“An AI Chatbot System for Tech Support in the MyDCampus Website of De La Salle Lipa using Expert System and Natural Language Processing Techniques”

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ACCEPTANCE AND APPROVAL SHEET

This Proposed Thesis entitled **"An AI Chatbot System for Tech Support in the MyDCampus Website of De La Salle Lipa using Expert System and Natural Language Processing Techniques"**, prepared, and submitted by **Arguelles, Zeth Raphael, Pangilinan, Patrick, Sajnani, Sanjay, and Vergara, Aaron Charles** in partial fulfillment of the course requirements for **Thesis 2** was examined and recommended for acceptance and approval.

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ABSTRACT

The thesis focuses on the development and implementation of a Rule-based AI Chatbot that emphasizes on improving online help support in the MyDCampus site. The system development process followed an agile methodology, in which development was performed in iterations and divided into three (3) sprints representing the main functionalities of the system. The design of the chatbot referenced the user needs according to the requirements analysis, incorporating appropriate HCI principles and accessibility features. The chatbot was developed through the use of the Botpress framework to implement rule-based and Natural Language Processing algorithms, such as Intent Classification, Slot Identification, and Entity Extraction. As part of the implementation plan, user acceptance testing was conducted with 25 DLSL-affiliated respondents. Results of the UAT concluded with a “STRONGLY AGREE” rating for the chatbot evaluation, “AGREE” rating on the positive user satisfaction evaluation, and “DISAGREE” rating on the negative user satisfaction evaluation. All software test cases for the chatbot systems were successfully passed. The study recommends the chatbot UAT to be expanded in respondent size, improve the system’s NLP capabilities, and extend accessibility features and data analytics through dashboard.

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Chapter 1

BACKGROUND OF THE STUDY

Introduction

As internet access became a more widespread commodity throughout the world, it influenced the continued proliferation of websites or web portals powered by different individuals and organizations. These sites are built to accomplish a specific purpose for the average end-user; mostly towards providing services that are either tangible or intangible. Current day service websites can be one that promotes business services and online marketplaces, such as Amazon and eBay, provides social networking services, such as Facebook and Twitter, or serves as a search engine, like Google and Yahoo. Service-oriented websites have served a significant part in the online experience, addressing not only the needs of a general audience, but also the demands of such for a specific and specialized group of users under a specific organization. Medical associations and educational institutions create and utilize their own personalized web portals for their respective audiences, such as medical professionals and students, to be able to provide appropriate information and resources to individuals subscribed to or looking into their services.

The proliferation of internet use and online service sites comes with the increase of technology integration among existing educational institutions and organizations. The advent of increasing technology integration led to dependency on its presence for educational uses. This has become more apparent among institutions in the Philippines that integrate technology as part of their academic curricula, programs, and services. De La Salle Lipa can be considered one of those technologically integrated institutions with its continuous use of the Canvas Learning Management System (LMS) and the development of its own web portals to efficiently address educational needs of students. These online institutional website services have become more valuable, as online learning becomes more integrated as an essential education channel due to the influence of the COVID-19 pandemic. These online avenues of De La Salle Lipa became gateway for students to be able to access their course modules, communicate with fellow classmates and teachers, and access valuable DLSL libraries and features. Furthermore, it opened up an easy access for parents to be able to look into the DLSL education system, monitor their children, and be notified on DLSL related news and requirements. Considering the fact that such valuable online channels connect the institution's beneficiaries to its own services and materials, there is a need to take into consideration how DLSL should design its online media in order to effectively provide value to its resources and maximize user experience.

Providing a satisfactory user experience in a website requires understanding of the problems that site visitors must solve. Addressing these problems can be done through the application of web design principles that can effectively convey the site's message whilst simultaneously engaging the visitor. According to Kandababu et al. (2011) on their analysis of website design, standard usability principles and its role on human-computer interaction is valuable and must be followed in all departments of web design to reach a high degree of usability. This foundation is then supported by a functional help system that can provide relevant information within a very specific context in the site that accommodates the user's lack of adeptness with a task or familiarity of a concept. Also, from Ye Chen's (2004) findings on the usability of a campus-wide online help system in the University of Maryland, it was noted that a lack of specialized, time-critical, and task-sensitive online help in a campus context led to low extent usage, unpopularity, and ineffectiveness among students and teachers. As such, online help systems must be designed in a way that respects the user's time, purpose of usage, and their condition as an individual in order to ensure quality user experience.

Help support systems or services have been a significant feature for websites as a method of providing end-users valuable information or guidance relating to a website's functionalities, content, and services. These help and support systems allow online websites to feature a more user-friendly experience

for users, especially for those who are less technologically capable or unfamiliar with the website itself. Alongside this, help support systems can also make a website feel more inclusive and interactive with the appropriate execution, which could significantly benefit end-users who experience physical and/or mental hindrances. Help support systems can complete a satisfactory user experience that a website needs, as it can fill up needed understanding on website problems that the site visitor may encounter. Findings from Gee et al (2022) on the investigation of usability among university websites conclude in their analysis that there is significant positive tendency towards improvements in features that provide and accelerate the dissemination of information, which includes an effective implementation of a website helpdesk.

One way of providing an effective help support system design is through the addition of an AI chatbot into the website. Stemming from the study of Okonkwo and Ade-Ibijola in 2021, it was found out how chatbot technology proves itself to be beneficial and innovative in improving education on its various aspects towards a wide range of users within the system, such as providing campus-related services. The use of a chatbot system could potentially help in addressing the given issue in order to provide an avenue for user help, thereby innovating the existing help desk system. AI chatbots allow for a more interactive, straightforward, and specialized experience, which open up more potential to reach a bigger audience that can be more accommodating and inclusive,

especially for those with difficulties using technology or have physical conditions. The technical environment of an AI chatbot also strives to minimize human intervention during operation, minimizing the possible human error that could occur during the support process (Maglogiannis et al., 2020). With such characteristics, having a dedicated AI chatbot design can make site navigation and troubleshooting be more time-efficient by being readily accessible and providing straightforward responses. They can also make the site navigation more inclusive with the boost in interactivity and the addition of accessibility features, and higher usability, with the improved ease of use through a simplified and dedicated design.

It is from this perspective that the researchers formed the idea of developing a Rule Based Expert Chatbot AI System to improve the user experience of MyDCampus users. This primarily entails the implementation of an AI chatbot that utilizes the concepts of Rule-based Expert System, Machine Learning, and Natural Language Processing to be able to accept user queries and provide appropriate responses based upon the existing ICT support information available from DLSL. The system also includes accessibility features to ensure inclusivity among physically challenged users. The framework for this system is Botpress, which is an open source framework that offers modular architecture for building chatbots. The processing capabilities and built-in

features of the framework allow developers to automate workflows and self-serve users through rule-based or AI-based chatbot conversations.

Statement of the Problem

De La Salle Lipa features the use of MyDCampus website that allows users, mainly DLSL students and parents, to interact with different DLSL related features and requirements within one centralized site. However, one of the significant concerns relating to the use of the site is that the current interface does not sufficiently support effective user-friendly features for finding solutions or guides to address website related concerns and issues for users. Some of these concerns relate to the processes of site navigation, content access, and payment processes. Users have to rigorously search through multiple options within the MyDCampus site or search through Google or the official DLSL website in order to find solutions for their specific needs. This leads to users finding the site and its features too intimidating or time consuming to use especially for less technically literate users, leading to continuous, repetitive, and less efficient attempts of troubleshooting towards user issues within the site. This lack of user-friendly troubleshooting, alongside having no direct messaging methodologies with an ICT support personnel within the website, would often lead to unequipped DLSL teachers and staff having to carry the burden of user inquiries in different social media or communication apps.

The proposed system attempts to address the following questions:

1. How to provide users with a more interactive, streamlined, and user-friendly approach for general tech support in the website through a website chatbot?
2. How to build the MyDCampus chatbot to be able to show intelligent behavior that can better understand the users' inputs and provide them with the right response?
3. How to produce consistent and effective automated DLSL-related query responses appropriate to the users and their inputs through the AI chatbot?
4. How to generate necessary reports for maintaining and improving chatbot activity and performance?

Objectives of the Study

With the existing troubleshooting difficulties that users have experienced within the MyDCampus site, there is a need for an appropriate solution that addresses the needed improvement in user experience. Such development is essential for the current learning environment where students and parents use the internet as a main tool of interaction online. Similarly, the proposed improvement will benefit DLSL itself by incorporating a border free experience in education.

The aim of this project is to identify and assess important key factors in designing a functional AI chatbot, develop and evaluate the project throughout its development life cycle, and execute a satisfactory implementation of the project towards the improvement of the MyDCampus website's troubleshooting capabilities. The proposed project will be developed guided by these specific objectives:

1. Design and develop an AI Chatbot System for Tech Support in the MyDCampus website of De La Salle Lipa consisting of the following features:
    a. An intellectually independent system that accepts and interprets both predefined options and typed input from the user with the use of rule-based system and natural language processing techniques.
    b. Accessibility features to assist physically challenged individuals, such as text and visual adjustment features.
2. Integrate Expert System and Natural Language Processing techniques into the chatbot, such as the application of conversational rules, intent classification, slot filling, and entity extraction to process and provide appropriate feedback from given user input.
3. Produce accurate Rule-based or AI generated answers in English and provide DLSL information by using or redirecting to existing DLSL resources appropriate to the user's settings and inputs.

4. Generate chatbot activity related statistics and receive user feedback through the use of Botpress features, including:
    a. A dedicated analytics dashboard, featuring monitoring of usage data and feedback inbox for user inquiries.
    b. A misunderstood module, catching misunderstood inputs or information that can be used to amend and improve the NLP model.

Purpose and Description

The purpose of the project is to assist De La Salle Lipa's online border free education experience through the goal of adding an AI chatbot in the MyDCampus website to improve user experience on site navigation, content access, and issue troubleshooting. The proposed project aims to address the importance of having a dedicated and user-friendly user support feature that assists the user relating to a site's contents and concerns.

The project also addresses the 9th, 10th, and 12th Sustainable Development Goals (SDG). The project aims to innovate the current MyDCampus website towards better user experience through the use of the techniques and algorithms of advanced technologies such as Expert Systems, Machine Learning, and Natural Language Processing, which compliments the 9th SDG towards fostering innovation. The system also complies with the 10th SDG

as the system promotes equality by providing tools to make it accessible to people who are physically challenged, thus reducing the inequality gap between them and abled persons. Lastly, the system complies with the 12th SDG as it is centered on streamlining the process of tech support and freeing up more time for the user. This can reduce their time spent on the website and potentially reduce energy consumption.

Once the proposed system is implemented, it will give significance to the following beneficiaries:

For the students

De La Salle Lipa students who are active users of the MyDCampus site will be able to utilize a new online help support feature which they could take advantage of in solving their DLSL-related issues. The AI chatbot will be able to provide a more interactive, easy to use, and responsive navigation and troubleshooting experience for their personal convenience.

For Parents/Guardians

Parents who use the MyDCampus site to monitor their children's school performance and utilize DLSL-related services will be able to benefit from the AI chatbot. This will be especially beneficial to those in the older generation who could be less technologically active or have an existing physical and/or mental disabilities. The chatbot system will serve as a more inclusive and straightforward system to assist parents and

guardians through providing accessibility and ease of use features to improve the navigation and inquiry experience.

For the DLSL Faculty Members

DLSL Faculty Members who use the MyDCampus site will be able to utilize a more interactive and easy to use feature for DLSL and ICT related support through the AI chatbot. The existence of this chatbot feature will also benefit the faculty members by minimizing the possible user inquiries that they will receive from concerned students and parents, as they will also be able to utilize the chatbot on the site portal.

For the ICT Department

The ICT department would be able to save on resources and manpower through an automated chatbot for help and support. It would be beneficial in improving the MyDCampus site itself and would minimize the concerns or complaints that would be directed to them. The implementation of this new chatbot feature would allow the ICT department to reallocate their resources towards other tasks and planning, which would help increase the department's efficiency and productivity.

