Technologian Exclusive Research Assistant: A Virtual Research Assistance Platform with Recommendation Algorithm

Sumalinog, Lucelle D.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
322 617 741, +63
lucelle.sumalinog@cit.edu

Albano, John Robbie V.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
322 617 741, +63
john.albano@cit.edu

Emorecha, Jarry B.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
322 617 741, +63
jarry.emorecha@cit.edu

Mondejar, Yanni Jan G.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
322 617 741, +63
yannijan.mondejar@cit.edu

Talatagod, Ryan A.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
322 617 741, +63
ryan.talatagod@cit.edu

Barbaso, Leah V.
Cebu Institute of Technology University
N. Bacalso Ave.,
Cebu City 6000
(032)261-7741 loc 110
leah.barbaso@cit.edu

ABSTRACT

Technologian Exclusive Research Assistant (TERA): A Virtual Research Assistance Platform with Recommendation Algorithm is a mobile and web-based application that offered a collaborative tool and a recommendation system to cater users' ease in accessing and saving online references for their research works.

TERA was designed with a goal of providing a single platform that would enable its target users, the students and faculty of Cebu Institute of Technology University, to access e-resources from online databases subscribed by the university. Furthermore, this system also allowed availability to access future and past dissertations accomplished by the university alumni.

To arrive at suitable system requirements, survey questionnaires were utilized to gather relevant data. The survey disseminated through Google Forms, involved a total of 47 respondents, selected through Complete Enumeration technique, where respondents are from the third year Research class of the IT department of the university. To design the system, Use-Case Diagram, Class Diagram, Entity-Relationship Diagram, and MVC Architecture were assembled to guide the team.

TERA offered a bookmarking tool that allowed its users to bookmark references and store them to their library, a collaborative tool that allowed users to work together, and a recommender system that recommended relevant articles for users. Furthermore, TERA also aimed to be used at any place and at any time with presence the presence of Internet, hence, its mobile usability was strengthened.

The SUS Score of TERA arrived at a mean of 64.26 and a standard deviation of 10.14, indicating that the usability of the system did not meet the average scale and certain issues were having the need to be addressed.

With the procedures conducted and the results that came out in accomplishing this research, it was concluded that TERA required further modifications and improvements to fully provide the features and services that it initially specified.

CCS Concepts

• Information systems → Database management system engines • Computing methodologies → Massively parallel and high-performance simulations •Prescriptive Research → Recommendation algorithm •General and references → Cross–computing tools and techniques → Reliability • General and reference → Document types → Reference works •Applied computing → Operating research → Computer-aided manufacturing •Applied computing → Document management and text processing → Document management

•Information systems → Information retrieval → Document representation → Document collection models

Keywords

Research Assistant; Citation; Bibliography; Platforms; Collaborative Tool; Technology; Substantive Knowledge; Research Workforce; Data; Information; Traditional Research Assistant, Innovation; Academe; Institution; Virtual Research Assistant

1. INTRODUCTION

Research, the process which aims to assemble a set of substantive knowledge and findings to generate questions and solutions for further inquiries, has long been situated at the forefront of different fields of knowledge. Over the years, the means, and processes of conducting research methods and techniques has been gradually transfigured in a faster but accuracy-consistent manner in order to harmonize with the rapidly increasing global needs without jeopardizing its essence— to push the boundaries of knowledge and to break free from limiting personal beliefs about the way things should be.

With the aid of the constantly evolving technology, various tools and techniques have been introduced to improve the status and performances of different fields of knowledge, including research, to provide better products and more accurate solutions to existing problems in the holistic aspects. Research plays an immensely vital role in our society, hence, in this era where technology is in its prime years, an equally significant category of the research workforce is considered — the Research Assistant.

The key role of a Research Assistant is to use not only a single, but multiple streams of data to find information to help researchers in collecting necessary and relevant data and information. The type of Research Assistance practiced by researchers has been primarily relying to the traditional or manual method of gathering research tools and relevant information. However, this manual undertaking can be mended by using a new form with the aid of technology— the virtual research assistants.

With utilizing this technology, both researchers and their assistants can collect the necessary supporting data to aid their investigations easier, faster, and with more accuracy. The proposed project Technologian Exclusive Research Assistant (TERA) is a mobile and web-based application that aims to help users, particularly the students in and out of Cebu Institute of Technology University (CIT-U) to do research with the aid of a research assistance system.

TERA offers built in research tools necessary for a research paper— importing PDF (Portable Document Format) files, a bookmarking tool that allows its users to bookmark web pages and contents and store them directly to their accounts, a collaborative tool to allow users to work together, and a recommender system that recommends relevant articles for users based on what they are storing in their library. Furthermore, TERA also aims to be used at any place and at any time if internet connectivity is present, hence, its mobile usability is aimed to be strengthened.

A system that propels students in improving the content and substance of research papers is an innovation that majority from the academe and several institutions can essentially use, knowing that constructing proper research papers is a common issue and concern that teachers have towards their students. The main goal of TERA is to serve as a platform which would cater the users' needs in creating the appropriate research and academic papers.

2. REVIEW OF RELATED SOFTWARE

This section discusses the specifications of each software which were used by the team to come up and construct the positioning map. There is a total of eight software that were utilized as bases for this project. The stipulations of the description, functionalities, purpose, and features of each software that will be shown at the succeeding parts will serve as a guide for the team to compare and determine similarities and differences that TERA has among the following software.

Turnitin

Turnitin is a plagiarism detection and originality checker that identifies unethical copying and citation errors in written work (APUS librarians, 2020). Its aim is to ensure student honesty when it comes to paperwork and to resolve even the most sophisticated possible misconduct. By offering tools for manual grading processes, it allows teachers to spend more time teaching rather than manually reviewing documents. Turnitin is widely used **in** schools and universities to ensure the originality of what students say**.** (*Features of Turnitin Originality Report* 2021). The software is also very user-friendly; once the work is submitted, it compares the text to sources in its vast database and sends a report on similarity and originality (*Features of Turnitin Originality Report* 2021). While useful, the method has some flaws, such as the inability to recognize all similar sources and the fact that it is more concerned with achieving a certain percentage in the study than with improving writing skills (*Features of Turnitin Originality Report* 2021). Turnitin provides a life-saving straw by preventing learners from stealing information in the database for legitimate reasons. The teacher is responsible for all content that is not registered in the database. In addition to the documents not registered in the database, the inspection of the documents registered in the database is reduced (Khoza, 2021).

However, another problem is that although Turnitin can help teachers save time to catch fake students, most schools around the world cannot afford it because it is expensive. Schools that cannot afford it can seek support from higher education institutions to help students at their current levels so that teachers themselves can benefit from this process. This process allows most schools to carry out their work as a whole (Khoza, 2015).

