.00
Effectiveness (EF)	0.00	0.00	NA	0.00	0.00	0.00
Efficiency (Eff)	0.00	0.00	0.00	NA	0.00	0.00
Learnability (LE)	0.00	0.00	0.00	0.00	NA	0.00
Satisfactory (SA)	0.00	0.00	0.00	0.00	0.00	NA
Institute	0.043	0.52	0.52	0.37	0.42	0.57
Education level	0	0	0.019	0.02	0.012	0.119

4.5 Tracing the originality sourced to TUCL e-Library (DSpace repository)

The mechanism of plagiarism checking process is explained in the given diagram:

Figure 4.40. Plagiarism checking mechanism



As in Figure 4.40 expressed, all document inputs are indexed at first. It breaks down each word of document. It removes articles, and other common words that has no contribution to meaning. They are stop words. It changes words into its base form, for instance, change 'recognised' into 'recognise'. The basic forms of words aim to generate the statistics of words frequency. Then, it compares those words with another document in database. Input documents in iThenticate are compared with documents uploaded in TUCL e-Library (DSpace database). Once iThenticate software could access the different document database created either in DSpace or other software like CDware, Eprint, Fedora, Greenstone, and others are also possible to traced out those sources. Since the highest number of database (39%) are created in DSpace (Formanek, 2023), it has the higher possibility. The

more document database created in DSpace means the more documents to trace with.

Maintaining plagiarism has been growing problem in academia (Phuyal, 2021). Students sought help, or collaborate, or follow systematic cheating due to which plagiarism is compromised by them (Hellas, Leinonen, & Ihantola, 2017). For this study purpose, plagiarism detection for sampled theses were selected. It examined how similarity has been detected using i-Thenticate software. The TUCL e-Library (DSpace repository) provided resources for tallying plagiarism, though the resource was not incorporated into iThenticate. It was tallied as the source of Internet. TUCL authority mentioned that they made the request to the iThenticate software provider to enlist TUCL e-Library resources as sources for plagiarism check (Bijaya Sharma, personal communication, February 14, 2023). iThenticate covered 89.4 million journal articles, and have the partnership with Crossref plagiarism checking software too (iThenticate, 2021). The textual original sources (Hiremath & Otari, 2014) has been detected through iThenticate.

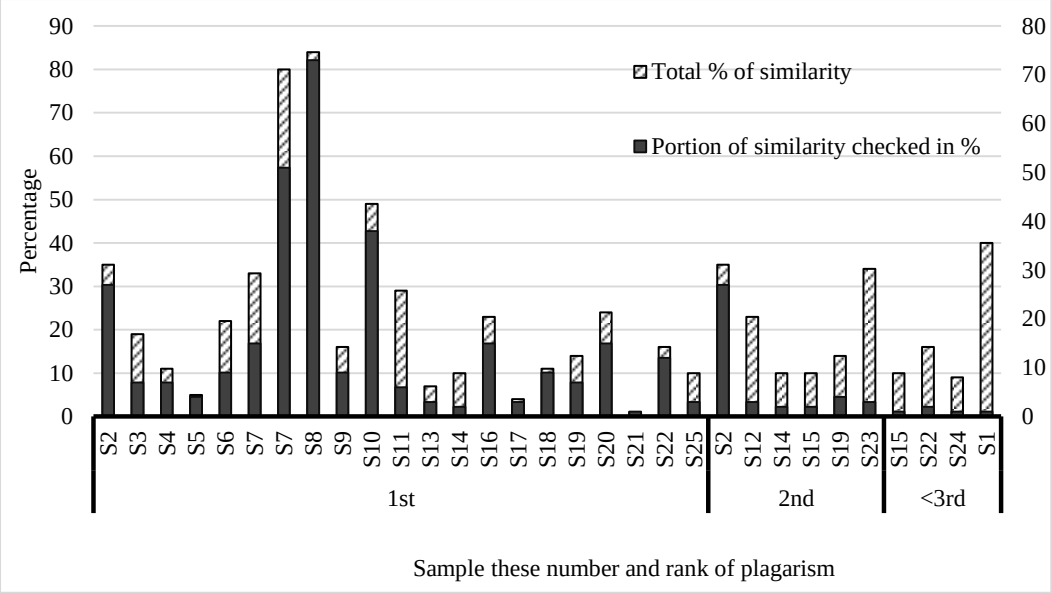
All 25 sample theses revealed the plagiarism source to TUCL e-Library, and are ranked to the 1st, 2nd, and 3rd or above 3rd (Figure 4.41). Altogether 21 documents were traced out their original source, and TUCL e-Library were the 1st ranked original resources. However, they were named as the Internet resources because TUCL e-Library was not listed as the checking resources of iThenticate plagiarism software. It implied the significance of TUCL e-Library resources as the original source. TUCL e-Library source is mostly local sources, which was uncovered by international database. Local resources are more

possible to be skipped during plagiarism check, hence, it caused academic trust issue, credibility issue, and duplication of tasks occurred. Duplication of tasks wasted the valuable effort of time and money.

Figure 4.41, the largest sample were ranked 1st for TUCL repository based on the percentage of plagiarism traced, where 73% is the highest. While the lowest traced was 1%. It suggested every level of copying from TUCL repository is in practice. Moreover, most of the sample suggested that there is the significant number of practices of copying from the repository, that was traced by iThenticate. It recommended to list TUCL repository in iThenticate, as the prominent repository to be checked out for tracing plagiarism.

All 25 sample theses revealed the plagiarism source to TUCL e-Library, and are ranked to the 1st, 2nd, and 3rd or above 3rd (Figure 4.41). Altogether 21 documents were traced out their original source, and TUCL e-Library were the 1st ranked original resources. However, they were named as the Internet resources because TUCL e-Library was not listed as the checking resources of iThenticate plagiarism software. It implied the significance of TUCL e-Library resources as the original source. TUCL e-Library source is mostly local sources, which was uncovered by international database. Local resources are more possible to be skipped during plagiarism check, hence, it caused academic trust issue, credibility issue, and duplication of tasks occurred. Duplication of tasks wasted the valuable effort of time and money.

Figure 4.41. Plagiarism detection sourced from TUCL e-Library



Source: TUCL

The more collections development in institutional repository like TUCL e-Library, the more potentiality of tracing plagiarism. Currently TUCL e-Library has 13,162 collections. If all the constituent colleges of TU, central departments of TU, Institutes of TU, and other Universities of Nepal have built one consortium for institutional repository, it would have far better resources for tracking the plagiarism check. It would be home grown and be useful for nation-wide academics of Nepal.

Chapter 5 : Discussion and conclusion

5.1 Comparing the result with past studies

Increasingly, qualitative content analysis (QCA) is being used to assess usability instead of quantitative analysis (Shava, Hleza, Tlou, Shonhiwa, & Mathonsi, 2021). However, library and information science fields are more quantitative in character. This study has incorporated a greater portion of this study is a quantitative analysis. It has combined usability and the technology acceptance model (TAM) to test usability in an extended dimension. Research has demonstrated a connection between TAM and usability (Amiruddin, Dewi, & Widodo, 2021; Burney et al., 2017). This research has expanded studied usability factors instead of establishing a relationship between TAM and usability.