For the researchers

The researchers will be able to gain more knowledge and experience in applying computer science concepts such as Expert Systems, Machine Learning, Artificial Intelligence, and Natural Language Processing in a practical setting. Alongside this, the researchers will also

be able to build a fully functional AI chatbot that will serve as an output for the Thesis course subject requirement.

For the future researcher

Future researchers will be able to use the project as a learning reference for learning the application of computer science in making a chatbot. Alongside this, the paper and the implemented system could be used for future research of related concepts or development of new innovative UI/UX systems.

For the school

De La Salle Lipa will greatly benefit from the new chatbot system as it can assist in the improvement of the online learning experience that the school provides. Through the project, student and parent users of the MyDCampus site will be able to handle DLSL related processes within the site in a more productive and time-efficient manner. This will also lead to unequipped DLSL teachers and staff to experience reduced inconveniences from student and parent inquiries relating to the site.

Scope and Limitation

This project will mainly focus on the development life cycle of the AI system for the MyDCampus website's tech support. The AI chatbot will aim to improve user experience for MyDCampus users in the MyDCampus website

when attempting to navigate or troubleshoot content within the site. The proposed system will be capable of providing general site information alongside general troubleshooting assistance through the use of a rule-based system and natural language processing techniques. The system will also be capable of supporting several accessibility features to improve the ease of use and assist physically challenged users.

The proposed project will not be capable of providing its services outside of the MyDCampus site, such as with the official DLSL website. However, it would be able to redirect users outside of the site when needed. The program will be designed to handle queries that involve general DLSL and MyDCampus content in a way that utilizes the free services of the tool/s specified for project use. The chatbot would not be designed to be capable of retaining user specific details, considering time and scope constraints. The chatbot will also encounter difficulties in interpreting informal text and have limited understanding of human context, as current NLP capabilities are still imperfect or limited, especially when handling languages mixed with slang terms (Parikh and Raval, 2020).

Definition of Terms

Artificial Intelligence (AI) – Computer program/system developed to perform tasks that were intended to be performed by humans

Application Programming Interface (API) - a software intermediary that allows two applications to talk to each other.

Botpress – open-source software for developing conversational chatbots

Chatbot – A software program that simulates human conversation

Expert System – a computer program/software that utilizes rules or conditions to solve specific problems within a certain field of expertise that a human expert would be in.

Information and Communications Technologies (ICT) – tools and resources used for sharing and handling information through devices

Learning Management System (LMS) - an online integrated software primarily used for the delivery of educational services such as learning materials, assessments, etc.

Machine Learning - the study of computer algorithms that can improve automatically through experience and by the use of data.

MyDCampus - web portal containing De La Salle Lipa resources for student and parent users

Natural Language Processing (NLP) – a branch of computer science, more specifically AI that deals with studying how a computer is able to understand text and spoken words as a human would be able to.

Rule-based - a system that applies human-made rules to store, sort and manipulate data.

User Experience (UX) - the ease of use experience when interacting with a feature or application.

User Interface (UI) - the graphical layout of an application.

Chapter 2

REVIEW OF RELATED LITERATURE AND SYSTEM

Technical Background

A chatbot is a computer program or software that is designed to conduct an on-line conversation through text or text-to-speech mediums. This type of software enables the capacity for automating conversations and interactions in messaging platforms, which provides a significant use for assisting users or customers without human intervention. Typically, a chatbot program consists of 7 functionalities, which are as follows (Hajjar, 2022):

1. **Natural Language Processing** - this feature/functionality enables the chatbot to convert user input text and speech into structured data that could be understood by the computer more easily.
2. **Natural Language Understanding** - a subfield of NLP which focuses towards the understanding of the meaning of human speech through the recognition of patterns in an unstructured text or speech input.
3. **Knowledge Base** - a library of information in which the chatbot utilizes and relies on to fetch data used to respond to users. The content of the knowledge base will be highly dependent on the purpose and context of the chatbot.

4. **Data Storage** - used to store conversations and bot training and testing purposes. Data can be stored in SQL form either on-premise or on a cloud.
5. **Dialog Manager** - the component responsible for the flow of the conversation between the chatbot and the user, by keeping a record of the interactions within one conversation to be used in deciding how to respond.
6. **Natural Language Generation** - process of transforming produced structured data by the program into human-readable text.
7. **User Interface** - the front-end of a chatbot where the physical representation of the conversation with the user can be found

The use of chatbots has its own advantages and disadvantages, due to how it is designed and utilized as a program. From such, the pros and cons of chatbots are the following (Aivo, 2021; Verstegen, 2020):

Pros of Chatbot Use:

1. **Faster customer service** - chatbots can alleviate the immediate basic inquiry needs of users without the need to call for human intervention.
2. **Constant availability** - chatbots can respond to users 24/7 with its capacity for automated runtime, which allows it to be available outside of normal working hours.

3. **Promotes conversational marketing** - chatbots engage users with an immediate conversational option to receive their needed answers, rather than having to scroll through answers or filling up a contact form or email.
4. **Beneficial towards flexible manpower** - the automation capabilities allow for manpower to be dedicated to solving complex problems instead of simple customer service tasks.
5. **Capable of gathering user insights** - chatbots are designed to be able to attain and learn from the data provided through conversations and interactions, which can be used for improvement and strategic purposes.

Cons of Chatbot Use:

1. **Can easily give a mechanical, non-emotive feel** - chatbot interaction will not be able to provide the same level of emotive feeling as human interaction due to technological limitations.
2. **Difficult to understand natural language** - it can be difficult for chatbot to adapt to unconventional human language, such as slang, misspellings, and sarcasm.
3. **Difficult to create** - chatbots are made using machine learning techniques such as natural language processing, which can be difficult to make without the right tools and expertise.

4. **Higher capacity for misunderstanding** - a chatbot can misunderstand a user's input whenever it is not specific or clear enough for what it has learned or experienced. This can lead to inaccurate results.
5. **Requires constant maintenance** - chatbots require constant optimization to ensure that it is working properly to accommodate user demand, business needs, and trend shifts.

The general architecture of a chatbot serves as the backbone of its processes (Maruti Techlabs Inc., 2021). The architecture of a chatbot may vary depending on factors such as use-case, domain, and chatbot type. However, the basic key conversational flow components of the chatbot's general architecture remain the same, as displayed in Figure 1.

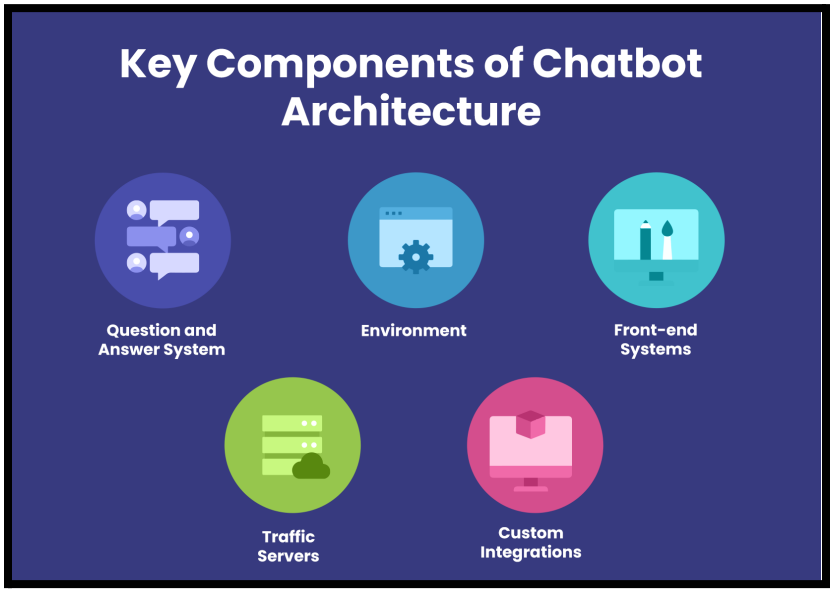


Figure 1. General Architecture of a chatbot (Maruti Techlabs Inc., 2021)

Components of a Chatbot:

1. **Question and Answer System** - responsible for answering user's inquiries by interpreting questions in the Q&A system, which gives the appropriate response from the knowledge base.
2. **Environment** - responsible for contextualizing user messages through the NLP engine, which performs intent classification, entity extraction, feedback mechanism, and policy learning.
3. **Front-End Systems** - the client-facing systems where users interact with the chatbot, such as Facebook Messenger, a website, or a mobile application.
4. **Node Server / Traffic Server** - the server that deals with the user traffic requests and routes them to the other components, from the front-end systems to the internal components and vice versa.
5. **Custom Integrations** - the chatbot's existing backend systems can be integrated with custom features to enhance the functionality, such as payment apps, calendars, and other tools.

A chatbot program may utilize an expert system to fulfill the conversational needs of its users. An expert system is a computer program that is designed to function similarly to a human expert, with the capability to solve complex problems and provide decision-making ability (Javatpoint, 2020). The characteristics of an expert system include high performance and efficiency for

solving complex problems of a specific domain, easily understandable by the user, reliable for accurate answers, and highly responsive in providing results for a complex query within a very short period of time. The general architecture of this system consists of three main components, which is displayed in Figure 2.

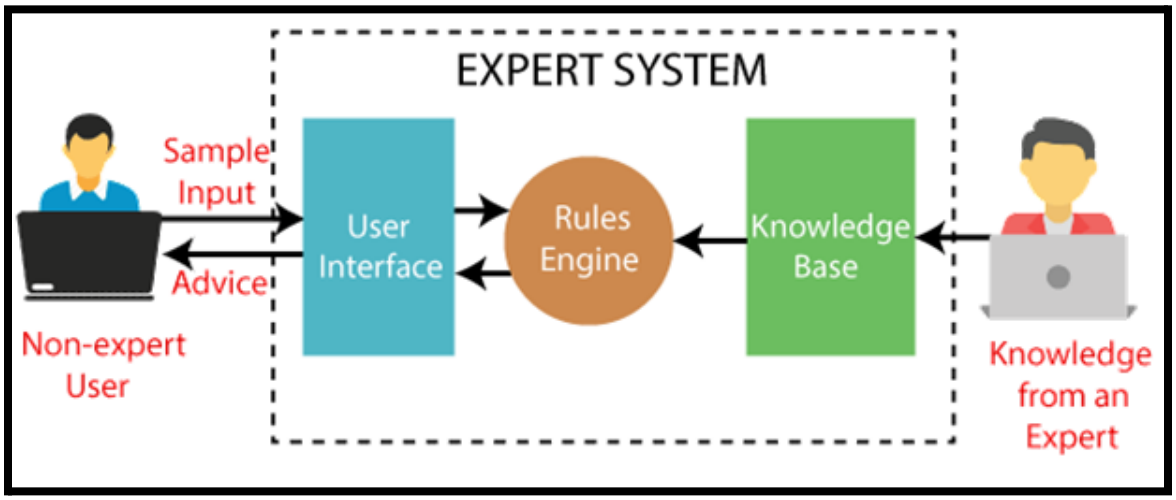


Figure 2. General Architecture of an Expert System (Javatpoint, 2020)

Components of an Expert System:

1. **User Interface** - the user can interact with the expert system through this component. The UI of the system takes queries and displays outputs in a readable format, allowing non-expert users to communicate easily.
2. **Inference or Rules Engine** - this component is the brain of the expert system, as it serves as the main processing unit of the system. This engine applies rules to the knowledge base and extracts knowledge from it in order to derive a conclusion.

3. **Knowledge Base** - a type of storage that stores information acquired from the different experts of the domain that the system is particularly focused on. The more content the knowledge base has, the more precise the expert system can be.