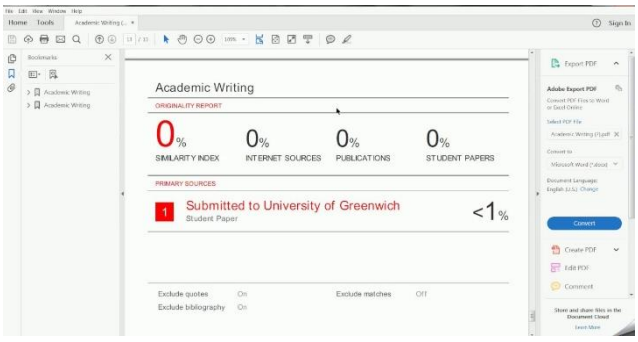

Figure 1. Turnitin Main Page

Zotero

Zotero is a program that can assist you in creating a personal library of source material derived from journals, books, documents, websites, and other sources. This personal library of references can be used in conjunction with the word processing program to format a document in the style of your choosing. Users can save quotations from directories, websites, and library catalogues. It handles, categorizes, and organizes information. It is also a set of citation preferences. Finally, it adds PDFs, photographs, web page snapshots, reading notes, and other attachments to citations in your list. Zotero does not cater a web platform, but only desktop and to use it, users should add the Zotero extension to their browsers and install the app itself to their desktop. Zotero is a Firefox browser (which can also be downloaded for the Chrome or Safari connector) that operates in its own window, separate from web pages. It recognizes content in your web browser and allows you to connect it to your personal library with a single click.

Zotero can work with a variety of citation export options, which are formatted using many built-in editors and journal styles (Ahmed, 2011). Moreover, he said that Zotero synchronizes, and stores saved research libraries on its website where a user can access them. Accounts may be conveniently built-in order to login to the internet and save data online (Ahmed,2011.) In addition, Zotero is an open-source software where you can download and look the source freely (Puckett, 2011). He also said that the main reason for using recommended managers is to save time and effort (Puckett, 2011). Many academics recommend Zotero (Trinoskey, 2009).

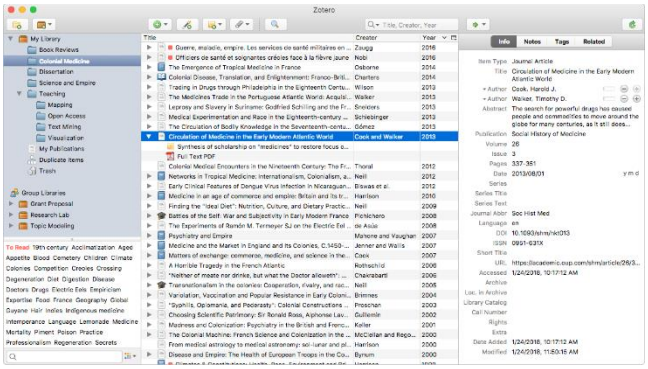

Figure 2. Zotero Main Page

Endnote

EndNote is often defined as a software program that allows users to handle and fit their references and help them in creating bibliographies. It also allows users to type in or capture references from Electronic Resources. In using EndNote, users can generate bibliographies within Microsoft Word or other word-processor programs. EndNote can format bibliographies such as Chicago Manual of Style, APA, Turabian, Science, MLA, and all other journal-specific bibliographic citation styles. EndNote Online is another alternative where it is an online version of EndNote, formerly known as "EndNote Web." Signing up for free basic account is possible, but some features and functionality are limited. MSU users through MSU Libraries have a complimentary premium account subscription, accessed from the electronic resources page. Special features of EndNote include citations, and bibliographies are accessible anytime and anywhere. After an account is created, EndNote users can access it on any workstation as long as there is an internet connection. Another feature is a collaboration of research through the use of sharing of the bibliographies, adding an email address of other users to share a list of resources. Citation sharing can be accessed as a read-only or a read & write to give specific users the privilege of adding some citations. Also, the display of the shared lists is discretionary on any EndNote homepage. Another notable feature of EndNote is the use of Cite While You Write. It makes it easy for the user to cite references in their research papers. Another feature is inserting EndNote citations into the new documents, including in-text citations and endnotes and footnotes. A plug-in is also available for users to download, wherein bibliographies written in various styles can be instantly generated for printing, saving, or emailing. An additional feature where users can transfer citations between the website version and the downloaded software version.

The release of the newest version EndNote X9, making necessary and impactful research has always been the primary aim of Clarivate Analytics in its dedication to serving researchers. Aside from that, it conjointly helps give exclusive access for up to one hundred team affiliates, enabling them to use the web interface to obtain materials from all specific areas and on any device, might or not it's in iOS, Windows, and many more The administrators can set limits on what they can access, specifying "read-only" or "write" way into the bibliography or selected collection of sources for individual team members.

A research collaboration through the use of sharing of citations or bibliographies is possible with EndNote (Mintz, 2018). Another alternative approach is reviewing reference lists of relevant reviews, and those already included citations to ascertain studies that aren't yet retrieved (Chandler, Churchill, Higgins, Lasserson, Tovey. 2013). EndNote can add 5-10% of the citations located in the new content, as Chapman et al. (Chapman, Morgan, Gartlehner. 2010) experienced. Nonetheless, remarkable studies have found that searching reference lists can append tremendous value to database searches and should not be omitted (Horsley, Dingwall, Sampson. 2011).

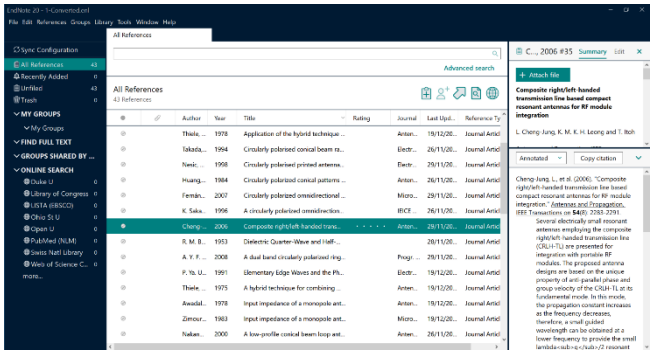

Figure 3. Endnote Main Page

Mendeley

A research conducted by Butros and Taylor (2011) suggests that Mendeley, a web-based and desktop program named after Dmitri Mendeleyev and Gregor Mendel, is a free tool that is primarily used to organize, discover, and share research papers that distinguishes it from other programs and web applications such as Refworks and EndNote. Zaugg et al. (2011) also supports the claim by suggesting that Mendeley features tools such as citation management, synchronization and collaborative tool, and the

capability to serve as an extension of word processing program such as Microsoft Word and adds that Mendeley, aside from the aforementioned features, also serves as a tool that annotates and cites PDF articles. To do this, Mendeley will be looking through the metadata from the PDF files in order to read through the essential details and will further update the citation (Butros & Taylor, 2011). Additionally, Mendeley also integrates the capability of peer-to-peer collaboration which enables researchers globally to collaborate and connect with each other. Gunn (2014) suggests the same idea in his paper by describing Mendeley as a Desktop program for organizing and collaborating— two essential approaches in strengthening scientific collaboration, especially by providing a novel way to understand the impacts of citation analysis. Furthermore, it also serves as a medium to discover the depths of research and expertise along with other services.