Usability test was conducted mostly in Human computer interface (HCI) (Bevan, 2001), however, this usability test is conducted upon software operational functionalities. DSpace usability has a lot to impact on the maximum utilization of it. The usability and utilization has direct relations (Bolaji & Jimoh, 2023). So, the usability test of DSpace software and digital repository built in DSpace was conducted to evaluate the usability with factors Ease of Use (EoU), usefulness (U), effectiveness (EF), efficiency (Eff), learnability (LE), and satisfaction (SA).

Regardless of the challenges faced, if a user is persistent and diligent about learning the software, it becomes understandable and helpful. Bolaji and Jimoh (2023) has also emphasized on the trained teachers and continuous training for usability of ICT use. Yet, it underscored the importance of the collaboration between IT specialists and librarians is. It was suggested through different opinions of amateur librarians and experienced librarians. Amateur librarians were sure of installing DSpace, however, they were not sure of solving unseen

problems, hence they viewed the need of IT specialist. Such experiences have indicated the reason behind the weaker usability of DSpace for Nepali librarians. In the case of customization of DSpace, the 44% librarians have asked for the expert help. They are not able to customize it for their libraries.

In the pre-test, five factors (U, EF, Eff, LE, and SA) among six (U, EoU, EF, Eff, LE, and SA) have impacted usability. In the post-test, all six factors have a significant impact on DSpace usability. The interrelationship among those six factors were interconnected in the post-test. That means one factor's improvement has enhanced another factors' performance. However, in the pre-test, U and EF were correlated with all other factors except Eff. The usability test was measured on institutional repositories over the performance time, device responsiveness, and HTTP 2 implementation (Masinde & Sanya, 2022). It was not measured over different functionalities of DSpace repositories, which this study has gone through. Even such factors were not measured in detail.

In different usability test, the pre-test, and post-test was not conducted. It was merely respondents' view that they required training for better usability, and some studies have empirical test for certain functions of DSpace (Masinde & Sanya, 2022; Ottaviani, 2006; Veitch, 2019) . This study proved statistically that the principal factors influencing usability is different in pre-test and post-test. This study has proved the influencing usability factors can vary as per users' experiences, and knowledge upgrade.

Testing the usability on two types of users brought two different results. For librarians, usefulness (U), effectiveness (EF), learnability (LE), and satisfaction (SA) are more impactful in usability, while for end users, EoU, EF, Eff, LE, and SA have more impact on usability. The requirements for librarians

and end-users are two different but aimed for the same, i.e., having an enhanced institutional repository with better usability. These two categories of users and usability test on them is also a new achievement of this study. There was not such demarcation made in previous studies.

No matter how well DSpace software for institutional repository has been implemented in other countries, the fundamental importance for Nepal is the better use of it in Nepali digital library context, which has leisurely growth in Nepal. DSpace usability has lot to impact upon the maximum utilization of DSpace. The lesser usability for librarians and end-users of DSpace has limited the use of it in Nepali libraries. While, it is the high time for the growth of digital resources. During Covid-19 pandemic, Nepali were highly involved in online teaching and learning (Gautam, 2022; Vaidya, 2022), however, the number of digital repository creation in Nepal is limited. So, the usability test of DSpace software and digital repository built in DSpace was conducted to evaluate the usability along with usability factors Ease of Use (EoU), usefulness (U), effectiveness (EF), efficiency (Eff), learnability (LE), and satisfaction (SA).

DSpace is more used by academic libraries for their digital repositories, apart from academic libraries, special libraries have been using it. In total 9 Nepali libraries are using DSpace repository, with some thousands and hundreds of collections, which is the lesser in number of collections. The highest collection is 15218 owned by OLE Nepal, the second highest (13,162 till the date 2023) is collected by TUCL e-Library. The lowest (101) collections are hold by CAAN DSpace repository. None of these repositories were set up, configured, or customized by librarians; rather, they hired a team of technical consultants. However, CAAN DSpace, and Nepal Army DSpace repository was installed and

configured by Prof. Dr. Mohan Raj Pradhan. He was a professional librarian too (Goma Banjade, Personal Communication, 18 February, 2023). The files had been uploaded by librarians following installation. The fewer collections have a detrimental effect on the papers that are returned when searching for information using different keywords, which reduced the repository's usability for users.

Each library's localization and modification of DSpace has often included using the repository's name and logo. While the TUCL e-Library has expanded the browsing possibilities beyond those offered by default. Institutions, level, and submitted date have all been added. The accuracy of the information retrieved has benefited from this new option. Each library had adopted DSpace, as a means to digitally organized, preserved and disseminated information. They had not pre-evaluation and depth study made before adopting DSpace and analyzed their institutional and users' requirements. So, the default available functionalities were kept as the basic arrangement of DSpace.

It was important to provide adequate instructions for the installation, setup, and customization of DSpace based on the experiences of librarians and technicians for the installation usability. Similar to that, it necessitated looking into solutions for a range of issues that sprang up throughout installation, configuration, and customization. High levels of competency, knowledge, and experience are required from librarians to carry out these tasks. Furthermore, since Windows operating system, not Linux operating system, is used in everyday computer use, it is unusual for librarians to use Linux instructions. Linux OS has many advantages for high-quality software. Many librarians had anticipated working with a Graphic User Interface (GUI) rather than a command line (Tomer, 2017). Using Linux command lines gives librarians strange feelings. The lack of a

Linux Operating System course in LIS education is mostly to blame for students' lack of knowledge of the command line, which is necessary for installing DSpace. Similar to this, knowing how to use the command line is essential if you need to copy, paste, remove, or create folders as part of an installation.

Second, the responders frequently use the internet to look out error codes, which is a helpful practice for self-study as well. However, the ability to comprehend the provided answer is another crucial factor, without which the user will be ineffective. Therefore, in such a situation, the existence of a mentor for the DSpace installation who can help the user comprehend is inevitable. Similar to that, the installation guide had helped with installing DSpace. Regardless of the challenges faced, if a user is persistent and diligent about learning the software, it becomes understandable and helpful. Yet, it underscored how important collaboration between IT specialists and librarians is.

Nepali librarians and end-users are new users of DSpace. They have very general know-how about DSpace, so 39.2% of librarians viewed that they only 'heard' about DSpace, only 9.8% have skill of DSpace in pre-test. Once they were trained, their view has changed. So, the moderated usability test (post-test) has resulted greater usability than unmoderated test (pre-test). Their views on all six factors of usability scored higher in post-test than in pre-test (Figure 4.38).

The multiple-choice structure questionnaire to Nepali librarians have picturized the preferences of librarians over verities of functionalities of DSpace, for instances, on the sufficiency of meta-data, ability of customization by librarians, customization requirements for librarians, and data harvest learnability. In these four functions, majority of librarians (32.6% in pre-test and 34.8% in

post-test) viewed easy for meta-data, and 51.2% in pre-test and 47.8% librarians viewed sufficient meta-data in DSpace. Nevertheless, they (44% in pre-test and 40% in post-test) librarians said the need of expert for customization. They (26.8% in pre-test and 48.9% post-test) have mentioned the need to customize community file. Likewise, they said the data harvest is easy to learn for them (46.7% in post-test). In this way, the score for views in pre-test and post-test varied. It suggested the different opinions of amateur librarians and experienced librarians.