Alongside expert systems, another method a chatbot program could be deployed is through Natural Language Processing (NLP). NLP is a subfield of computer science, artificial intelligence, and linguistics used by machines to analyze, manipulate, and interpret the human language (Javatpoint, 2019). This technology implements various arrays of approaches to be able to accommodate text and voice based language data, leading to multiple techniques for interpreting human language. These techniques range from statistical and machine learning methods to rule-based and algorithmic ways. Generally, NLP breaks down language into shorter, elemental pieces, in which pieces are compared in order to understand the relationships that will lead to the overall meaning. This technology is applied alongside two other main components:

1. **Natural Language Understanding (NLU)** - helps the program by the extraction of metadata from content such as concepts, keywords, entities, and emotion in order to understand and analyze human language. NLU is used to map the given input into structured and useful representation for the system to use and to analyze different aspects of the language.

2. **Natural Language Generation (NLG)** - acts as a translator that converts structured, computerized data into understandable, natural language equivalent representation. This is done through text planning, sentence planning, and text realization.

Overall, NLP, NLG, and NLU work under a technology stack called the Natural Language Automation. These components of the whole NLP system are considered to be part of the foundation fabric of the customer relationship management architecture. Here all components collaborate to provide intelligent interactions to cater to users or customers. The general basic architecture for this automation process is as shown in Figure 3. It is presenting a linear relationship from a top to bottom approach. The process starts with NLU, as it seeks to determine the meaning of a given input by analyzing and utilizing input text. This is done by matching, classifying, and ranking the input to training data that corresponds to an “intent” or the outcome the user wants to receive through the output, which the NLP engine can process. After this, NLP will locate and classify the entities, such as a word or a phrase that consistently refers to the same meaning, in order to add structure and semantic information into the unstructured text. Lastly, the structured text will be turned into output response through the NLG’s dialog execution processes where aspects such as sentence structure, grammar, and language presentation are realized.

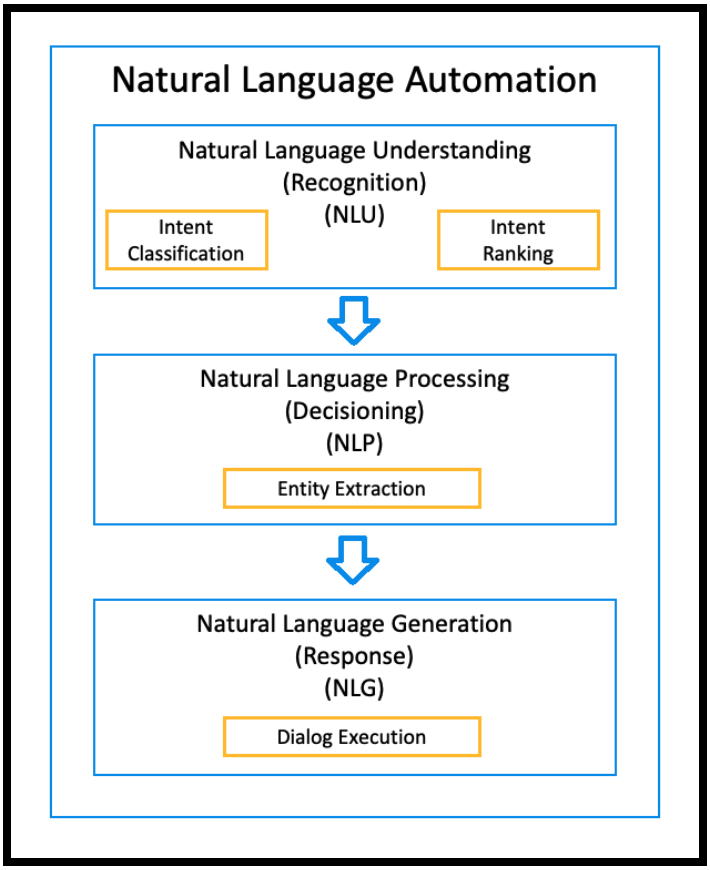


Figure 3. Natural Language Automation Architecture (Polsani, 2020)

Going back to the nature of AI and chatbots, a study by Caldarini et al. in 2022 had shown how AI can be used in multiple varieties in chatbots. It discussed whether it may be on rule-based, expert system models or in AI-based techniques and processes such as Natural Language Processing (NLP). A rule-based model is a system that utilizes human-made rules in order to perform functions such as storing, sorting, and manipulating data. Pre-defined rules used by the system refer and rely on pre-populated responses such as buttons or one-word answers, which prompts the user to a pre-configured reply. This makes

chatbots of this type cheaper, easier to implement, sufficiently effective, and quick to address general and well-defined questions. On the other hand, AI-based chatbots simulate human-like conversations using machine learning techniques and algorithms such as Deep Learning and Natural Language Processing to have a more contextual understanding of user inputs. This type allows a focused approach on uncontrolled dialogue flow systems that handles human variance, which a normal rule-based chatbot would be too rigid to handle. With such capabilities and features, these chatbots are able to imitate human behavior or at least provide the illusion of artificial intelligence to be able to provide for the users' needs.

In developing chatbots, Botpress is one of the commonly used open source frameworks that can be utilized to develop both rule-based and AI-based chatbot models in order to make a hybrid chatbot. The framework puts together boilerplate code and infrastructure that gives a developer friendly experience that ships all needed tools to build, deploy, and manage production-grade chatbots in an efficient timeframe. The platform includes the following features:

1. Built-in Natural Language Processing tasks such as intent classification, entity extraction, and spelling checking
2. A visual interface studio for designing multi-turn conversations and workflows
3. An emulator & debugger to simulate and debug the chatbot

4. Support for popular messaging channels such as Slack, Facebook Messenger, Telegram, Microsoft Teams, and an embeddable website chat
5. Built-in Software development Kit (SDK) and code editor to extend the capabilities and functionalities, and
6. Post-deployment tools such as chatbot analytics and human handoff.

With such features, the development framework will be an essential and beneficial tool for any team working on to produce an effective chatbot. Alongside these features, the algorithms are also crucial in making an AI chatbot function efficiently. This is highly desirable for improving user experience. In collaboration with NLU, NLP, and NLG, understanding and processing contextual user input into intelligent responses is performed. The main tasks that the NLP engine performs, and which the Botpress platform also supports are:

1. **Intent Classification** - recognizing what the user wants by categorizing phrases by meaning
2. **Entity Extraction** - pulling out structured data or information from unstructured text with reference to predefined categories, such as dates, time, cities, and names

3. **Slot Tagging** - identifying contiguous spans of words in an input that correspond to certain parameters, labeling a user query with semantic meaning
4. **Language Identification** - knowing which language the user query is written
5. **Spell Checking** - making sure that the user input is spelt correctly by fixing spelling errors
6. **Out of Scope Recognition** - identifies instances of which user input is not within the scope of the chatbot

An effective chatbot experience does not only include the design and features that the end-user interacts with. It also incorporates the components that assist in monitoring and troubleshooting the technology itself. Having access to such features is significant for the chatbot developers and managers, as inputs and interactions that the chatbot have experienced could be utilized and maximized towards the improvement of the further implementation of the technology. In such case, a web front-end can be developed, utilizing main web development languages such as HTML, CSS, PHP, and Javascript in order to build a fully functional dashboard. The webpage will serve as a dashboard for chatbot activity and user feedback management for the purposes of monitoring, maintenance, and troubleshooting. But with the use of the Botpress framework, the following monitoring and troubleshooting features are already readily

available within the Botpress Admin dashboard, through the Analytics and Misunderstood modules.

In the development of this project, the previous technologies, techniques, algorithms, and framework discussed will be utilized to create a functional AI chatbot service in the MyDCampus site, in collaboration with the ICT department of De La Salle Lipa.

Related Literature

Current Situation of Service-Oriented Websites

According to Netcraft's web server research survey of April 2022, there are responses received from 1.16 billion websites, with around 200 million of them being active sites. Each of these sites are designed and developed with a specific purpose or service in mind, and most of the identified active sites attempt to be in line with today's current market standards and demands. With such existing requirements comes the fact that it is now imperative for web developers and administrators to be able to sufficiently provide and satisfy the end users' experience to stay competitive and relevant. This could be done by catering to end-users' design and feature preferences, as well as other relevant factors that influence the user's longevity of use and sentiment towards the website experience.

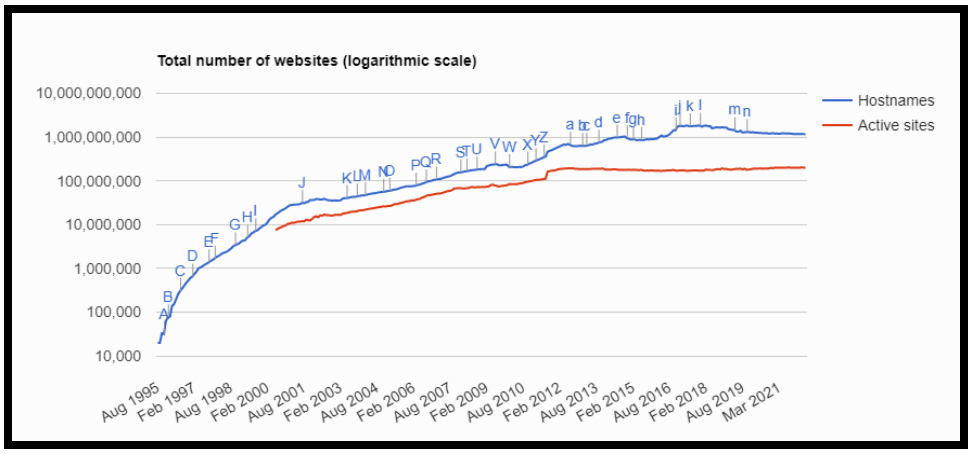


Figure 4. April 2022 Netcraft Survey on the Total Number of Websites

Factors involved with User Experience

The concept and application of User Experience (UX) in the design of current website services is becoming popular among many sectors and industries as a vital factor of success. With such, measuring UX and the variables that comprise it is important for the purpose of having a good product or service. A 2017 study conducted by Paredes and Hernandez at Misamis University, students had attempted to use six scales or attributes of measuring the institution's online web service, namely: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. Results from the study determined that attractiveness, efficiency, perspicuity, dependability, and stimulation are positive factors for the success of the institution's website UX. This research outcome can be compared to another research by Pratama and Cahyadi in 2020, which attempted to determine the effect of user interface and user experience on application sales through an observation methodology. From their observations, it

was also concluded that conveniences of a user significantly affect the sale of an application. This includes a positive experience relating to appearance, intuitiveness or familiarity, design efficiency, and the overall usefulness of the application. These factors of user experience are valuable to keep in mind when considering to build a functional website or application, especially considering the capabilities and preferences of a specific targeted consumer population.

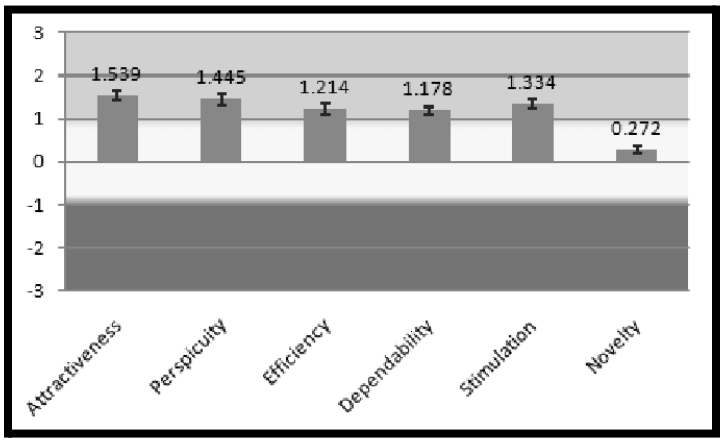


Figure 5. Bar Graph of the Six UX Factors in Paredes and Hernandez 2017 Research on Misamis University website

The two studies show that different services provide different user experiences, which would display different usability characteristics based on their service design. This concludes that features included within these specific services should follow appropriate and essential usability principles dependent on the medium they are featured on, in order to serve a satisfactory purpose. Alongside this, user interface designers are expected and required to understand

the users they will cater to and should be supplied with the appropriate information to ensure the implementation of effective service features. Having valuable data and insights would be essential in addressing the possible experience issues that users may encounter during site use (*Esmeria and Seva, 2017*). A proper application of usability techniques on website features, such as with its interface design and online help system, would lead to a more elevated, user-friendly experience.