Butros and Taylor (2011) further states that in terms of utilizing the citation tool of Mendeley, two different strategies can be approached by the users— first is through plainly dragging and dropping PDF files from the Desktop into Mendeley's Desktop Window, and the second strategy is through importing citations directly from the web by using Import feature of the browser plugin of Mendeley. In line with the presence of the Web Importer of Mendeley, the distinguishing feature of the scholarly cloud is also highly possible with this web application, thus, the folders created in a user's account can be mirrored not only from one device such as laptop, to other device, such as Desktop computer, and also allowing members of the folder to have access to it (Gunn, 2014).

Mendeley Desktop can be synchronized with its tandem web application enabling the citations and bookmarked articles to be backed up in the 500 MB of storage for the free version, and 2 GB storage for the premium version. Although Mendeley is prominent for having refined management and organizational tools, however, the feature for stand-alone bibliography tool is still limited (Butros & Taylor, 2011).

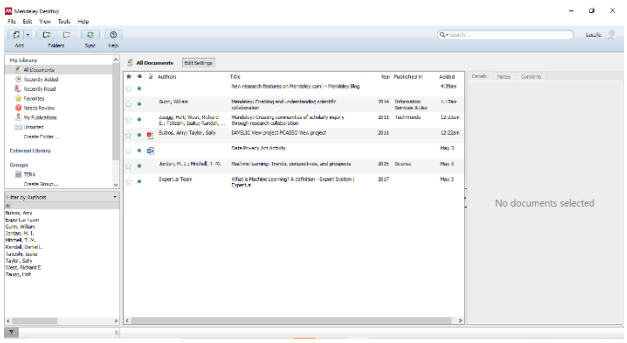

Figure 4. Mendeley Main Page

RefWorks

RefWorks by Ex Libris is their web-based line management software package. Used for storing user reference databases online with the ability to be accessed and updated with the availability of an internet connection. RefWorks comes with licenses with institutional permissions that allow the subscription from universities for their students. RefWorks implements the ability to export references directly. With each reference citation saved as text files to the users corresponding computer then imported to RefWorks. Together with the partnership with Scopus, it allowed the enhancement of integration with its bibliographic database. RefWorks gives the users the choice of their RefWorks databases to be public, all of it or a portion. When on bibliographic websites, capturing information is possible with RefGrab-It.

With a web-based format instead of a stand-alone program was added by RefWorks to CMS (Roseler et al., 2019). Giving the program an increased accessibility, thus giving the advantage. Now users from any location can access their libraries. Roseler et al. (2019) further suggests that another advantage of RefWorks is its independence on a specific computer platform.

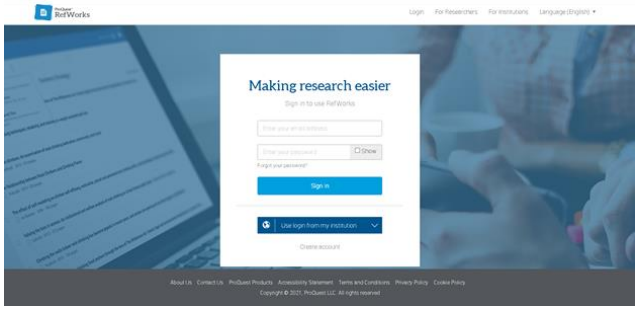

Figure 5. RefWorks Main Page

Matrix of Comparison

The table below (see Table 1) shows the matrix comparison between TERA and the software indicated in the Positioning Map (Figure 3) and in the earlier sections of the Review of Related Software. This is to allow the team to identify the similarities and differences that exist in the features of each software in order to further determine what features are to be included in TERA to make it unique from the other software.

Table 1. Matrix of Comparison

Features	TERA	Turnitin	Zotero	EndNote	Mendeley	RefWorks
Group Collaboration	/		/	/	/	/
Import and Remove PDF Files	/	/	/	/	/	/
Citation Creator			/	/	/	/
Plagiarism Tool		/				
Dynamic Privileges	/					
Bookmark References	/		/	/	/	/
Recommend Articles	/			/	/	
Paper Feedback		/				
Bibliography Tool				/		/

3. METHODOLOGY

The different figures and descriptions presented in the following sections gave great contributions to the team in order to arrive to more suitable and relevant specifications for the creation of this project. This section also presents discussions of the means and methods that the development team conducted and made use of to support the essence of innovating this project, more importantly for the students at Cebu Institute of Technology University.

The series of investigations and information-gathering implemented to supply evidence and data for this project manifested that a use of Research Assistant has not been practiced and brought to familiarity to several potential users. Hence, this section mainly put emphasis to the need of TERA's target users for an application that would cater their needs in utilizing and managing references for their research works. Although have been existing platforms already, but the primary goal of TERA is to offer services exclusively for the students and faculty of Cebu Institute of Technology University by giving them automated access to the institution's dissertations accomplished by the alumni, as well as from the online databases subscribed by the institution.

3.1 Data Collection

The data collected enabled the team to answer the stated research questions, gather the relevant potential system requirements, and analyze accurate insights for the research by accumulating and measuring information on variables of interest. In collecting the raw data for this research project, the team made use of survey questionnaires where consent and confidentiality were asked and given respectively to the respondents who participated in the conducted study without any resort. In answering the survey, the given name and surname must be answered to correctly identify the sample population respondents who answered the provided survey questionnaire and for tracking purposes.

3.3.1 Sampling Technique

The team selected the respondents for the data collection through the use of Complete Enumeration and Convenience Sampling techniques, where the sample size was based on the total number of students enrolled in the class since selecting respondents within the circle was the most suitable option. With this, the team was able to survey 47 respondents from the IT Department from Cebu Institute of Technology University, excluding the research project team members. The survey was disseminated via email using Google Form, a platform which the team also used to design the survey questionnaire because of its efficiency to connect in an online class setup. The survey questionnaire included one numerical data and 13 categorical data. The question intended for the numerical data was to determine the average amount of time the respondents spend in gathering information without losing track of specific website links in their everyday search. In addition, the numerical data was for the team to calculate the answers given by the respondents accurately.

The survey questionnaires in categorical data were to deduce how strongly respondents agree or disagree with the questions presented, such as the difficulty on their side managing references and the inefficiency to list down sites without any platform. Also, it aimed to know how strenuous it is in their part to track down browser history, if or not respondents use a browser bookmarking feature when they save websites and realize what existing research platforms respondents often use. In addition, categorical data was for the team to see the insights of respondents and their concerns.

3.2 Methodological Approach Evaluation

Due to the current academic setup, the team have been organizing and conducting virtual meetings in order to arrive to a suitable and relevant project based on the data gathered through survey. Prior to the decision of the structure and content of the selected data collection method, the meetings have been held mostly in two social platforms, Facebook Messenger and Microsoft Teams, where the team spent an average of twenty hours each week. With these, the team was able to arrive to an agreement as to how the survey questionnaire would be structured including the type and number of questions.