Apart from descriptive analysis, the statistical analysis for the data form System Usability Scale (SUS) has proved improved usability in post-test. In pre-test, five factors (U, EF, Eff, LE, and SA) among six (U, EoU, EF, Eff, LE, and SA) have impacted upon usability. While in post-test, all six factors have significant impact upon DSpace usability. The interrelationship among those six factors was interconnected in post-test. That means one factors improvement has enhanced another factors' performance. Yet, in pre-test, U and EF were correlated with all other factors except Eff. The EoU has significant relation only with U, LE and SA; similarly, the LE and SA have significant relation with all other factors. Based on views of amateur librarians, there was variety in the correlation, but it differed for experienced librarians (after training).

In the case of end users, the data was collected only after using DSpace repository with their search results. Maximum end-users did not know about the DSpace repository available for them in their institutions. So, at first, they were made aware about its use, then the SUS questionnaire was distributed.

For end users, EoU, U, and EF factors have greater impact on DSpace usability for end users in compare to Eff, LE, and SA factors. Where as in the case of librarians EoU has the lesser impact on usability. Due to the limited number of

resources available in DSpace resources (TUCL e-Library and GCI e-Library). Two types of academic level were hold by end-users: Masters' degree and above is one and Bachelors' degree is another level. EoU has been significant relation with the institutions. The change of institution has brought change in EoU. It is because TUCL e-Library did not authorize users with username and password while GCI e-Library has managed the authorized users, which they have forgotten during their user for data collection. Hence, the EoU was under great scrutiny for them.

Lastly, the testing of the similarity check on Masters' theses which was traced from DSpace repository resources as the iThenticate anti-plagiarism software has resulted. The result revealed that the DSpace repository resources are also important to be enlisted on anti-plagiarism software. Usability test of institutional repository in DSpace is the first kind of study being met because other studies on usability of DSpace was conducted in certain parts like for installation and data uploading (Körber & Suleman, 2008; Ottaviani, 2006). The present study has incorporated the usability test from installation, Dublin core meta-data scheme of DSpace, file uploading process, e-people making, data harvesting, and information searching process. So, it captured the wider range for evaluating the usability of DSpace. Some studies were from technical point of view on interface usability (Batagoda, 2020). It has accommodated two prominent users of DSpace: the librarians and the end-users. These two types of users have two different tasks aiming one for service providers and another service receiver. Their aim should be met at a point to build usable system.

Testing the usability on two types of users brought two different results. For librarians, usefulness (U), effectiveness (EF), learnability (LE), and satisfaction (SA) are more impactful in usability, while for end users, EoU, EF,

Eff, LE, and SA have more impact on usability. The requirements for librarians and end-users are two different, but aimed for the same, i.e., having the enhanced institutional repository with better usability.

Usability test were focused in identifying usability factors (Aljohani & Blustein, 2015b; Battleson et al., 2001; Colter, 2016; Salau, 2021; Shiweda, 2018); however, they did not investigate on which factor impact more for usability, which this study has filled up. The qualitative test of DSpace installation for Nepali librarians gave the perceptional context for quantitative data analysis of DSpace usability for librarians, as it was the aim of sequential mixed method research (Shiyanbola et al., 2021).

Except few countable users, all were new about the use of DSpace. The lesser extension of use in Nepal was the major constrain for testing usability of DSpace. Because of this less awareness of users, data collection was possible only moderating them about its use. So, it is basically a moderated usability test. Moreover, the data collection time for librarians was the time of Covid-19 pandemic time, that pushed to conduct online data collection method, even for the face-to-face interview through zoom application. The training for librarians was also conducted online. With this virtual session, there was sort of disturbance for fluent communication with participants. However, the end-user's data collection was conducted physically.

DSpace software is continuously developing. The usability test was conducted on DSpace 6.3 on Nepali users. The new DSpace version 7.3 and 7.4 are not in use in Nepali institutional repositories. Nevertheless, the aim of having DSpace is for the better information services to users. The users' and their

particular context has made the usability of DSpace different. Primarily, it was aimed to plug-in anti-plagiarism software in DSpace, but there was no successful implementation, so it traced the similarity check traced from DSpace repository resources as the iThenticate anti-plagiarism software has resulted. The result revealed that the DSpace repository resources are also important to be enlisted on anti-plagiarism software.

Institutional repository build in DSpace in Nepal has many unexplored aspects. Usability is one among such unexplored part, which was conducted in this study. Usability test on separate tasks in detail are possible in future studies so that those functions be implemented extensively. Moreover, the growth of resources is very important. If researchers, and scholars could make uploading their publications in DSpace, it would contribute much for the resource increasement. Similarly, usability on data harvesting, e-people making are also important for the extensive utilization of DSpace.

Lastly, the testing of the originality check on Masters' theses which was traced from DSpace repository resources as the iThenticate anti-plagiarism software has resulted. The result revealed that the DSpace repository resources are also important to be enlisted on anti-plagiarism software. It is the first attempt to trace the significance of digital visibility and establishing DSpace repository as one of the important sources to trace plagiarism.

For the future implication, tracing the similarity on new resources are possible with DSpace institutional repositories. They could be recommended to enlist in different plagiarism checking software. It is of the crucial element for

ensuring the credibility of DSpace repository at one hand, for maintaining academic integrity by elimination plagiarism.

5.2 Future of DSpace

Since it is an open-source software, people of the world can contribute to add features in DSpace. Besides, it has DSpace community, DSpace developer's group. The continuous efforts of many people have enabled DSpace for continuous evolution. In 15 November 2023, the version 7.6.1 has been released for improved user interface and fixing bugs (Donohue, 2023; DSpace, 2023), and it wouldn't stop to be upgraded which they planned for version 8 in 2024. In version 6.X there is the provision of two types of user interfaces, while in the version 7.X, feature of two have been cocktailed in one, and added the counting item provision for community, bulk access management, added multiple language provision, and so on (Donohue, 2023, November 16). These regular updated version releases have kept the possibility of DSpace repository sustainability. However, it also demands for the dedicated time and in-depth knowledge for the DSpace repository librarians. It is the demand of higher skill and regular concern for DSpace repository.

5.2 Recommendation for future research

i. Research related to digital library management (like video, photographs, maps, datasets, and so on) would be sustainable issue.
ii. The interoperability of DSpace with plagiarism checking software would be researchable issue in future.
iii. The data preservation mechanism in DSpace is another significant research issue.
iv. Utilization of DSpace as the subject specific repository.