Help Support Systems and User Experience

When end users utilize a website or application service, it is a common occurrence that a number of individuals may encounter issues that may interrupt the experience from running smoothly. These unfortunate events may be caused by different factors, such as confusion due to unfamiliarity of the site or application features itself, an actual technical error of the established features, or it could also be an accessibility or ease of use issue due to the end user experiencing physical and/or mental hindrances. To be able to provide a better experience to users, an effective online help support system can be implemented to address issues in the website or application, established with the right features and design appropriate to the factors of user experience. Zhao Huang's 2020 case study on the usability of tourism sites indicate that deficiencies in online help, such as the lack of usefulness and having no clear or intuitive indication or UI for getting online help, is a significant sign of website weakness. An online help service can also be a strongly associated and effective service to a site with

a straightforward, integrated, and familiar design, as concluded by Linek's 2017 usability study. Linek attempted to uncover the impact of order effects in usability of website design, which refers to the differences in participant response based upon the presenting order of treatments in an experimental matter. In the case of the study, this refers to the ordering of the homepage and the three services within the site, which are the online help, literature search, and publishing portal. Results for the online help service indicated a high usability evaluation regardless of the order effect, considering that the layout of the online help is cognitively available. From such, it could be concluded from both studies that having an effective online help system within any service-oriented website would alleviate deficiencies that might occur, as well as assist users in maximizing and becoming more familiarized with the website.

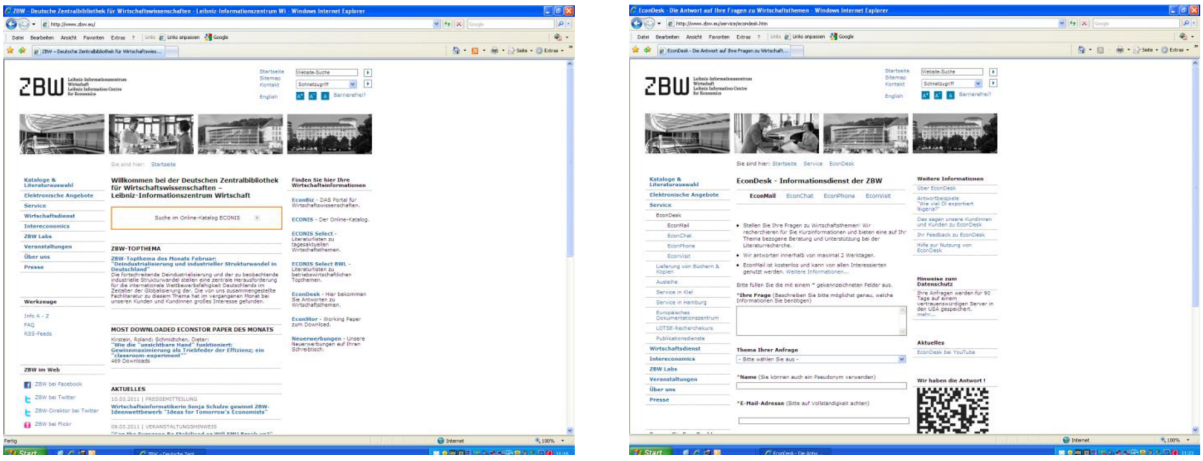


Figure 6. Screenshots of the homepage and online help section of the former website of the ZBW organization used in Linek's 2017 study

Chatbots as a Community and User-Oriented Tool

With the emergence of more online services established by different individuals and organizations alongside the recognition of the value of having an effective online help system for a website's usability, the more prominent chatbot technology has been utilized to provide services to various kinds of end-users. A chatbot must effectively analyze the user's input and create a relevant and appropriate answer to adequately resemble a human conversation (Khante, N., & Hande, K. N., 2019). As a result of advances and the growing popularity of artificial intelligence, chatbots are becoming a more preferable option, particularly in the business sector. The nature of AI chatbots can be interpreted from the aforementioned studies of Okonkwo and Ade-Ibijola in 2021, and Maglogiannis et al., in 2020, as an entity that provides an easier handling of an activity or action while striving for lesser human intervention in the whole process itself. This goes along the very nature of AI to strive for almost an exact way of performing as a human would, replicating its every action while improving upon possible areas that human action is not able to efficiently address in various fields. Through AI techniques, chatbots became more capable of imitating certain human characteristics and expertise alongside a significant amount or full capacity for automation, which is favorable for reducing manpower on repetitive or customer service tasks. According to Meaghan Yuen on chatbot market statistics in 2022, consumer retail spend via chatbots worldwide is around $2.8 billion in 2019, and is predicted to reach $142 billion by 2024. Additionally, nearly 40% of internet

users worldwide now prefer interacting with chatbots over virtual agents, especially as major industries such as retail and healthcare are turning towards digital technology.

The prominent use of chatbots have shown wide impacts in different sectors and fields. A study in 2020 by Cheng, Y., & Jiang, H., gives insights into the uses of chatbots for corporate communication, as well as advice on how to improve customer experience and develop tactics that successfully support the continuous use of chatbot services. The findings initially revealed that smart media appeal has a major impact on customer satisfaction. Corporate service providers should make it easy for consumers to utilize chatbots, and saving customers' time to handle problems swiftly is the key to meeting or exceeding their expectations. In another study by Haugeland et al in 2022, the user experience for the use of AI chatbots were experimented on through various types of methods within the nature of the chatbot. These ranged from using topic-based interaction to free-text interactions. It was discovered that the methods that lead to a higher human likeness to the chatbot would generally give a positive experience to the users. However, the social likeness of the chatbot was not fully understandable for all users due to the current limitations with chatbot technology and research. The study had shown that the attribute of being human-like with chatbots was positively received due to its flexibility and ease of use implications on the overall user experience. Thus, for a chatbot to be generally well-received by the end users, the factors that lead towards improving

the aspect of human likeness should be kept in mind when attempting to build a chatbot. Lastly, according to a study by Adamopoulou and Moussiades (2020), chatbots in educational use can span from many beneficial uses from tutoring to school administration and even to answering student queries on concerns such as those regarding their enrollment status, grades, and other needed academic functions. It was also shown that the preference towards the chatbot systems grew due to its capabilities especially with its availability of use allowing for an easier time in performing to the user's needs.

Chatbot technology can also help in addressing issues tackled by the Sustainable Development Goals. In a 2020 field report by Go et al. from the International Care Ministries in Manila, the organization was able to deploy multiple health and awareness related chatbots, in collaboration with the Department of Health, partnered religious pastors, and other highly vulnerable populations in the Philippines that needed assistance during the COVID-19 pandemic. Chatbots that were developed are the Thrive Network Chatbot and the COVID-19 Assessment Chatbot. These websites aimed to connect pastors to the community amidst ministry challenges and to be able provide easily accessible COVID-19 information respectively. Hence, the organizations were able to take action upon issues through the establishment of chatbots. This addressed the 3rd SDG for good health and well-being and 11th SDG for sustainable cities and communities. Another study in 2020 by Feitosa et al. pushed for a proposal to contribute towards food security, increasing productivity, and fighting against food

waste to address the 2nd SDG towards zero hunger. The study aimed to develop a chatbot prototype which is capable of answering the most frequently asked questions regarding the Plant Health department of the Brazilian Ministry of Agriculture, Livestock, and Supply (MAPA).The process of creating this chatbot allowed the researchers to recognize the potential of AI and chatbot technology, not only for commercial use but on an e-government level and of the a society at large. Chatbots provided a better option for the allocation of resources, especially when resources are considerably scarce during the COVID-19 pandemic situation.

Chatbot Quality Dimensions for User Experience

In establishing a good user experience on chatbot technology, quality dimensions must be considered and recognized. These quality dimensions or categories of quality could serve to be critical in the formulation of strategies towards a well-established chatbot. Li et al. (2021) utilized five quality dimensions to study chatbots from Chinese travel agencies, which are understandability, reliability, responsiveness, assurance, and interactivity. Understandability pertains to the chatbot's capacity on handling simple tasks, conducting intelligent behavior in understanding human dialogues, context, and nuances, and capable of providing appropriate solutions and performance (*Nguyen, 2019; Park et al., 2018; Sensuse et al., 2019; Thies et al., 2017*). Reliability is defined whether the chatbot is capable of providing a meaningful response, which in return could

increase user acceptance (*AlHagbani and Khan, 2016; Kalia et al., 2017; Sensuse et al., 2019*). Next, responsiveness is described as a user's perception towards the chatbot's capability to help users and provide prompt and efficient response on its services (*Meerschman and Verkeyn, 2019; Nguyen, 2019*). Assurance is the user's perception that the chatbot service has the knowledge and skills to persuade the user that it is credible and high quality (*Lee and Park, 2019; Li et al., 2020; Pereira and Díaz, 2018*). Lastly, interactivity refers to the perceived humanness of the chatbot, allowing for a more approachable and stimulated feel for the user (*Go and Sundar, 2019; Sannon et al., 2018*). Overall, these five quality dimensions capture the service capabilities of a chatbot among its possible end users.

Related Study

Chatbot for university related FAQs

The study was conducted by Ranoliya et al. in 2017 where they proposed a design for a chatbot that would use a FAQ dataset to answer any queries users would ask it with. The paper offers a base which allows us to choose what design choices to take and implement it into our own project. The chatbot used was made with the Artificial Intelligence Markup Language (AIML), an XML language used for the purpose of creating software that include Natural Language

processing. The system also uses a simple flowchart (Fig. 7) as the basis for how it operates.

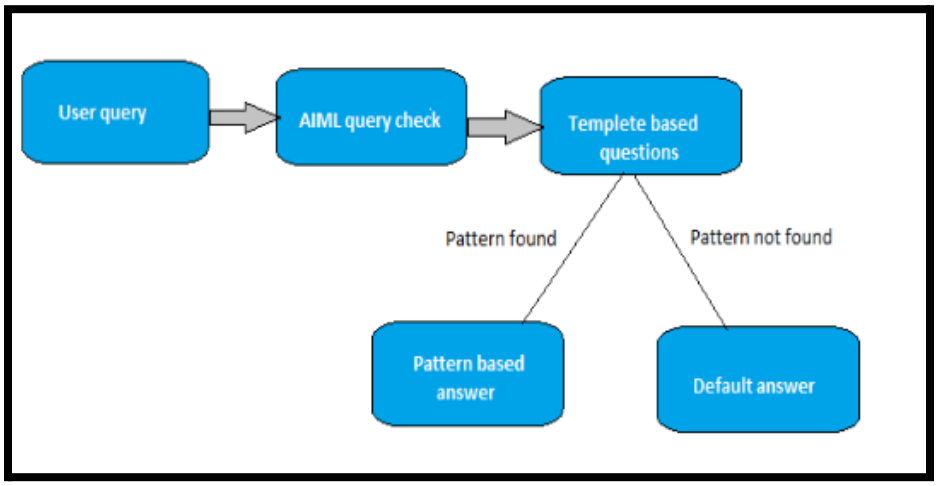


Figure 7. Operational Flowchart of Chatbot (Ranoliya et al., 2017)

Chatbot to Replace Work of Helpdesk

This study was conducted by Chandu Sanjith et al. in 2018. It detailed the creation of an AI chatbot helpdesk that is able to use embedded knowledge to identify the user inputs and respond with its self-decision making. The study had shown that the use of an AI chatbot could be less expensive than a conventional helpdesk due to its cognitive computing capabilities. Though it also showed that in order to develop a proper AI chatbot, it should be important to watch over probable mishaps in its growth in pervasiveness. Given this point, the process of the chatbot AI to be developed must be given attention on its growth on

pervasiveness and other undesirable aspects that it might be able to learn to ensure it is able to live up to the objectives of the study.