The questions supplied in the questionnaire were based on the standards of Likert Scale, most specifically in terms of measuring statements of agreement. The sample size of the survey conducted has been uniformly decided by the entire class, in which out of 52 students, only 47 of which are set as respondents, excluding the five members of the development team to avoid biases. The team also discussed to utilize Microsoft Excel for the data analysis method in order to evaluate the data.

3.3 Data Analysis

In order to evaluate the data gathered after conducting the data collection method through survey questionnaire, the development team relied on Microsoft Excel in order to analyze the raw data. The total responses have been itemized and categorized into two groups, the qualitative data, which encompassed 13 questions, and quantitative data, which encompassed one question, in order to see the comparison among the answers for every corresponding question.

The responses of the categorical questions 1,2,3,4,5,8,10,12,13, and 14, which were originally referred to the Likert Scale, had to be converted into numerical values based on the five-point scale of measuring statements of agreement, questions 7 and 11 fetched Yes and No responses and were indicated by 1 and 0, respectively. The last categorical question was seeking to know the relevant research assistant applications known by the respondents, and the values 0, 1, 2, 3, 4, 5, were its indicators. The responses for quantitative questions were left as their numerical values.

3.3.2 Statistical Treatment

According to Jamieson (2004), both the mean and the standard deviation are technically inappropriate for analyzing ordinal data points. Since majority of the survey questions were derived from the five-point Likert Scale and other categorical inferences which furthermore assessed primarily as to how the design of the system would be, they were technically considered to be ordinal values, thus, the development team analyzed these results by summarizing them using the mode among the measures of central tendency to interpret the data easily. In order to get the mode, Microsoft Excel was employed, by applying the formula for the aforementioned measure in each of the questions.

3.4 Diagrams

Out of the results fetched from the data collection and analysis conducted, it is apparent that a need for a platform that would allow users to bookmark and remember web references for their research, organizing these references, and to recognize relevant

references to their saved references is immensely convenient for the target users of this project, hence, the initiation of this project, Technologian Exclusive Research Assistant: A Virtual Research Assistant Platform with Recommendation Algorithm. The following diagrams supported the development team to arrive to a significant plan and design that would cater the needs of the target users by providing aid to the aforementioned concerns.

Entity-Relationship Diagram

The diagram presented in this section helped the team to determine and identify the important relationships that exist among the entities involved to create this system. This is important for the team to properly develop and execute the necessary specifications in the system's database to avoid potential redundancies and discrepancies in the future. This Entity Relationship Diagram will serve as an essential backbone to the system.

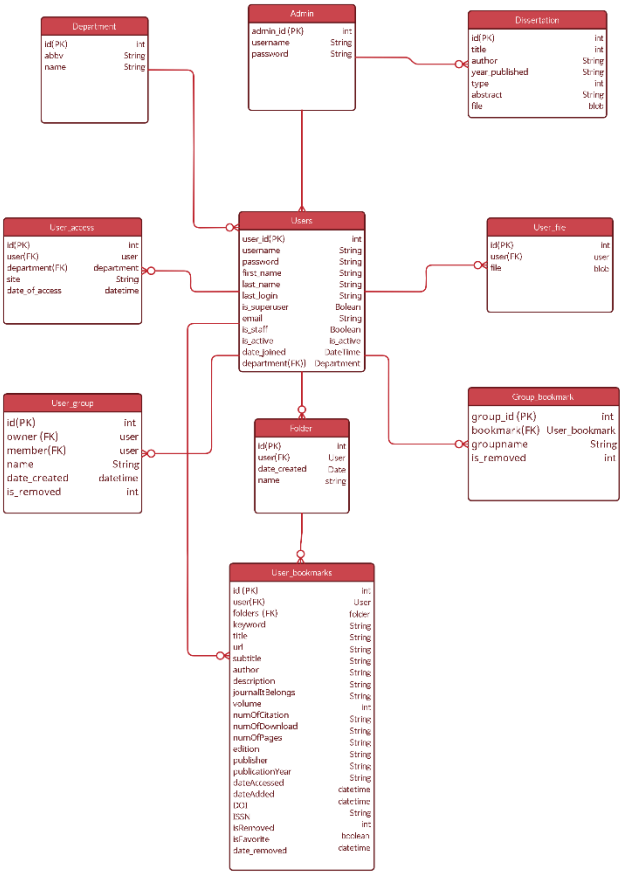

Figure 6. Entity-Relationship Diagram for TERA

Class Diagram

The diagram presented in this section helped the team to determine and identify the important relationships that exist among the classes involved to create this system. This is important for the team to properly develop and execute the necessary specifications in the system's database to avoid potential redundancies and discrepancies in the future. This Class Diagram will serve as an essential backbone to the system.

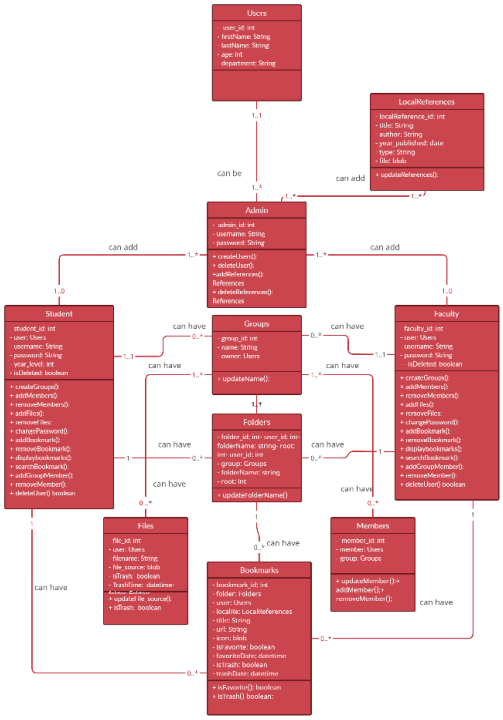

Figure 7. Class Diagram for TERA

Use-Case Diagram

Use cases are essential to develop projects since it specifies the expected behavior and not the exact method of realizing the project. The following visual representation of use cases was used in order to further determine how the system will behave both at the users' and system's end. This diagram effectively shows the entire flow of the system.

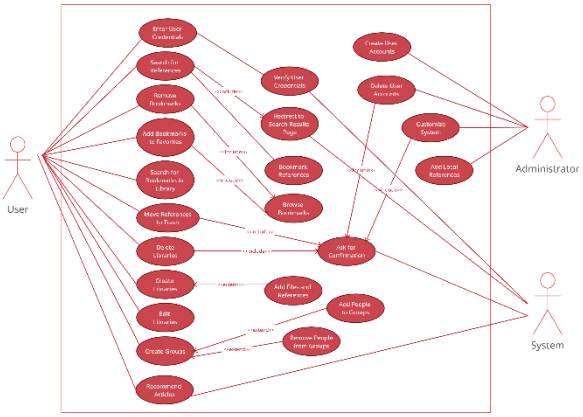

Figure 8. Use-Case Diagram for TERA

Model-View-Controller (MVC) Architecture

Model-View-Controller architecture in this section shows how the system is separated into three main logical components: Model, View, and Controller. This diagram assisted the development team to determine how the system's business logic and presentation layer will be autonomous from each other. The model stores the data and logic components, the view handles the presentation of the data, and the controller interprets inputs from the users to interact with them.