Chapter 6 Appendixes

Appendix I: Samples for the plagiarism traced out sourced from TUCL e-Library

14 elibrary.tucl.edu.np
Internet
142 words — 1%

Total 40%

consistency in the preference for each brand by a consumer over a period of time. "In place of brand choice sequence Leaster Guest used preference statement over time as a measure of brand loyalty. In 1941, he collected data concerning the brand awareness and preference of student. In follow up studies of these same person 12 and 20 years later he found suggestive evidence of high degree of loyalty toward brand name (although not to specific brand)"

From study of Leaster Guest brand loyalty exists even when it is defined as preference statement over time. According to preference statement approach, brand loyalty is measured on the basis of preference expressed by the consumer to a particular on brand over a certain time.

Literature review is basically stocktaking of available literature in one's field of research. The literature survey provides the student with the knowledge of the status of their field of

2.1.5 Brand switching and brand preference. Brand switching means consumer's habit of constantly shifting from one brand to another. In this sense, brand switching is opposite to brand loyalty. Customer switch brand for reasons of; curiously with respect to

1 elibrary.tucl.edu.np:8080
Internet
4542 words — 21%

2 elibrary.tucl.edu.np
Internet
1244 words — 6%

Total 35%

Chapter I
Introduction

1.1 Background of the Study

Dividend is a portion of a firm's current or retained earnings distributed to its shareholders. Generally, a firm announces dividend on the profit. Dividend policy is commonly defined as a policy implemented by the firm to decide how much dividend it will pay out to its shareholders. Dividend policy is defined as the policy of allocating the earning between the dividend and retention. In practical dividend is payable whenever the board of directors declares to pay whether it might be monthly, semiannually, or annually. In another word, dividend policy is regarding the separation of net earning between distribution to the shareholders as dividend and retention within the firm to meet its further financial requirement. Dividend policy decision is a major decision of a firm, which determines the division of earning between payment to stockholders and reinvestment in the firm (Alexander, Sharp and Bailey, 2003).

Dividend policy is a crucial area of financial management of a firm. The important aspect of dividend policy is to determine the amount of earning to be distributed to shareholders and the amount to be retained in the firm. There is inverse relationship between retained earnings and cash dividend. If more retained earnings is made, the amount of dividend would be less and in the case of less retained the investor would be able to enjoy more dividend. The objective of a dividend policy should be to maximize shareholder's return so that the value of his investment is maximized. Shareholder's return consists of two components, dividend and capital gains. Dividend policy has direct influence on these two components of return. If the firm adopts the policy of retained earnings for the purpose of expansion of its business in the long run capital gain would be the result. Dividend payment to shareholders will obviously reduce the capital gain but it will increase their current wealth and plug them back into the business (Bhandari & Pokhrel, 2012)

as dividend and retention for its investment is known as dividend policy. Dividend policy is to determine the amount of earnings to distribute to shareholders and the amount to be retained or reinvestment in the firms. Any change in dividend policy has both favorable

So, this study aims to mobilize the fund prevailing practice and policies, relevant factors of some Nepal's listed insurance companies of the Nepal have adopted different dividend

policy is an integral part of financial decision. The dividend policy is a major decision for the board of directors as the board of directors has to decide between paying out to shareholders and keep them happy in the short run or retain for investment which may be more beneficial to the shareholder in the long run. Dividend policy determines the division of earning between payments to stockholders and reinvestment in the firm. Retained earnings are one of the most significant sources of funds for financial corporate growth, but dividends constitute the cash flows that accrue to stockholders (Baker & Mayers, 2020).

Appendix II: Likert questions for end-users

Usability test for end-users of DSpace repository

Name: **Date:**

Internet speed at users' station **Age:** **Qualification:**

Name of DSpace Repository:

Please encircle a desired score for the following usability statements as follow:

1----------5

Strongly Disagreed *Strongly Agreed*

	Statements	Scale				
1	The given name to the community and collection is expressive to locate needed document.	1	2	3	4	5
2	Browsing options Title, Author, Issue Date, and Subject are easy to use.	1	2	3	4	5
3	Searching bar in DSpace at the top is easy to locate in user interface.	1	2	3	4	5
4	The provisions of searching filters (author, title, date,) are easy to use.	1	2	3	4	5
5	The retrieved documents from DSpace collections are relevant to my information need	1	2	3	4	5
6	I find relevant information sources in DSpace repository of my institution	1	2	3	4	5
7	DSpace repository help me solving my professional problems	1	2	3	4	5
8	The use of DSpace repository improved my information literacy (skill to retrieve needed information).	1	2	3	4	5
9	Your keywords fed to DSpace repository give relevant document to you.	1	2	3	4	5
10	The full information about the document and the abstract of documents help to decide the relevancy of document.	1	2	3	4	5
11	The login user name and password protection for users of DSpace helps for authorized use of DSpace.	1	2	3	4	5
12	The display of recently submitted documents helpful	1	2	3	4	5
13	Identifying the name of DSpace repository is a quick task	1	2	3	4	5
14	Browsing information through community name takes in an instant	1	2	3	4	5
15	Displaying of the relevant documents in DSpace takes in an instant.	1	2	3	4	5
16	Download for the full-text of relevant document takes in an instant.	1	2	3	4	5
17	Finding a search bar in DSpace takes place in an instant	1	2	3	4	5
18	A search filter in DSpace is in an instant.	1	2	3	4	5
19	Viewing the relevant document takes in an instant	1	2	3	4	5
20	Given instructions are clear for downloading document	1	2	3	4	5
21	The given instructions are helpful to use DSpace.	1	2	3	4	5

	Statements	Scale				
22	The visual appearance of user interfaces is attractive to me.	1	2	3	4	5
23	The display of issue date, title and author at the front page is helpful.	1	2	3	4	5
24	I am satisfied with using DSpace repository	1	2	3	4	5

Thank You!

Appendix III: Multiple choice questions for librarians

S.N	Statements
1	Name (optional)
2	Email
3	Name of Institution affiliated
4	Academic level
5	Gender
6	DSpace institutional repository building has been familiar to me.
7	I would like to learn about DSpace software.
8	I can install DSpace.
9	DSpace institutional repository building is effective tool for information service.
10	your view, what is the mostly liked usages of DSpace.
11	State your opinion on the need of customizing DSpace for your institutional repository building.
12	I can configure and customize DSpace.
13	DSpace is useful for your profession.
14	The meta-data structure for bibliographic information is sufficient in DSpace Institutional Repository.
15	The file formats pdf, docx, ppt, jpg, mkv, html, are feasible to upload in DSpace which is very useful feature of the DSpace.
16	The Doblin core meta-data scheme is easy to understand and use.
17	you are satisfied with the process of file uploading in DSpace.
18	The file uploading process is clear and understandable in DSpace.
19	The file uploading process takes lesser time.
20	The data harvesting in DSpace from OAI-PMH is effective and useful feature.
21	The data harvesting in DSpace from OAI-PMH is easy to use.
22	The data harvesting in DSpace from OAI-PMH is learnable process.