Artificial Intelligence (AI) Chatbot as Language Learning Medium

In this study by Haristiani in 2019, the use of an AI chatbot was studied for its potential as a medium of learning another language. The main attributes that influenced how well the chatbot was received in its overall learning experience with the users was primarily on its advantage with repetitiveness, opportunity provided to users with various languages, and efficiency with feedback and processing. But it was also discovered that because of the current technological feature constraints to chatbot AIs, certain language aspects, especially with grammar, are not yet fully efficient for the chatbot to fully engage in. This shows that for any potential language options for an AI chatbot, the considerations for that chatbot's ability to comprehend the language's grammar with its technological features should be a factor to take in.

Interactive Chatbot for Customer Service with Voice Recognition

In this study by Jacobe et al in 2021, an interactive chatbot was developed for the St. Paul University Philippines to answer the FAQ of its users and serve as an overall customer service system for inquiries. It uses pattern matching with the user inquiry to its database to provide a response that would solve the user's

concerns. It has functions to link in certain pages that might be in the request or inquiry of the user and is able to redirect the user towards an authoritative unit for other inquiries that it might not be able to handle.

A Bilingual Chatbot Using Support Vector Classifier On an Automatic Corpus Engine Dataset

Philippine brands usually rely on working staff to handle their customer service which requires constant manual overseeing. In this study by Catapang et al. 2020, the researchers propose a chatbot service with bilingual capabilities to handle customer complaints and feedback. The researcher's chatbot utilizes k-fold grid search cross validation on a dataset, vector classifiers and hash set containment. A bilingual automatic corpus engine is developed in order for the chatbot to understand English, Tagalog and even Taglish. The engine works by gathering keywords from the English language, namely verbs, nouns and adjectives, translates each of them into Tagalog then permutatively combines them.

A Chatbot Application and Complaints Management System for the Bangko Sentral ng Pilipinas (BSP). R2A Project Retrospective and Lessons Learned

The customer help desk used by the Philippines Central Bank, also known as "Banko Sentral ng Pilipinas (BSP)," is considered to be unsuitable for modern standards. It required manual processing of customer complaints which would

overburden the staff with repetitive work. The study conducted by di Castri et al. in 2020, stated that RegTech for Regulators and Sinitic cooperated to provide a chatbot solution that was requested by BSP themselves. The chatbot aims to address customer's queries, use expertise and historical data to manage automated conversations, update policies with the gathered data, and reduce employee workload.

Wordnet Semantic Relations in a Chatbot

In this study by Petralba, J. in 2020, a chatbot was developed and tested for querying Wordnet semantic relationships. WordnetBot, a contextual chatbot, is created as a web application utilizing technologies such as Dialogflow, React, NodeJS, Javascript, and MariaDB. The Wordnet database was used as the data source, which leverages all other dictionaries because to its semantic relations representation. From a user's message or enquiry, Phrase Structure Analysis extracts the keyword and the semantic connection. It augments Dialogflow's Machine Learning and AI capabilities in analysis. The researcher designed an architectural framework for integrating WordnetBot's several components. This research produces an architectural design that may be used as a starting point for those developing a contextual chatbot which may be relevant in the case of this study as the chatbot will be making different inferences on the user's requests depending on context.

Ask Iska and IskOU: Analysis of UPOU's Chatbot for Information Support Services

The UPOU chatbot was an online help tool developed and launched by the University of the Philippines to be able to streamline information support services to its constituents.This 2021 study by Serrano et al. on the satisfaction of UPOU chatbot users resulted in mixed experiences regarding its purpose as an information support tool. Due to being a Facebook Messenger bot, the tool has issues in addressing complex, multiple, and specific/unique queries, alongside evident interpretational issues. The bot was also seen to be useful, intuitive, easy to use, and overall providing a satisfying experience. The study also provided suggestions for topics to expand upon outside of their study's scope, such as user behavior and gender differences, evaluation of chatbot responses per interaction, the number of interactions per user, user adaptation, and user retention. This study's conclusions can serve to guide how to work on a chatbot that would serve to satisfy a significant number of general audiences in an educational setting, which applies similarly to the objective of this study. However, the chatbot project for the MyDCampus aims to improve from what this study could not achieve, with the use of a more flexible framework like Botpress to address the rigidity in the chatbot's interpretation of queries. Alongside this, the framework allows the chatbot to be freely embedded and modified to fit into

an institutional website, rather than being confined into a Facebook Messenger chatbot.

AI-based chatbots in customer service and their effects on user compliance

According to a study by Adam et al. in 2020, Conversational Software Agents (CAs) powered by AI are gaining popularity in a number of settings and have the potential to save time and money. However, many users continue to have negative encounters with chatbots (e.g., high failure rates), which may lead to skepticism and resistance to the technology, preventing users from complying with the chatbot's suggestions and requests. The study's findings show that anthropomorphism, as well as the desire to be consistent, have a significant favorable influence on the chance that users would comply with the CA's request. These impacts show that, while the interaction between firms and customers is progressively developing to become more technologically dominating through technologies such as CAs, people nevertheless assign human-like qualities, actions, and emotions to nonhuman agents. These findings suggest that organizations employing CAs can reduce the negative effects of a lack of human engagement by inspiring perceptions of social presence.

Potential effects of chatbot technology on customer support

A 2019 study by Nguyen, T.S., looking at how the consumers utilized the chatbot during the experiment, the data revealed that out of 521 conversations, there were 142 situations when the chatbot could not address the problem on its own and advised the customers to contact the support team. This was the case because either the chatbot was unable to comprehend the situations and discover acceptable answers, or the instances were too complex and required human agents to make the necessary judgments. That provided a very clear picture of the current level of chatbot technology; it is not flawless or ready to entirely replace human agents, but it can undoubtedly assist enhance the operation of customer service. In the case of a chatbot that requires additional human intervention, the study claims that when the chatbot is unable to handle, or has been designed not to solve, specific sorts of 61 difficulties, the process of escalation to a person may not be as destructive as the initial forecast. Customers may not mind going through another step after the chatbot if they have a reasonable estimate of how long it would take customer assistance to handle their difficulties, especially if they have a more sophisticated problem.

Conceptual Framework

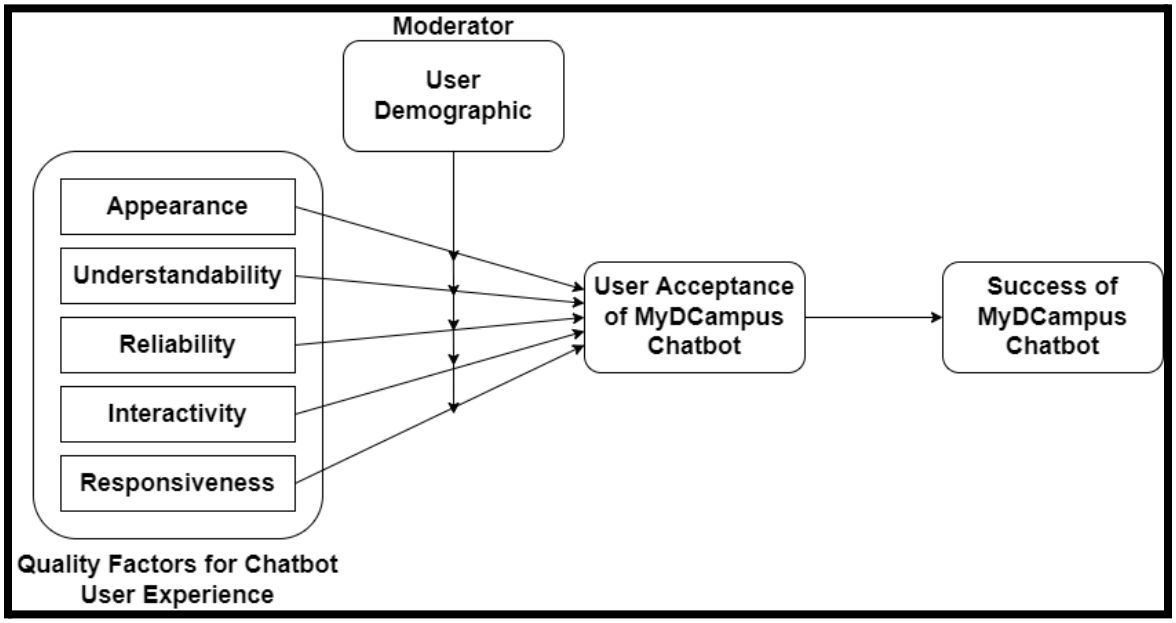


Figure 8. Conceptual Framework

With reference to the discussed factors of UX and the quality dimensions of a chatbot program in Chapter 2, the following conceptual framework is established. The model depicts a left to right flow to reflect the influence of the variables, which are the quality factors that completes a chatbot experience and how those variables influence the users' acceptance of the chatbot project, leading towards the success of the MyDCampus chatbot project. These variables would be necessary to take into consideration to ensure that the quality of the chatbot would be in a satisfactory state upon implementation.

The first quality factor, appearance, pertains to the overall look quality of the chatbot itself. This could mean a variety of attributes that influence the design of the chatbot itself, such as the attractiveness of the look from the user's perspective, the explicitness and intuitiveness of how the chatbot features are designed, and how efficient and convenient is the design for the user's use. This is a significant factor that can influence how the user would approach the chatbot program, as the appearance serves as the first impression that a user receives from the service.

The second quality factor aims for the understandability of the chatbot, which leans towards its NLP capabilities. Here, the attributes that are influential to this factor relates to the chatbot's capacity to be able to conduct intelligent behavior. Intelligibility on a chatbot signifies that the program is capable of understanding human dialogue, such that it would be able to provide appropriate solutions in return.

The third quality factor is about the reliability of the chatbot as an online help support service. Reliability in the chatbot refers to the dependability of the chatbot as a functional and significant feature for the user, assurance on the chatbot's capacity to provide credible, meaningful, and high quality responses, and the overall usefulness of the service itself. This factor is valuable to ensure user longevity, as a reliable service will ensure that the user's trust would be maintained, leading to continued use of the chatbot service.

The fourth quality factor is regarding the interactive experience of the chatbot service. A chatbot's interactivity factor relates to the stimulation that the service is providing in its use, as well as how it provides a human-like experience as a help support service. The level of interactivity is valuable particularly in how users will perceive the chatbot experience during their use of the chatbot, as it would determine whether the chatbot can provide them either a seamless, personalized feel or a mechanical, non-emotive sense that can skew their perception of the chatbot's quality.

Lastly, the fifth quality factor is about the service pace of a chatbot as perceived by the user during its usage. Responsiveness in a chatbot takes account of the service's promptness and efficiency to provide outputs accordingly when a user performs an action or does an inquiry. Being able to provide an immediate response to the user would ensure the minimization of inconvenience that a user may experience, leading towards a more improved quality of service.

User demographic is also a present variable within the framework, serving as a moderating variable between the relationship of the quality factors towards the user acceptance of the chatbot. The factors of age, type of user (student, parent, DLSL faculty staff), existing physical hindrances/difficulties, and experience with technology use may be influential factors that affect the strength of the relationship between the two. These considerations are applied as the MyDCampus site is a website service aimed at different DLSL-affiliated users,

which may have different experiences and needs hinged upon their characteristics as a user.

Synthesis

The researchers and authors of the following related literature present the current situation of service-oriented websites, how influential the factors of user experience are towards a site's success, and how online help systems have become a valuable asset to a website's usability. The significance of these details, alongside the current advancements in the fields of computer science and artificial intelligence, gave rise to the popularity of using chatbot technology as an online help tool, in order to improve users' experience in various fields and sectors and to address Sustainable Development Goals. From these, quality dimensions for chatbot technologies are recognized and imposed in order to ensure a satisfactory online help service, which are understandability, reliability, responsiveness, assurance, and interactivity.