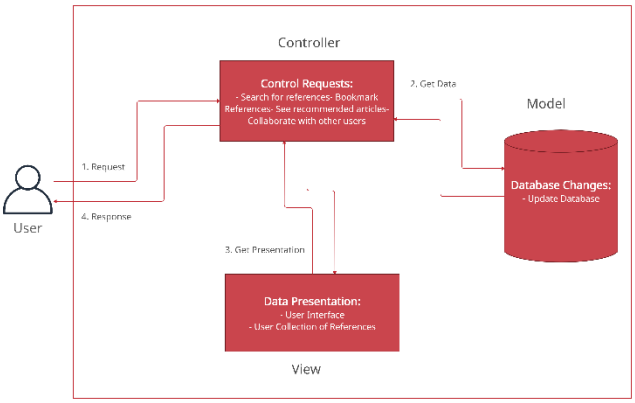

Figure 9. MVS Architecture for TERA

3.5 Framework and Application Programming Interface

To bring this project into a fully operational system, the development team made use of several frameworks and Application Programming Interface to support the structure of TERA. Since this project is intended to be both a web and mobile application, two separate frameworks will be utilized. For the web application of TERA, Django framework incorporated with Python programming language will primarily hold the system, while for the mobile application, Flutter Framework will be used.

In order to allow both applications to access data and interact with several components associated and necessary for its operability, such as microservices, Django Rest will be used by the development team. The utilization of this API will allow the responses between the system and the users to be delivered effectively.

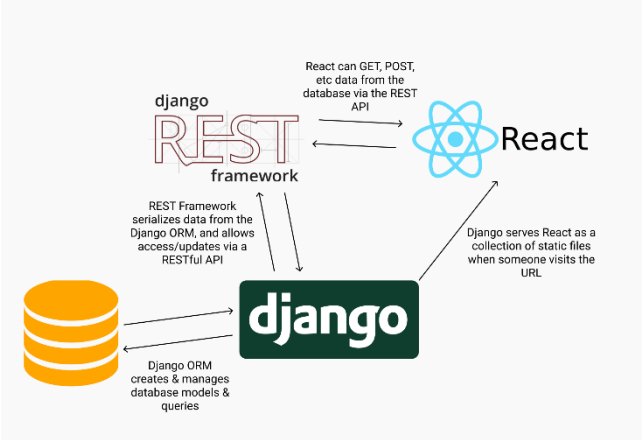

Figure 10. Framework and API Diagram to be applied (Garner, 2021)

4. RESULTS, ANALYSIS, AND DISCUSSION

This section presents a series of visual representations and interpretations of the data gathered from the survey conducted in the previous chapter. The following presentations emphasize that there are two sets of results obtained for this chapter since the team conducted a total of two surveys, the first set is from the data collection which served as the reference to the system's features and requirements for this research, and the second set is from the data collected from the System Usability Scale that would measure the usability performance in terms of the overall ease of use and effectiveness of the system from the users' experience.

4.1 Demographics

This section primarily presents the data for the respondents who took part in the survey conducted. The respondents who are all encompassing the third year Research class of the Department of Information Technology in Cebu Institute of Technology University, are distributed by their genders. This demographic is applied for both the data collection process in identifying the system requirements, and the System Usability Survey. The table below shows that out of 47 respondents, 26 of them are male, while 21 are female.

Table 2. Distribution of Respondents According to Gender

Gender	Number of Respondents
Male	26
Female	21

The pie chart below also shows the distribution of the respondents by gender according to the percentage of each gender. Out of the 100% population of respondents, 55.3% are encompassed by the male while 44.7% are encompassed by the female.

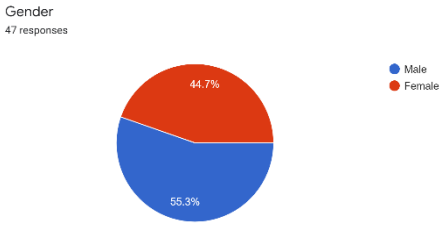

Figure 11. Pie Chart Showing the Distribution of Respondents According to Gender

4.2 Summary of the Collected Data for Determining System Features

The results of the survey conducted by the team assisted and gave ideas to arrive to the suitable and relevant system features that will be encompassed in the system.

The summaries of the raw data are presented in the succeeding figures to easily understand and evaluate their significance. The total responses for the initial survey conducted to determine the system requirements and design have been itemized and categorized into two groups, the qualitative data, which encompassed 13 questions, and quantitative data, which encompassed one question, in order to see the comparison among the answers for every corresponding question.

The succeeding tables below show the summary of the responses collected from 47 respondents. Categorical questions 7 and 11 fetched Yes and No responses, indicated by 1 and 0, respectively.

Table 3. Summary of Questions with Yes and No Responses

Survey Questions	Yes or No Responses	
	1	**0**
7	34	13
11	8	39

Question number 9 also requires a categorical data and is seeking to know the relevant research assistant applications known by the respondents, and the values 0, 1, 2, 3, 4, 5, are indicators of None, Refworks, EndNote, Mendeley, and Zotero, and others respectively.

Table 4. Summary of Research Assistant Platforms Known by the Respondents

Name of Software	Number of Responses
None	**41**
Refworks	**1**
EndNote	**1**
Mendeley	**2**
Zotero	**2**
Others	**0**

The responses of the categorical questions 1,2,3,4,5,8,10,12,13, and 14, which were originally referred to the Likert Scale, had been converted into numerical values based on the five-point scale of measuring statements of agreement where 1 indicates strong disagreement, 2 indicates disagreement, 3 indicates neutral, 4 indicates agreement, and 5 indicates strong agreement.

Table 5. Summary of Responses for Survey Questions Derived from Likert Scale

Survey Questions	Likert Scale Responses				
	1	**2**	**3**	**4**	**5**
1	0	1	15	20	11
2	1	3	11	24	8
3	0	4	12	25	6
4	0	3	9	17	18
5	0	3	6	19	19
8	16	6	9	13	3
10	0	1	9	26	11
12	2	8	18	17	2
13	0	2	10	22	13
14	0	1	10	16	20

Lastly, the raw responses for quantitative questions were left as their numerical values.

Table 6. Summary of Hours Spent by Respondents to Gather Information Without Losing Track of References

Time Spend (Hours)	Number of Responses
0	3
1	16
2	17
3	4
4	4
5	1
8	1
12	1

4.2.1 Statistical Treatment and Analysis

According to Jamieson (2004), both the mean and the standard deviation are technically inappropriate for analyzing ordinal data points. Since majority of the survey questions were derived from the five-point Likert Scale and other categorical inferences which furthermore assessed primarily as to how the design of the system would be, they can technically be considered as ordinal values, thus, the development team analyzed these results by summarizing them by measuring and determining the mode among the measures of central tendency to interpret the data easily. In order to get the mode, Microsoft Excel was employed, by applying the formula for the aforementioned measure in each of the questions.