Appendix IV: Likert questions for librarians

S.N.	Statement	1	2	3	4	5
1	DSpace configuration and customization comes under Librarian's job	1	2	3	4	5
2	DSpace customization is essential for presenting institutional repository as its own.	1	2	3	4	5
3	It is learnable to configure and customize DSpace as per my institutional need.	1	2	3	4	5
4	It is easy to configure and customize DSpace software for making institutional repository	1	2	3	4	5
5	The customized DSpace is effective in use for institutional repository	1	2	3	4	5
6	The login as the administrator process is easy to know and use after the installation.	1	2	3	4	5
7	The use of community, sub-community and collection is understandable by their name.	1	2	3	4	5
8	Configurating community, sub-community and collection is easy to do from the instructive lines found in user interface.	1	2	3	4	5
9	Filling the forms for creating community, sub-community and collection is easy and understandable to fill.	1	2	3	4	5
10	All the information to be filled in the community, sub-community and collection are useful and essential.	1	2	3	4	5
11	The division of community and sub-community is effective for federated collection.	1	2	3	4	5
12	The purpose of e-person is understandable in DSpace institutional repository.	1	2	3	4	5
13	The user registration through email is satisfying facility in DSpace.	1	2	3	4	5
14	The categorizations of groups with particular authorization is useful for DSpace institutional repository building.	1	2	3	4	5
15	The authorization given to group of users as submitters of files is effective.	1	2	3	4	5
16	The provision to provide full access to download the files of DSpace is useful service.	1	2	3	4	5

Appendix V: Explanation of applying Pearson chi-square test

1. Give description of Pearson Chi-square test in the Appendix.
    a. A Pearson's chi-square test is a statistical test for categorical data. It is used to determine whether your data are significantly different from what you expected
    b. You want to test a hypothesis about one or more categorical variables. If one or more of your variables is quantitative, you should use a different statistical test. Alternatively, you could convert the quantitative variable into a categorical variable by separating the observations into intervals.
    c. The sample was randomly selected from the population.
    d. There are a minimum of five observations expected in each group or combination of groups.
    e. Explanation: Since the study has followed census population for librarians and random sampling (112) for end-users, it can follow the Pearson Chi-square test.

Appendix VI: DSpace 6.3 installation and configuration

Step 1: Update Debian/Ubuntu patches to latest packages.

#sudo apt update

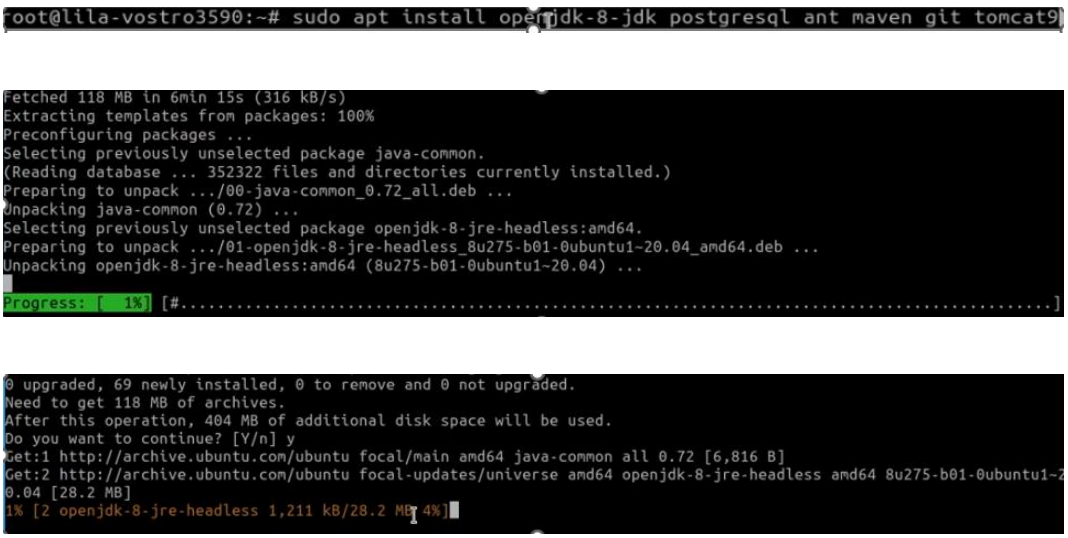
#sudo apt upgrade

Step 2: Install required system applications: (openjdk-8, postgresql, ant, maven)

#sudo apt install openjdk-8-jdk postgresql ant maven git tomcat9

But in the case of Debian, the tomcat8 is compatible. Hence the command for Debian is:

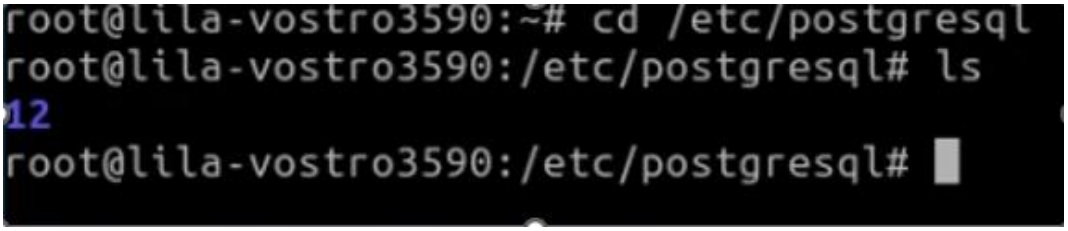
#sudo apt install openjdk-8-jdk postgresql ant maven git tomcat9



Step 3: Postgresql

First check the postgresql version number, in the folder /etc/postgresql/. So, the command was given as:

#cd /etc/postgresql/



Step 3.1 After confirming the version number of postgresql, the full path should be /etc/postgresql/12/main/ inside which the postgresql.conf file should be edited. So, give commands:

#vim postgresql.conf

The postgresql version for in Ubuntu 20.04 is 12 that is different for Debian. It was 10 for Debian.

In the file /etc/postgresql/12/main/postgresql.conf comment the line

listen_addresses = 'localhost'

Commenting mean making is inactive.

Step 3.2 Restart PostgreSQL server

sudo service postgresql restart

Step 4: Configuring PostgreSQL Permissions on a Host Server

trust postgres all local

```
local   all             postgres                                peer
```

```
# "local" is for Unix domain socket connections only
local   all             all                                     peer
```

```
# "local" is for Unix domain socket connections only
local   all             all                                     md5
```

In the file /etc/postgresql/12/main/pg_hba.conf replace ‘local all postgres peer’ with ‘local all postgres trust’. Another similar line local all all peer was also changed with local all all md5 and ‘local all all peer’ with ‘local all all md5’.

Step 4.1: Restart the database server

sudo service postgresql restart

Step 5: Create a database user in postgres. So, in this step, the command to enter postgres is given as: #Sudo su postgres

```
root@lila-vostro3590:/etc/postgresql/12/main# sudo su postgres
```

The folder path given preceded by '#' sign is just of the continuation of previous steps. After entering in postgres, the user named ‘dspace’ and the database named ‘dspace’ in postgresql was created.