The related studies feature various studies and systems that examined and implemented chatbot technology within the researchers' or developers' specific fields. Systems tackled in the studies feature the use of chatbot technology among university services, work and customer service related functions, and as a language learning and analyzing tool. These studies and systems concluded chatbot technology has a number of technical constraints that developers should consider, but it also has significant potential to be a valuable

asset as an online help service when it properly accommodates the users' needs as well as their overall perception of the feature. From such, the researchers of this study will delve into addressing these technical constraints and potential benefits in order to provide a satisfactory MyDCampus chatbot service for the use of DLSL-affiliated users.

Chapter 3

DESIGN AND METHODOLOGY

Software Development Paradigm

The proposed chatbot system was developed following an Agile SDLC Model, which is a combination of iterative and incremental process models that focus on process adaptability and customer satisfaction *(Javapoint, 2019)*. This model breaks the product into small incremental builds which are provided in iterations that last for a few weeks. Every iteration involves the collaboration of individuals and cross functional teams that are working simultaneously to provide a rapid delivery of the working software product in various areas such as planning, requirements analysis, design, coding, unit testing, and acceptance testing. At the end of every iteration, the product is presented and displayed to the intended customer/s and involved stakeholders. The Agile model follows the principles of customer collaboration and adaptive changes to be able to deliver the best possible working software to its customers. This is deemed necessary as customer interaction is the backbone of the Agile methodology. The advantages of the Agile model approach are as follows:

- A realistic approach to software development that promotes teamwork and cross training, rapid and flexible functionality development, and minimal rules and easy to employ documentation

- Resource requirements are minimum but can be suitable to either fixed or changed requirements and environments with little or no planning required
- The model's quick approach allows for developers to deliver partial working solutions early in a software development timeline

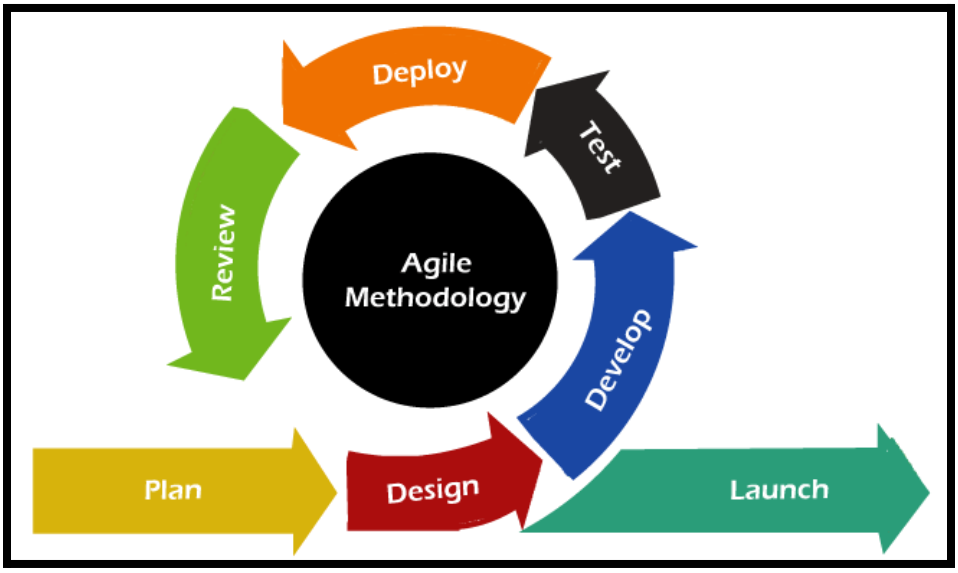


Figure 9. Agile Model (Javapoint, 2019)

The chatbot system development followed an adaptive approach through the Agile model rather than a predictive approach considering its AI nature, requiring constant maintenance and adaptation to changing user requirements to make it a more effective product. Predictive methods entirely depend on the requirement analysis and planning done in the beginning of the cycle, which makes changes to the requirements go through a strict change control management. This is an inefficient approach when considering how a chatbot

system works, which involves continuous machine learning and maintenance to adapt and grow to a variety of human language differences and nuances. Meanwhile, an adaptive approach does not produce a heavily detailed plan and instead forms future tasks in respect of what features need to be developed, making it a feature driven development. The product is tested frequently through release iterations to minimize the risk of major failures in the future. From such, the phases of the Agile Model are as follows:

1. **Requirements Analysis and Gathering** - In this phase, the development team defines the user requirements, identifies opportunities, and plans the time and effort needed to build the project. Within this phase, activities such as identifying the scope of the project, feasibility reports, and collaborations with customers and stakeholders are performed to finalize the project requirements.
2. **Requirements and Software Design** - This phase is where user requirements are transformed into a suitable form in which programmers and designers can use. This process specifies the requirements into more technical details such as software coding design or into generally understandable information such as user flow or high-level UML diagrams to showcase the features. For chatbot development purposes, creation, review and formalization,

and handover of conversational design to the development team is performed in this phase.

3. **Construction or Product Development** - This phase is where the work starts after defining the requirements. The designers and developers start working on their projects towards deploying a working product, through various stages of improvement. Chatbot developers and service developers create the front-end and back-end services during this part of the chatbot development.
4. **Product Testing and Integration** - Examination of the product's performance is performed by the quality assurance team in this phase. Testing is covered in two steps, which are unit testing and integration testing. The product can be tested using different agile testing techniques, such as SCRUM, Crystal, Dynamic Software Development Method, Feature Driven Development, Lean Software Development, and eXtreme Programming. In chatbot development testing, an automation tester is often preferred for use over a manual tester.
5. **Product Deployment, Feedback, and Maintenance** - A partial or complete version of the application will be deployed, in which it will be used live by its intended users or customers in order to get user feedback. Usage data and user reports would then be utilized for maintenance purposes or for starting another iteration of the

development life cycle, such as for future updates and feature releases.

Requirements Analysis

The current MyDCampus website of De La Salle Lipa utilizes a help support system through the ICT Support option. This Support option is a knowledge base website composed of a set of instruction manuals towards different DLSL-related concerns. This ongoing system of online help is managed and provided through the efforts of the school's ICT department and is available for use to DLSL-affiliated students, faculty staff, and parents to supplement their MyDCampus website experience. Each instruction manual consists of PDF files containing instructions and visuals of varying quality. This manual provides valuable information to alleviate the users' concerns. The service has been functional and maintained for years within the MyDCampus website, serving as the institution's method of a streamlined online help service.

However, survey results regarding the ICT help center experience had shown the option to not be considered a vital service to catered users, with 24 out of 30 DLSL-affiliated respondents (80%) having not visited or used the service. Alongside this, there were mixed responses towards familiarity of where to find the online help option in the MyDCampus site, with only 11 out of 30 respondents (36.7%) having completely no issue locating it and around 9 out of 30 respondents (30%) range from taking a substantial amount of time to find it to

completely not knowing where to find it. Unfamiliarity and lack of highlighted visual importance towards the service led to its underuse. This also resulted in DLSL-affiliated individuals, particularly students and parents, to redirect concerns towards DLSL faculty or staff members who would be more likely to be under prepared to address their issues.

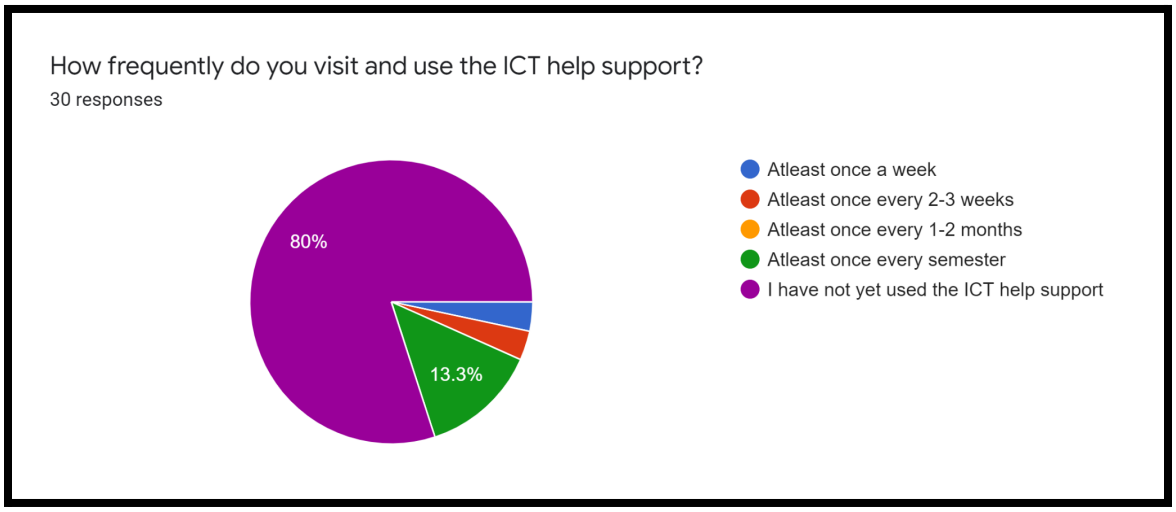


Figure 10. Graph of Usage Frequency of the ICT Help Center

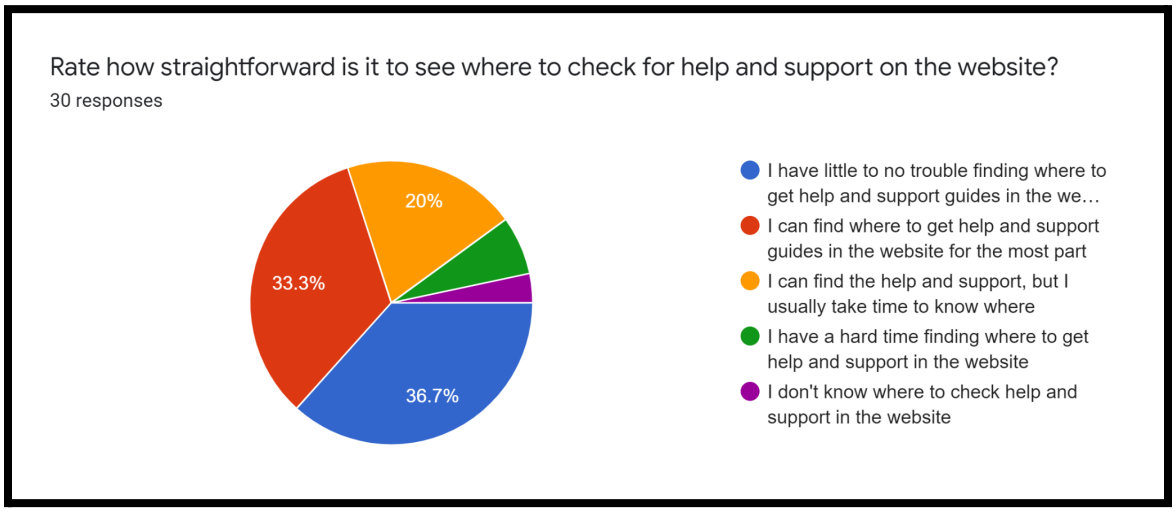


Figure 11. Graph of Straightforwardness of Finding MyDCampus Online Help

In terms of usage of the current online help service, 4 out of 7 (57.14%) who have used the ICT help center were facing varying degrees of use difficulties, ranging from slight usage confusion to requiring assistance to use the site itself. Alongside this, 4 out of 7 (57.14%) of those who have used the service took at least 5-10 minutes to search and apply the solutions provided in the knowledge base. The difficulty in usage was also due to existing physical hindrances, as 6 out of 30 (20%) respondents have shown to have eyesight concerns.