As a result, the team was able to arrive to the following values of the mode:

Table 7. Summary of Mode Values for Every Survey Question

Questions	Mode	Indication
1	3	Neutral
2	4	Agree
3	4	Agree
4	5	Strongly Agree
5	4	Agree
6	2	2 Hours
7	1	Yes
8	4	Agree
9	0	None
10	4	Agree
11	0	No
12	3	Neutral
13	4	Agree
14	5	Strongly Agree

4.2.2 Interpretation

From this summary of mode values, the following interpretations have been concretely deduced: first, respondents feel neutral when it comes to managing references for their research. Second, respondents agree that they spend a lot of time jotting down sites and references every time they want to remember either of those, or both. Third, without using any platform that would list down sites and references, the respondents agree that they find it hard to be fast and precise. Fourth, the respondents strongly agree with the claim that losing track of the references' links and tracking them manually from the browser's history is a hassle for their side. Fifth, the respondents agree that they find it stressful to track their browser history without organizing them in categories. Sixth, the mode measurement tells that the respondents mostly spend two hours to gather information needed for their research without losing track of the sites and references that they use. Seventh, the respondents are using the bookmarking features to save for websites and references. Eighth, the respondents claim that they agree how lacking it feels for them to make user of bookmarking features only through using the browser. Ninth, although there are already existing research assistant applications, however the respondents normally do not use any of them for

their research and for managing their references. Tenth, respondents agree to the claim that they spend a lot of time figuring out the necessary references that best fit their research study. Eleventh, in terms of having access to past dissertations accomplished by the students and faculty of Cebu Institute of Technology University, the respondents responded that they don't have access to these. Twelfth, respondents are neutral when it comes to using online databases subscribed by Cebu Institute of Technology University as their references. Thirteenth, the respondents agree that they find switching and logging in to online databases subscribed by Cebu Institute of Technology University every time they use these media as inconvenient to their part. Lastly, during groupworks such as research works, respondents strongly agree to the claim that they prefer to collaborate with their groupmates when it comes to deciding and choosing the references to be used for their work.

4.3 Prototype

With the aid of the results from the survey that has been analyzed and interpreted in the preceding section, the team has arrived at a set of features to be included in the system. This section presents how the Graphical User Interface of TERA would appear to be at the users' and administrator's sides both for the web and mobile applications of TERA. The prototypes that are displayed in this section are still works in progress and are subject to further enhancements based on the results of the System Usability Scale (SUS) survey.

3.6.1 Web Application

The succeeding figures for this section focused on the flow of the user interface for the web application of TERA.

This figure showed the log in page of the system where users were asked to provide their account credentials defined by the administrator.

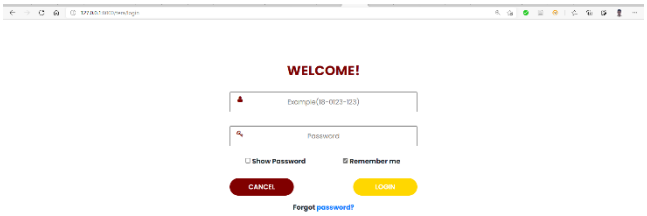

Figure 12. Login Page

This figure showed the home page of TERA where users could input specific keywords, titles, and authors of the references they opted to search for.

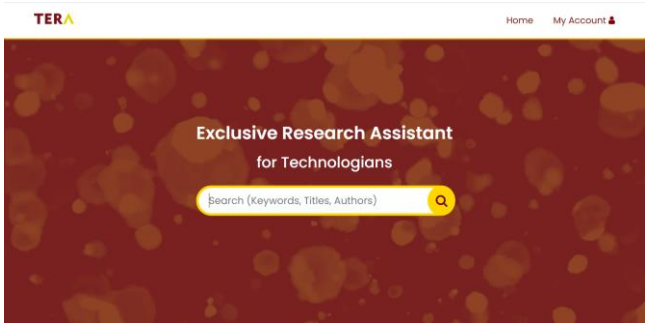

Figure 13. Home Page

This figure showed a list of studies with regarding what the user has searched for. The users could then choose from a selection of categories on what they were looking for.

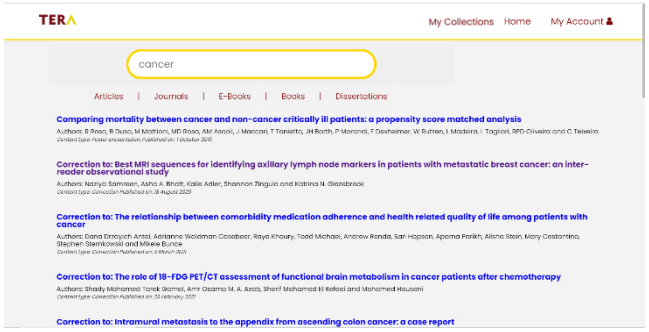

Figure 14. Search Results Page

This figure showed the official site where the user is redirected to. After the user selected and clicked on an interesting study, they were then redirected to the site.

Figure 15. Official Site Redirected Page

This figure showed the All-References tab, where the user would find all the websites and references that they have bookmarked from the search results page. As for PDF files, the user could drag and drop files to the bookmarks list as well.

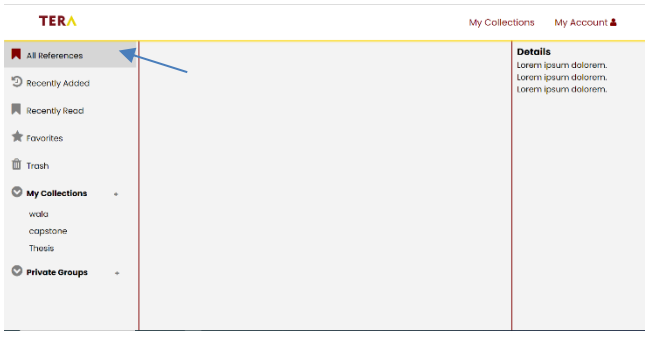

Figure 16. Page Showing All Bookmarked References

This figure showed the Recently Added tab. As the users add new sets of bookmarked items, the references would be updated and would be sorted based on the corresponding dates.

Figure 17. Page Showing Recently Added References

This figure showed the Recently Read tab. Everything that the user has opened or read would be shown and would be constantly updated.

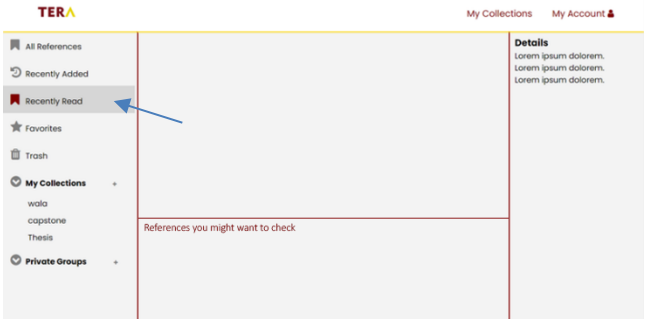

Figure 18. Page Showing Recently Read References

This figure showed the Favorites tab. Users would be able to access the frequently used items for faster access in the future. This page would also show references recommended by the system according to the content of recently read.