Step 5.1: creating the user “dspace” and the database “dspace” in PostgreSQL

In order to create a database user (dspace) and a DSpace database (dspace) the following command was given:

#createuser -U postgres -d -A -P dspace

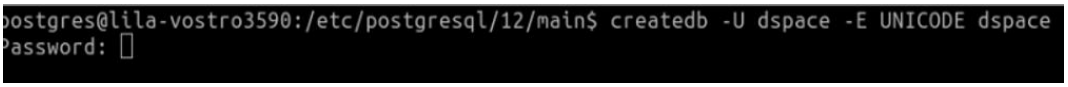
```
postgres@lila-vostro3590:/etc/postgresql/12/main$ createuser -U postgres -d -A -P dspace
Enter password for new role:
Enter it again:
```

The user's name is *dspace* here and the password was also given for this user. If it is in the case of creating multiple instances, the name of user and database should be named differently, for example, the name could be *'user1'* instead of *dspace*.

Step 5.2

#createdb -U dspace -E UNICODE dspace

The password should be given for the database user. It is the same password given before for the name of user



Step 5.3: Exiting from 'postgres' database.

Exit; (Now it is exited from the postgres.)

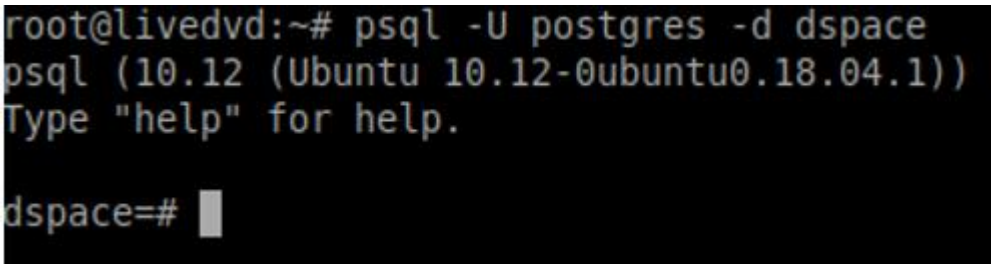
Step 5.4: Restart postgres

#service postgresql restart

Step 6: Setting the password, owner and privileges of the DB "dspace" and user "dspace"

We connect to the PostgreSQL database server and enter the PostgreSQL shell.

#psql -U postgres -d dspace



Step 6.1: Setting the password.

Set password for user “dspace” (specify your option):

ALTER ROLE dspace WITH PASSWORD 'XXXXXX';

```
dspace=# ALTER ROLE dspace WITH PASSWORD 'dspace';
ALTER ROLE
dspace=#
```

Step 6.2: Let the user “dspace” be the owner of the database “dspace”

ALTER DATABASE dspace OWNER TO dspace;

```
dspace=# ALTER DATABASE dspace OWNER TO dspace;
ALTER DATABASE
dspace=#
```

Step 6.3: Assigning roles to newly created database.

Give all privileges to the “dspace” database to “dspace”

GRANT ALL PRIVILEGES ON DATABASE dspace TO dspace;

```
dspace=# GRANT ALL PRIVILEGES ON DATABASE dspace TO dspace
GRANT
dspace=#
```

Step 6.4: Adding crypto extension in the new database.

Add the “crypto” extension to the “dspace” database.

CREATE EXTENSION pgcrypto;

```
dspace=# CREATE EXTENSION pgcrypto;
CREATE EXTENSION
dspace=#
```

Step 6.5: Exiting from the new database

Exit the shell of the database.

#\q (exit command)

```
dspace=# \q
root@livedvd:~#
```

Step 7: procedure for installing phpPgAdmin and All Dependencies

Optionally install phppgadmin

And now we are ready for installing phpPgAdmin

PhpPgAdmin are available in the Ubuntu repository. So, you just need to install them with the apt command.

sudo apt update

Step 7.1: Installing 'phpgaadmin'

sudo apt -y install postgresql-contrib phppgadmin

```
root@livedvd:~# sudo apt -y install postgresql-contrib phppgadmin
```

Step 8: configure Postgres User

#su – postgres

```
root@lila-vostro3590:/etc/postgresql/12/main# su - postgres
```

Step 8.1

#psql

```
postgres@lila-vostro3590:~$ psql
psql (12.5 (Ubuntu 12.5-0ubuntu0.20.04.1))
Type "help" for help.
```

Step 8.2

\password postgres

```
postgres=# \password postgres
Enter new password:
Enter it again:
```

Step 8.3

Here at the prompt: Enter new password ‘psql’ is given. You may change the password as per your convenience.

Then enter \q to leave the psql command line

\q

```
postgres=# \q
postgres@lila-vostro3590:~$
```

exit;

```
postgres@lila-vostro3590:~$ exit
logout
```

Step 9: Configure Apache Web Server

cd /etc/apache2/conf-available/

vim phppgadmin.conf

```
root@lila-vostro3590:/etc/postgresql/12/main# cd /etc/apache2/conf-available
root@lila-vostro3590:/etc/apache2/conf-available# vim phppgadmin.conf
```

```
<IfModule mod_dir.c>
DirectoryIndex index.php
</IfModule>
AllowOverride None
Require all granted
```

Save and exit.

Step 9.1: Configure phpPgAdmin

cd /etc/phppgadmin/

vim config.inc.php

```
root@lila-vostro3590:/etc/apache2/conf-available# cd /etc/phppgadmin/
root@lila-vostro3590:/etc/phppgadmin# vim config.inc.php
```

Find the line '$conf['extra_login_security'] = true;' and change the value to 'false' so you can login to phpPgAdmin with user postgres.

```
// If extra login security is true, then logins via phpPgAdmin with no
// password or certain usernames (pgsql, postgres, root, administrator)
// will be denied. Only set this false once you have read the FAQ and
// understand how to change PostgreSQL's pg_hba.conf to enable
// passworded local connections.
$conf['extra_login_security'] = false;
```

Save and exit.

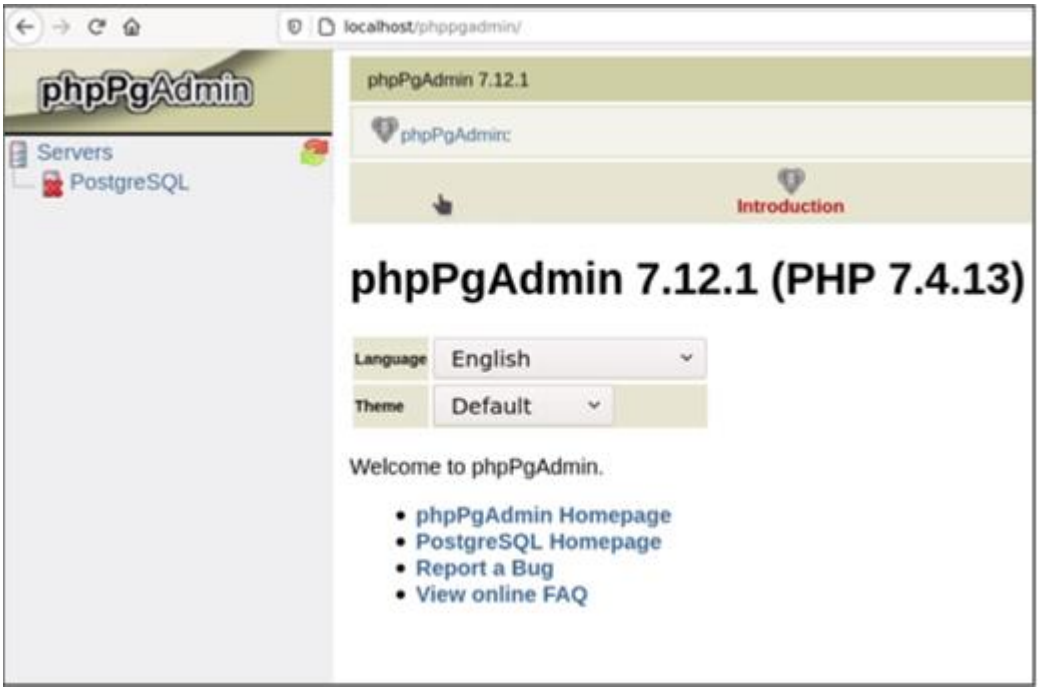
Step 9.2: Now restart the PostgreSQL and Apache2 services one by one.