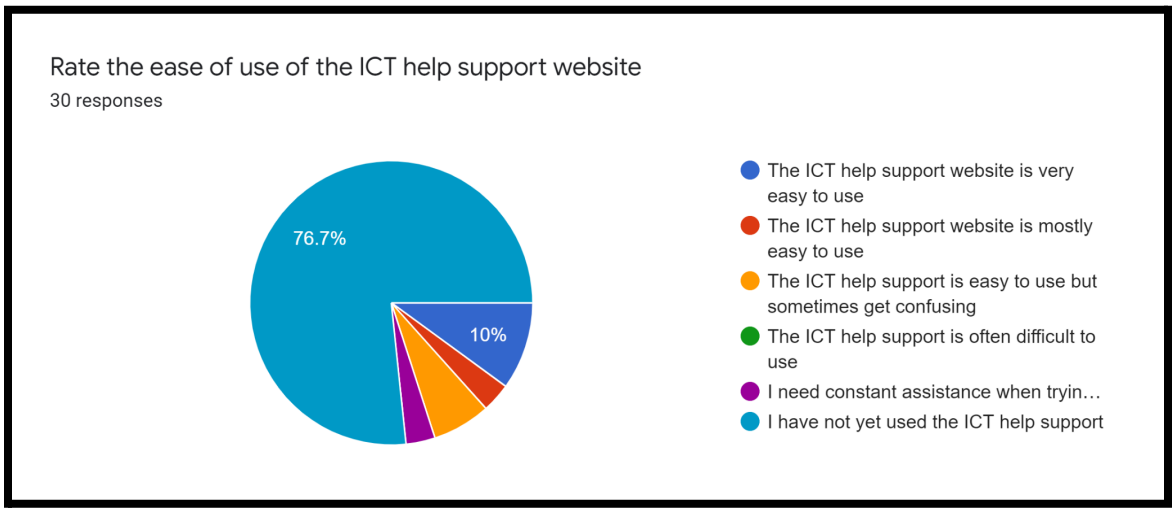


Figure 12. Graph of ICT Help Center's Ease of Use

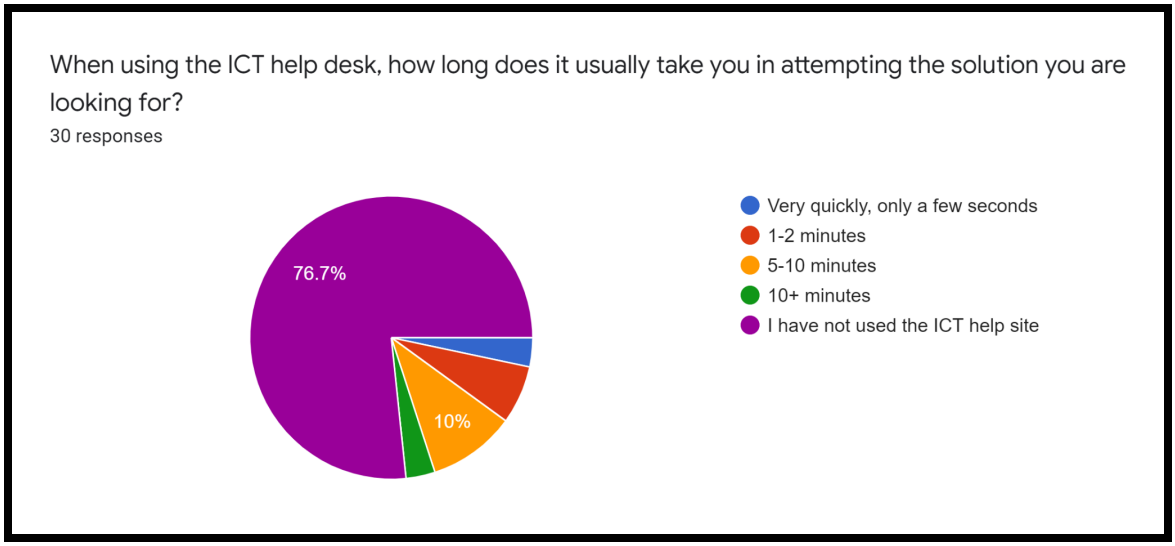


Figure 13. Graph of User Duration of Solving Concerns through the ICT help center

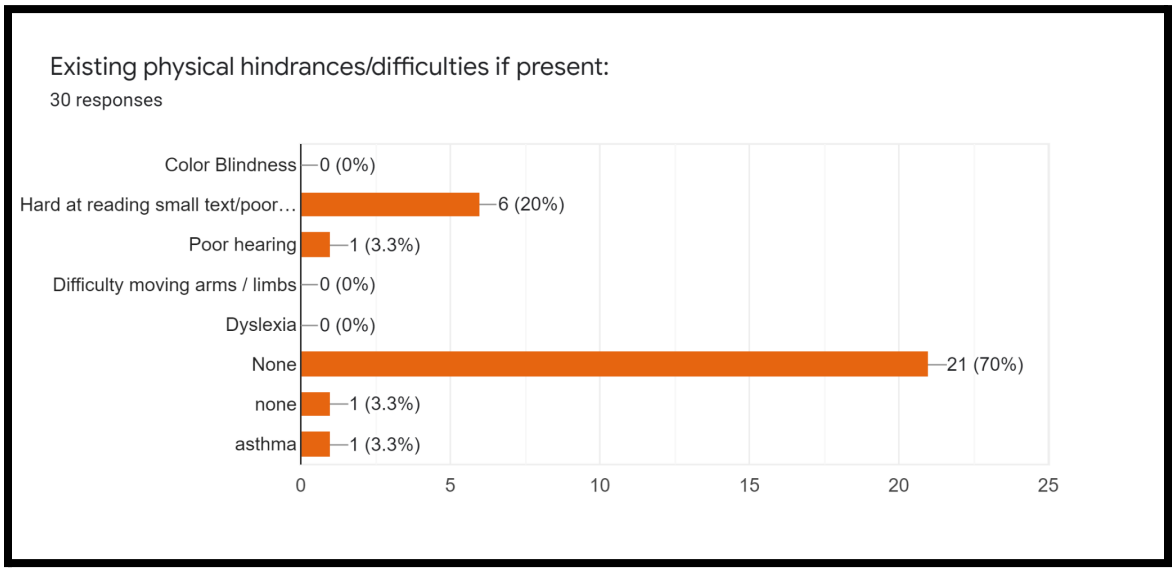


Figure 14. Graph of Respondents' Existing Physical Hindrances

Aside from ease of use concerns, the frequency of concerns getting addressed were given mixed responses, with only 2 out of 7 (28.57%) who used the help center having their concerns completely addressed by the site, while the

remaining 5 of the 7 (71.42%) either had some occasions where their concerns were not addressed, up to having no concerns addressed at all. This shows that the current help system is facing usage issues by its design, as well as inadequacies in its capacity to provide online solutions to user concerns. Despite the existing usage inadequacies, the current system's solution quality was rated high by the users, with 6 out of 7 (85.71%) respondents rating it as mostly to always useful, indicating that the current system's solutions are satisfactory enough for the current users.

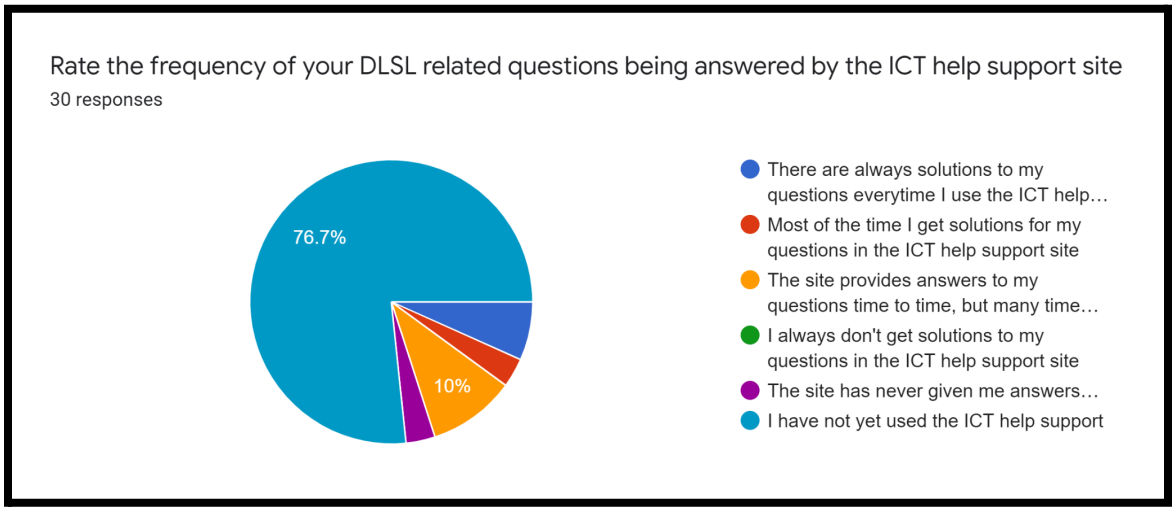


Figure 15. Graph of Frequency of DLSL-related concerns being addressed

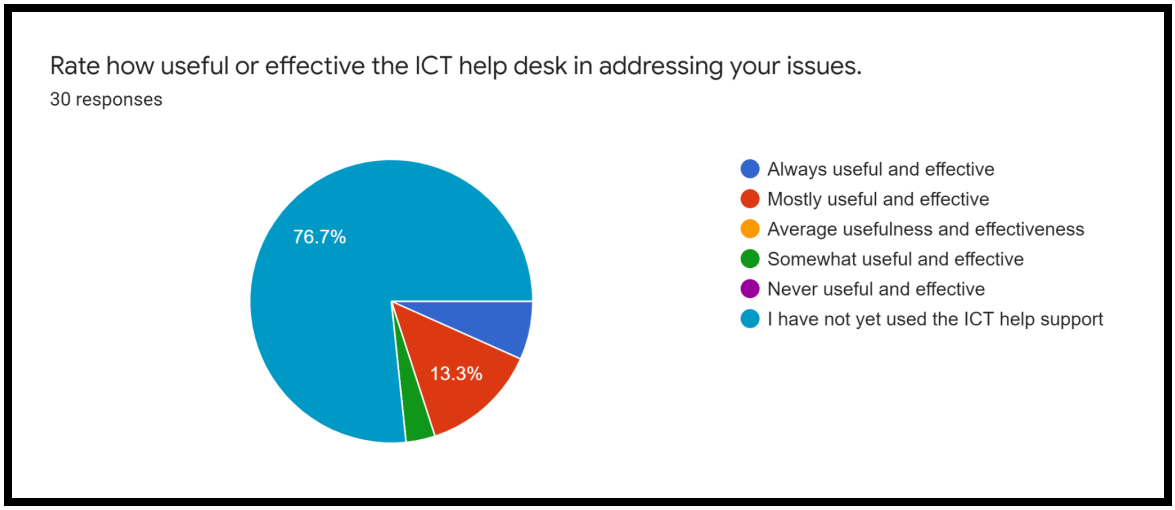


Figure 16. Graph of the Effectiveness of the ICT Help Center

The basis of pursuing this proposed project was to improve the existing online help functionality that the current ICT help center is providing in order to attain a higher quality of user experience. The proposed solution targeted the improvement of the ease of use experience by providing a chatbot interface that is more interactive and visibly accessible within the site to facilitate the existing satisfactory tutorials and guides provided in the current ICT help center. This interface was designed to fit the DLSL theme, incorporating visuals and design that is appropriate to the MyDCampus site design. This chatbot would be readily available in the homepage of the MyDCampus site, situated as a chatbot icon at the bottom right corner of the site. Text settings or tools to assist visually challenged users were incorporated in the interface design as well.

Alongside this, the proposed system aimed to improve the current knowledge base by centralizing DLSL-related information or guides that are not

present within the ICT help center but could be found in other avenues. Answers that the chatbot may provide would be linked from DLSL-affiliated sources such as the ICT knowledge base itself, the DLSL main page, or the institution's Youtube channel. Centralizing the information would assist in minimizing the frequency in which concerns were not addressed, which would lead to improved user satisfaction and improve the operations of the institution.

There would be two different methods of query featured for the users' use, a rule-based system in which users can select from different predefined options, and an AI-based system, in which users can type their queries that the chatbot would either utilize intent and entity recognition or machine learning depending on the scope. Having these both options allow for the chatbot to be both straightforward and specific, but also flexible to the users' needs.