Figure 19. Page Showing References Under Favorites

This figure showed the Trash tab. As for every reference the user deletes, all of it would be reflect in this section. This page would also show references recommended by the system according to the content of favorites.

Figure 20. Page Showing Trashed References

This figure showed the My Collections tab. Users would be able to organize saved references based on the users' categories.

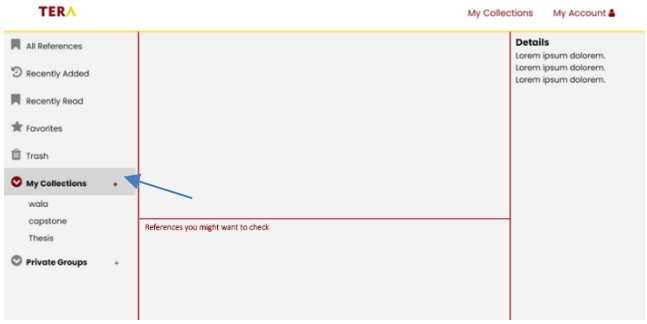

Figure 21. Page Showing Collections with Recommendation

This figure showed the creation of a folder under My Collections tab. As the user organizes their saved references, they can make their own categories where they see fit to put their saved references. This page would also show references recommended by the system according to the content of the folders.

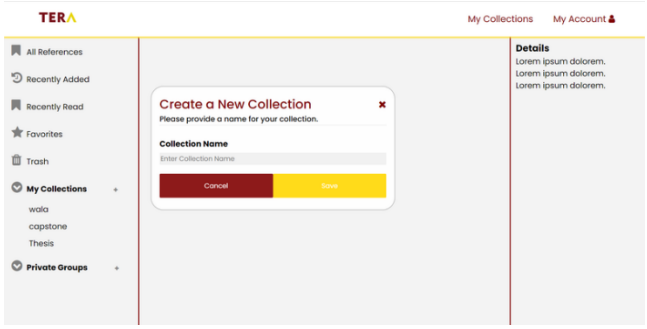

Figure 22. Modal for Creating A Folder Under My Collections

This figure showed the Private Groups tab. Here, users could collaborate with the team, colleagues, and work mates in terms of deciding what references to put and utilize for their work. This tab would allow users to add other users to form the group.

Figure 23. Page Showing Private Groups

3.6.2 Mobile Application

The succeeding figures for this section focused on the flow of the user interface for the web application of TERA.

This page served as the login page for the users where they could input their user credentials, the same way with the login page of the web application.

Figure 24. Mobile Login Page

After successfully logging in, the users would then be redirected to the main page where they could immediately see all the bookmarked websites and references. The users could also search for some bookmarked references through the search bar.

Figure 25. All References Page

The users could also see their folders under the My Collections tab where they could organize their references according to the folders they make. They could also mark references as favorite through the icon beside every title in the list.

Figure 26. My Collections Page

Under the Private Groups tab, the users would be able to browse through and create groups where they could collaborate with other TERA users in terms of managing references for their group works. This figure also showed the menu where the users could check the references under Recently Added, Recently Read, Favorites, and Trash.

Figure 27. Private Groups and Sub-Menu Page

Similar with the web application, the mobile version of TERA also offers search feature where users could search for references from online databases subscribed by Cebu Institute of Technology University which they can bookmark and add to their libraries.

Figure 28. Search Page

This page showed the search results page where users would be redirected to after tapping the search button. The users were given a filter option.

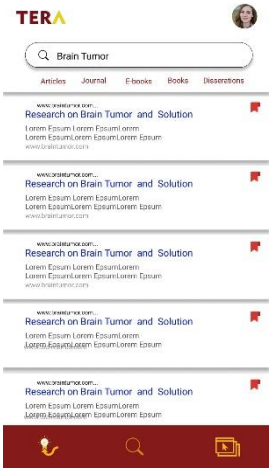

Figure 29. Search Results Page

This page showed the recommendation area where users would be able to see the recommended references by the system according to the references that the users' save and bookmark to their library.

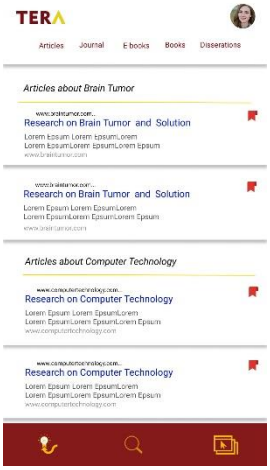

Figure 30. Recommendations Page

This page showed the options under the user account icon, where the users could edit their account settings such as changing their passwords and logging out of their account.

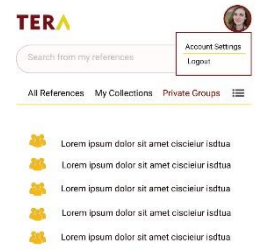

Figure 31. My Account Dropdown

3.6.3 Administrator Interface

In this section, the administrator dashboard through the web application could be seen. The environment of this interface can be dynamically customized according to how the admin aims in terms of its look and feel.

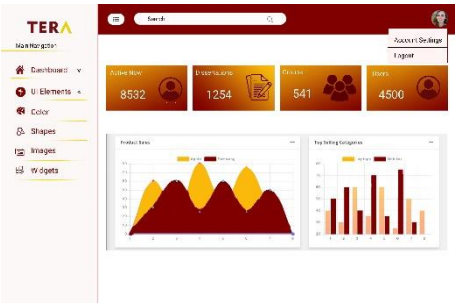

Figure 32. Administrator's Dashboard

4.3 Summary of Data from System Usability Scale

After the implementation of the aforementioned system prototypes, the team conducted an initial System Usability Scale (SUS) survey for the team to know how the target users look at the system holistically. The results of this survey serve as the basis for the future enhancements and improvements of the system.

This section highlights the data gathered after conducting the System Usability Survey. The survey questionnaire that was utilized by the development team followed the standards provided by the System Usability Scale to further arrive at the appropriate survey questions.

The descriptive data that is aimed to be acquired in this survey have been scaled into numerical inputs which are also equivalent to their respective points, hence the data have been converted into quantitative values. The numerical values indicate the following: 1 indicates Strongly Disagree, 2 indicates Disagree, 3 indicates Neutral, 4 indicates Agree, and 5 indicates Strongly Agree.

The structure of the survey has also been categorized into two: odd-numbered questions are pointing to a positive tone while the even-numbered questions are pointing to a more negative tone.

The table below shows the summary of the responses for the System Usability Survey for every question. The inputs from the 47 respondents are distributed to the aforementioned indicators above.