systemctl restart postgresql

systemctl restart apache2

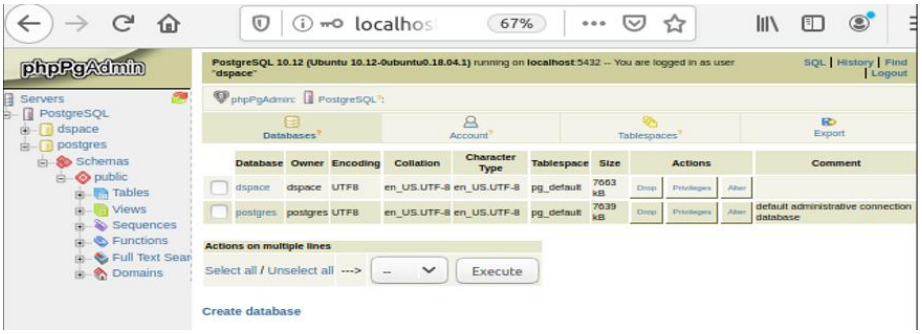
```
root@lila-vostro3590:/etc/phppgadmin# systemctl restart postgresql
root@lila-vostro3590:/etc/phppgadmin# systemctl restart apache2
root@lila-vostro3590:/etc/phppgadmin#
```

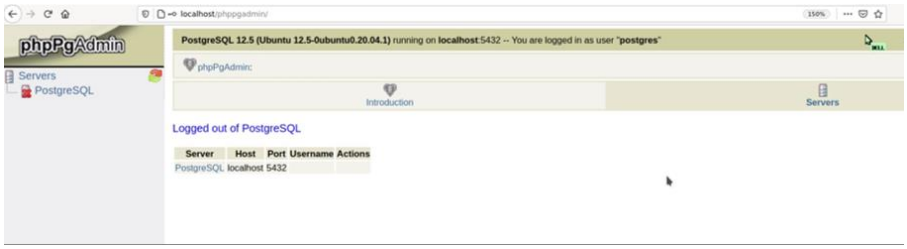
Step 9.3: Now access phppgadmin with the browser. http://yourip/phppgadmin/



Login to with user 'dspace' and your password i.e. dspace in this

example.





After logging in, you can go to phpPgAdmin dashboard interface (Kili, 2020).

Step 9.4

Restart the apache2 with the command:

sudo /etc/init.d/apache2/restart

```
root@lila-vostro3590:/etc/phppgadmin# sudo /etc/init.d/apache2 restart
Restarting apache2 (via systemctl): apache2.service.
root@lila-vostro3590:/etc/phppgadmin#
```

Step 10: create a DSpace user

sudo useradd -m dspace

```
root@lila-vostro3590:/etc/phppgadmin# sudo useradd -m dspace
```

Step 10.1

sudo passwd dspace

```
root@lila-vostro3590:/etc/phppgadmin# sudo passwd dspace
New password:
Retype new password:
passwd: password updated successfully
```

Step 11: creating a [dspace] folder to host the DSpace executable code

```
root@lila-vostro3590:/etc/phppgadmin# sudo mkdir /dspace
```

sudo mkdir /dspace

Step 12: tomcat9

```
root@lila-vostro3590:/etc/phppgadmin# cd /etc/tomcat9/
```

In the case of Debian9, it is tomcat8

Step 12.1

sudo chown tomcat:tomcat -R /home/*dspace/*

Or

sudo chown tomcat9:tomcat9 –R /home/dspace/

Or

chown tomcat:tomcat –R /etc/tomcat9

```
root@lila-vostro3590:/etc/tomcat9# chown tomcat:tomcat -R /etc/tomcat9/
root@lila-vostro3590:/etc/tomcat9#
```

sudo service tomcat9 restart

```
root@lila-vostro3590:/dspace# sudo service tomcat9 restart
root@lila-vostro3590:/dspace#
root@lila-vostro3590:/etc/tomcat9# sudo chown tomcat:tomcat -R /dspace/
root@lila-vostro3590:/etc/tomcat9# cd /dspace/
```

Step 13: download, compile, and install the DSpace release

Create a directory to build Dspace

#sudo mkdir /build

```
root@lila-vostro3590:/dspace# sudo mkdir /build
```

Step 13.1

#sudo chmod -R 777 /build

```
root@lila-vostro3590:/dspace# sudo chmod -R 777 /build
```

#cd /build

```
root@lila-vostro3590:/dspace# cd /build
```

Step 13.2: Download DSpace into /build directory

wget https://github.com/DSpace/DSpace/releases/download/dspace-6.3/dspace-6.3-src-release.zip

```
root@lila-vostro3590:/dspace# cd /build
root@lila-vostro3590:/build# wget https://github.com/DSpace/DSpace/releases/download/dspace-6.3/dspace-6.3-src-release.zip
```

Step 13.2: unzip DSpace package

Extracting Dspace package

#unzip dspace-6.3-src-release.zip

```
root@lila-vostro3590:/build# unzip dspace-6.3-src-release.zip
```

Step 14: Installation of DSpace

Enter into Dspace package folder and apply following commands one by one.

```
root@lila-vostro3590:/build# cd /build/dspace-6.3-src-release
root@lila-vostro3590:/build/dspace-6.3-src-release# sudo vim /build/dspace-6.3-src-release/dspace-api/pom.xml
```

#cd /build/dspace-6.3-src-release

Open following file and remove a piece of lines.

Step 14.1

sudo vim /build/dspace-6.3-src-release/dspace-api/pom.xml

Remove the following group of codes. Carefully check the lines in the file (L103-115).

```
<plugin>
    <groupId>org.codehaus.mojo</groupId>
    <artifactId>buildnumber-maven-plugin</artifactId>
    <version>1.4</version>
    <executions>
        <execution>
            <phase>validate</phase>
            <goals>
                <goal>create</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

Save and close the file.

Step 15: Update java with the following command

```
root@lila-vostro3590:/build/dspace-6.3-src-release# update-alternatives --config java
There are 2 choices for the alternative java (providing /usr/bin/java).