Table 8. Summary of Responses for System Usability Survey

Survey Question	Responses (Level of Agreement)				
	1	2	3	4	5
1	0	2	15	29	1
2	2	18	23	4	0
3	1	3	15	23	5
4	7	25	8	5	2
5	0	2	13	28	4
6	4	20	17	6	0
7	0	1	15	22	9
8	5	26	14	1	1
9	1	1	20	21	4
10	2	19	12	14	0

4.3.1 Statistical Treatment and Analysis

Measuring and interpreting the System Usability Scale for the raw data gathered from the system usability survey has utilized a different approach as compared to the process applied in the previous section's set of data.

In order to arrive at a reliable output, the System Usability Scale (SUS) Score for each participating respondent has been computed, segregating the inputs of the odd-numbered survey questions from the even-numbered questions. Calculating each respondent's SUS score would follow the standard formula and procedure where:

a. the summation of the odd and even-numbered questions must be calculated separately.
b. the summation of the odd-numbered questions is deducted by 5.
c. the summation of the even-numbered questions is subtracted from 25.
d. the differences of the two values and will be added and multiplied by 2.5.

To elaborate this, the team assigned the variables $\sum_{Odd}$ to store the summation of the scores under the odd-numbered questions and $\sum_{Even}$ to store the summation of the scores under the even-numbered questions. Consequently, the following equations have been applied:

$$Calc_X = \sum_{Odd} - 5$$
$$Calc_y = 25 - \sum_{Even}$$
$$SUS\ Score = (Calc_X + Calc_y) * 2.5$$

With these calculations, the table below shows the summary of the SUS Score of every respondent.

Table 9. Summary of System Usability Scale Scores

Respondents	Variables				
	$\sum_{Odd}$	$\sum_{Even}$	$Calc_X$	$Calc_Y$	SUS Score
1	17	14	12	11	57.5
2	18	10	13	15	70
3	16	13	11	12	57.5
4	21	12	16	13	72.5
5	20	7	15	18	82.5
6	21	14	16	11	67.5
7	16	11	11	14	62.5
8	20	11	15	14	72.5
9	17	12	12	13	62.5
10	18	9	13	16	72.5
11	19	14	14	11	62.5
12	20	14	15	11	65
13	20	9	15	16	77.5
14	16	10	11	15	65
15	17	18	12	7	47.5
16	18	15	13	10	57.5
17	16	19	11	6	42.5
18	17	15	12	10	55
19	20	13	15	12	67.5
20	17	10	17	15	80
21	18	10	11	15	65
22	16	14	13	11	60
23	21	13	14	12	65
24	20	11	15	14	72.5
25	22	12	10	13	57.5
26	16	14	14	11	62.5
27	18	10	12	15	67.5
28	19	8	16	17	82.5
29	20	10	14	15	72.5
30	15	11	14	14	70
31	19	12	12	13	62.5
32	21	10	16	15	77.5
33	13	18	8	7	37.5
34	15	13	10	12	55
35	20	12	15	13	70
36	17	10	12	15	67.5
37	14	14	9	11	50
38	17	14	12	11	57.5
39	20	14	15	11	65

40	19	17	14	8	55
41	16	12	11	13	60
42	16	13	11	12	57.5
43	19	14	14	11	62.5
44	18	20	13	5	45
45	21	8	16	17	82.5
46	21	11	16	14	75
47	24	17	19	8	67.5

To evaluate the explication of the System Usability Scale, the mean System Usability Scale (SUS) Score and its corresponding Standard Deviation is computed according to the following calculations:

Calculation for the Mean

$\mu = \frac{\sum X}{N}$ where μ is the mean SUS Score, X is the SUS Score of each respondent, and N is the total number of respondents.

Calculation for the Standard Deviation

$S = \frac{\sqrt{\sum (X-\mu)}}{N}$ where S is the standard deviation, X is the SUS Score of each respondent, μ is the mean SUS Score, and N is the total number of respondents.

Calculation Using Microsoft Excel

The calculations for both mean and standard deviation have also been made through using Microsoft Excel with its built-in formulas. This approach made the values to be computed faster.

The following are the attained mean and standard deviation values for the System Usability Scale (SUS) Scores for the conducted survey:

Mean = 64.25531915

Standard Deviation = 10.14410653

4.3.2 Interpretation

In interpreting the System Usability Scale (SUS) Score, certain normalization values are set for the information's validity and reliability. The ideal and average SUS score would be within the 50th percentile with a mean value of 68 and a standard deviation of 12.5 (Sauro & Lewis, 2016). This would imply that the score is higher than the 50% of all tested products and systems.

The individual SUS scores that are presented in the previous table have served as concrete bases to arrive to a mean SUS out of the 47 respondents and its corresponding standard deviation.

By following the preceding formulas and procedures, the team has arrived at a SUS mean value of 64.26, visibly implying that the score sits below the 50th percentile, and a standard deviation of 10.14. With these values, it can be implied that the usability of the system is below average which further evaluates that there are existing system issues and problems that are having the need to be addressed, and the system holistically needs significant improvements.

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6. APPENDIX

This section contains the supplementary materials that the team employed in this research in order to support the analysis conducted in the preceding chapter and validate the conclusion that has been deduced after thorough interpretations of the results.

Two sets of survey questionnaires are presented in total, the survey questionnaire used to determine the features that are included in establishing the system, and a survey questionnaire that aims to know the usability scale of the system.

Survey Questionnaire for Determining System Features

1. I find it difficult managing references for my research project.
2. I spend a lot of time jotting down sites and references whenever I want such a site to remember.
3. I find it hard to be fast and precise without using a platform that lists down sites I am interested with.
4. I find it hassle when I lose track of the website link and track it on the browser history.
5. I find it stressful tracking back my browser history without organizing them into categories.
6. On average, I spend this amount of time in information gathering without losing track of the website links every time I search.
7. I use browser bookmarking feature in saving websites.
8. It is good, although it kind of feels lacking as I can only access my bookmarks through browsers.
9. I use these existing platforms in managing my references in doing research.
10. I spend a lot of time just to figure out where to find articles that best fit my study.
11. I have access to studies such as past thesis papers and dissertations within CIT – U.
12. I sometimes refer to online databases that CIT-U is subscribed with in finding references (such as Ebscohost, Cambridge Core, ScienceDirect, and etc.).
13. I do not find it convenient switching and logging in to different sites when accessing the online databases that CIT-U is providing.
14. Do you prefer to collaborate with your groupmates when it comes to deciding what references will your group use for your groupworks and research?

Survey Questionnaire for the System Usability Scale

1. I think that I would like to use this product frequently.
2. I found the product unnecessarily complex.
3. I thought the product was easy to use.
4. I think that I would need the support of a technical person to be able to use this product.
5. I found the various functions in the product were well integrated.
6. I thought there was too much inconsistency in this product.
7. I imagine that most people would learn to use this product very quickly.
8. I found the product very awkward to use.
9. I felt very confident using the product.
10. I needed to learn a lot of things before I could get going with this product.
11. My comments or suggestions.