  Selection    Path                                            Priority   Status
------------------------------------------------------------
* 0            /usr/lib/jvm/java-11-openjdk-amd64/bin/java      1111      auto mode
  1            /usr/lib/jvm/java-11-openjdk-amd64/bin/java      1111      manual mode
  2            /usr/lib/jvm/java-8-openjdk-amd64/jre/bin/java   1081      manual mode

Press <enter> to keep the current choice[*], or type selection number: 2
update-alternatives: using /usr/lib/jvm/java-8-openjdk-amd64/jre/bin/java to provide /usr/bin/java (java) in manual mode
```

#update-alternatives --config java

At the prompt in choosing option: choose option 2 of openjdk-8-jdk

Step 16: Configuration of DSpace

Change directory to the initial configuration files repository with the following command:

vim /build/dspace-6.3-src-release/dspace/config/dspace.cfg

vim /build/dspace-6.3-src-release/dspace/config/local.cfg

```
root@lila-vostro3590:/build/dspace-6.3-src-release# vim /build/dspace-6.3-src-release/dspace/config/dspace.cfg
```

```
root@lila-vostro3590:/build/dspace-6.3-src-release/dspace/config# vim local.cfg
```

Particularly the following parameters:

Dspace installation directory:

dspace dir= /home/dspace

```
dspace.dir = /home/dspace
```

dspace.baseURL=http://dspace.your-domainname:8080

or http://ip_address:8080

db.url=jdbc:postgresql://localhost:5432/dspace

#Database username and password

db.username=dspace

db.password=dspace

Step 17: Compilation

#cd ~/dspace-6.3-src-release/

#mvn -U package

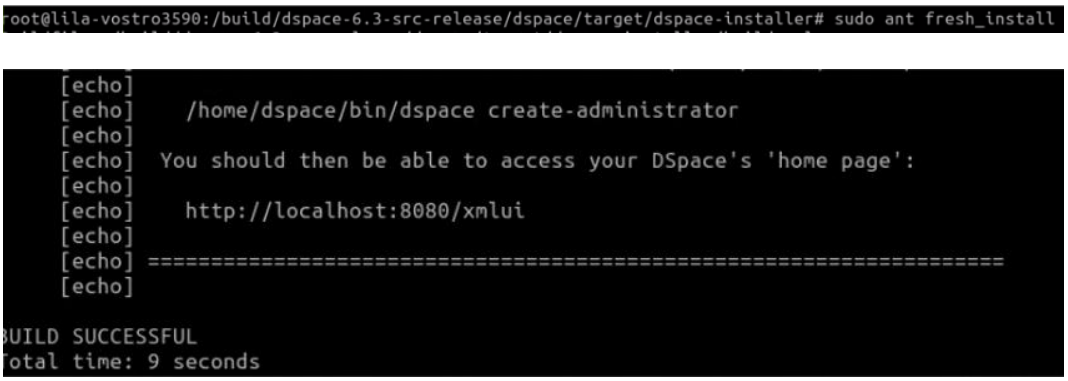
```
[INFO] DSpace XML-UI Mirage2 Theme ..... SUCCESS [  0.081 s]
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  20:49 min
[INFO] Finished at: 2020-12-08T21:06:51+05:45
[INFO] ------------------------------------------------------------------------
```

Step18: Install DSpace and initialize the database

Go to the directory:/build/dspace-6.3-src-release/dspace/target/dspace-installer

and run the command

#sudo ant fresh_install



Step 19: Initialization of server.xml for ‘dspace’ user

#vim server.xml

Add the following lines in the file server.xml at the end of the file, preceded by

<Host>

<!--Define a new context path for all DSpace web app-->

<Context path="/xmlui" docBase="/home/dspace/webapps/xmlui"

allowLinking="true"/>

<Context path="/sword" docBase="/home/dspace/webapps/sword"

allowLinking="true"/>

<Context path="/oai" docBase="/home/dspace/webapps/oai"

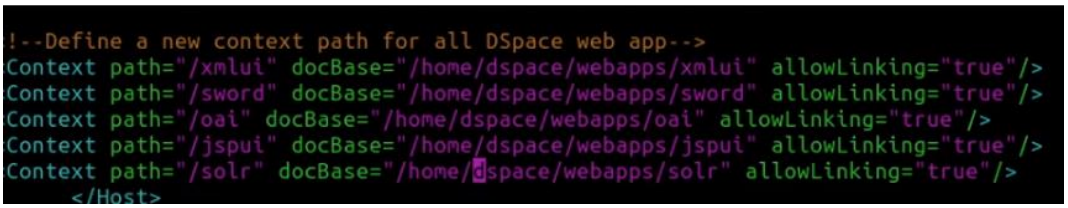
allowLinking="true"/>

<Context path="/jspui" docBase="/home/dspace/webapps/jspui"

allowLinking="true"/>

<Context path="/solr" docBase="/home/dspace/webapps/solr"

allowLinking="true"/>



Step 20: *Changing ownership*

chown tomcat:tomcat -R /etc/tomcat9/

chown tomcat:tomcat -R /home/dspace/

sudo service tomcat9 restart

Step 21: Create DSpace administrator

Go to home/dspace/bin and create administrator

#cd /home/dspace/bin/

./ dspace create-administrator

Enter an email address

First name:

Last name:

Enter a password:

Re-enter the password:

DSpace has two interfaces: xmlui and jspui. Both can be appeared in the browser

http://localhost:8080/xmlui

http://localhost:8080/jspui

Appendix VII: List of anti-plagiarism checking software

SN	Name of software	Qualities
1	Copycatch	Ensure originality. Prevent plagiarism with advanced AI powered anlysis
2	Copyleaks	AI detector. Detect ChatGPT.
3	Copyscape	AI content detector.
4	Docoloc	Can use by limited users of institutional users. Check similarites between document on Internet.
5	Dupli Checker	AI content detector. 1000 words per search gives better result. Free of the cost except for pro version.
6	Eve2 (Eassy Verification Engine)	It is not Internet-based.
7	Grammarly	Plagiarism checking and AI writing assistance
8	GPTZero	AI detector. Detect ChatGPT, GPT4, Google-Gemini, LLaMa, and new AI models.
9	iThenticate	Particularly good for academic institutions. Maintain integrety and authenticity of the work
10	JPlag	Open source software. It offers a powerful graphical interface to analyze its reslut. It supports Java, C#, C, C++, Python, Javascript, Typescript, Go, R, Rust, Kotlin, Swift, Scala and others.
11	MOSS (Measure of Software Similarity)	System for detecting software similarity
12	Originality AI Plagiarism	Detect if content was AI generated, understand AI uses, used for web publication
13	Paper Rater Plagiarism	Use Google, Yahoo, and Bing indexing API to search vast data stores
14	Checker	Free and accurate online plagiarism detector
15	Plagiarism Detect	
16	PlagTraker	Access 14 billion web pages, and 5 million academic papers, Access to University database
17	Turninit	Ensure original work from students.
18	Quetext	Use DeepSearch Technology, contextual analysis, fuzzy matching, conditional scoring.
19	QuillBot AI Detector	Detect ChatGPT, GPT-4, and Google Gemini
20	Viper Plagiarism Scanner	Text detection, rapid scan, ensure originality, accurate detection

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