The SWOT analysis of the proposed chatbot system is displayed in Figure 17. This analysis aimed to provide a detailed picture of the strengths, weaknesses, opportunities, and threats that are associated with the project and its implementation of chatbot technology for online help use. The analysis was based on the characteristics and capabilities of the framework and database to be used, as well as the general attributes of chatbot technology.

Figure 17. SWOT Analysis of Proposed MyDCampus Chatbot System

Strengths

- **Automatization of standardized conversation** - The chatbot can converse and lead a user towards predefined or within scope conversations that are frequently talked about. This enables the

chatbot to automate solving repetitive issues or concerns that are frequently encountered or asked by the users.

- **Improves overtime** - The chatbot learns more from experiences from user interactions, making it a better online help system in the long term.
- **Low Development Costs** - The chatbot framework and database are free for use and open source for developer use, significantly reducing possible developmental cost
- **Low knowledge barrier** - Botpress framework provides developer-friendly interfaces for using its chatbot modules, making it possible to create a chatbot without extensive machine learning, natural language processing, or programming knowledge.
- **Modularity** - The chatbot is flexible as its default functionality for NLU and QnA can be extended through the use of modules, which developers can customize and integrate.
- **Open Source** - The chatbot is made from Botpress open source that is free and flexible to the developers needs, making it easier to develop and customize whenever needed.
- **Active community** - With the chatbot's framework being an open source, there is a community of developers that constantly engage in developing and using it. This makes information and projects

about the software much more accessible and numerous. This leads to a better development of the chatbot.

- **Supports Javascript** - The chatbot can use the capabilities of Javascript through the Botpress framework
- **User-friendly, responsive, and intuitive user interface** - The chatbot's functionalities are designed for the ease of use of MyDCampus users, maximizing their user satisfaction

Weaknesses

- **Initial small amount of data for knowledge base** - The chatbot will start initially with only a small knowledge base based on given training data, which makes it not as flexible in initial short-term use.
- **Robustness** - The chatbot will start with a clear scope that is mostly limited to information related to the MyDCampus site and its contents, which limits the dynamic in the conversations it could provide to users.
- **Being trained with wrong or outdated information** - Human error or having misguided settings could cause the wrong data to be fed into the system, leading to a reduction in effectiveness and reliability of the system.

Opportunities

- **Emerging technology developments** - As NLP, AI, and chatbot development technologies continue to develop, the more

opportunities to improve the chatbot will be present for many to take advantage of.

- **Further hybrid / online learning integration** - The continued use of online avenues for educational purposes in DLSL can allow this chatbot to continue growing towards higher purposes, leading to improvement in functionalities.
- **Integration with various databases** - While having a default smaller and less secure database of SQLite3, the framework of the chatbot supports the use of more secure or advanced databases such as PostgreSQL
- **Enhanced work climate** - Repetitive queries from MyDCampus users could be automatically addressed by the chatbot, making ICT and DLSL faculty members to be able to focus more on value creating tasks rather than addressing repetitive user concerns that they receive, particularly with students.

Threats

- **Long-term acceptability** - Depending on the performance of the chatbot, the acceptability from users may vary and can affect its life cycle as an online help system.
- **Future technological or system requirements** - Future updates in hardware or software can cause possible incompatibility with running the chatbot.

- **Long-term state of DLSL resources** - A significant impact towards DLSL resources from known or unknown causes can possibly impede or halt the runtime of the chatbot service.

Design of Software and Processes

The use case diagram shown in Figure 18 shows two main actors that interact with the MyDCampus AI Chatbot system - MyDCampus users and the admin user. The MyDCampus user can interact with the system by being able to open the chatbot messaging interface and providing a query that the chatbot can provide a response to. Alongside this, this user can also provide or leave email feedback regarding online help content, technical concerns, or other comments or recommendations after experiencing the system's functionalities.

Meanwhile, the admin user has three main interactions with the chatbot system. First is the admin's capability to update chatbot information, which could be towards its programming or coding flow, front-end design, or could be content from the database itself. Performing an update to the information has multiple inclusions that revolve around changes to the system's information, which could be adding new information, updating existing content, or deleting information. The other two interactions are for viewing chatbot logs and email feedback, which are outcomes resulting from user interaction with the system. These actions can be extended by the deletion of data, which the admin could perform

after addressing feedback or to save database space. The query logs can also be extended to improving the NLP model in the case of misunderstandings in the free-text conversation, by adding misunderstood data as new utterances in the appropriate chatbot intent.

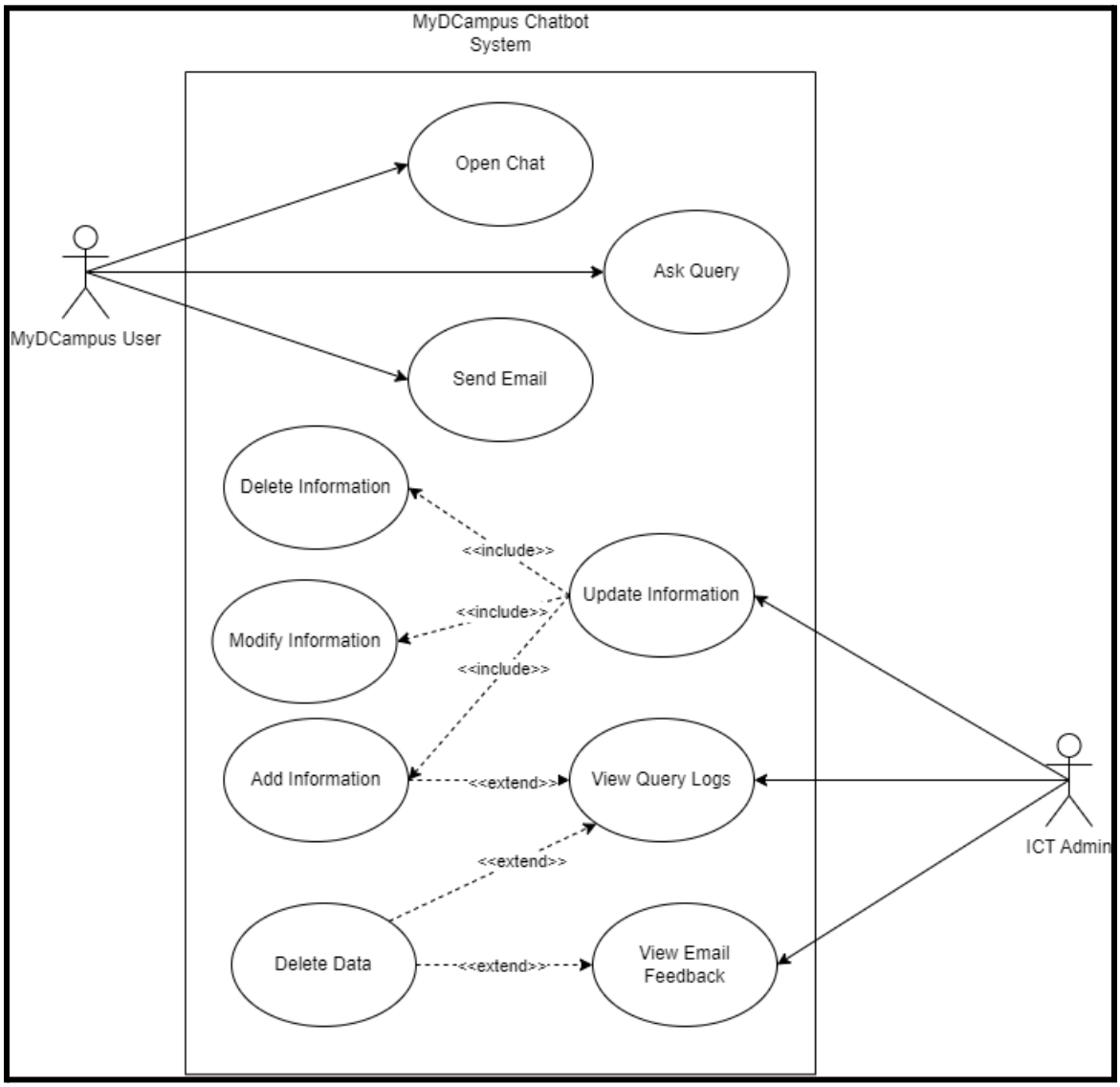


Figure 18. Use case diagram of the proposed system

The overall system architecture of the MyDCampus chatbot is shown in Figure 19 consisting of three layers: user experience, conversation or bot engine, and data or database.

1. **User Experience Layer** - This layer is where the user interacts with the system. The interface from this layer handles message-based conversations, which chat details are sent to or received from the conversation engine layer
2. **Conversation Engine Layer** - Composed of modules and algorithms that control the processing of inputs, using a rule engine for pre-defined inputs and NLP algorithms to make or direct users to an appropriate response. This layer interacts with both the user experience and data layer, serving as the main processing layer for data that travels between the front-end and back-end of the chatbot system.
3. **Data Layer** - Consists of the databases that store collected conversational data from user interaction with the chatbot.

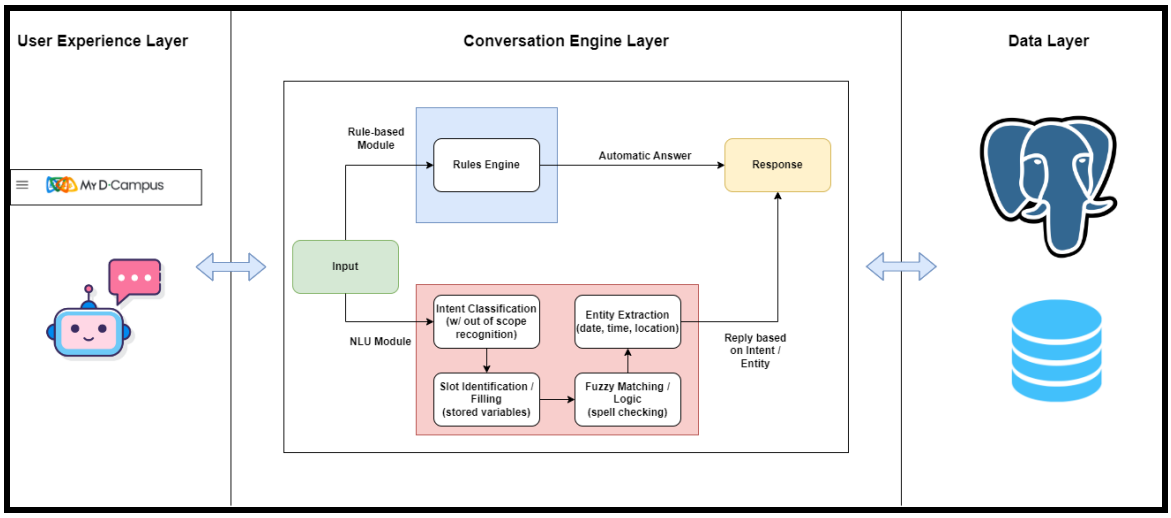


Figure 19. System Architecture of the MyDCampus Chatbot

Figure 20 shows the sequence diagram of the proposed chatbot system. A chatbot query can follow two initial steps: either the user follows a pre-defined options query or a free-text format query. The first method of query follows a MyDCampus user entering a rule-based query in the chatbot through given pre-defined options. The selection of choices will ultimately lead the user to retrieve or generate an appropriate response from the database based on the if-then conditions or rules applied on the query. The second method would be through a free-text query that makes use of the NLP capabilities of the chatbot. Once the user input is entered, the chatbot will proceed to run the NLP module to perform intent classification and entity extraction, allowing the chatbot to generate the appropriate response based on the user's intentions and its specific parameters. Out-of-scope inputs not within any existing intent in the NLP model will generate the appropriate misunderstanding response and push the user to

retry their input. The responses from both of these methods will be displayed to the MyDCampus user through the chatbot interface.

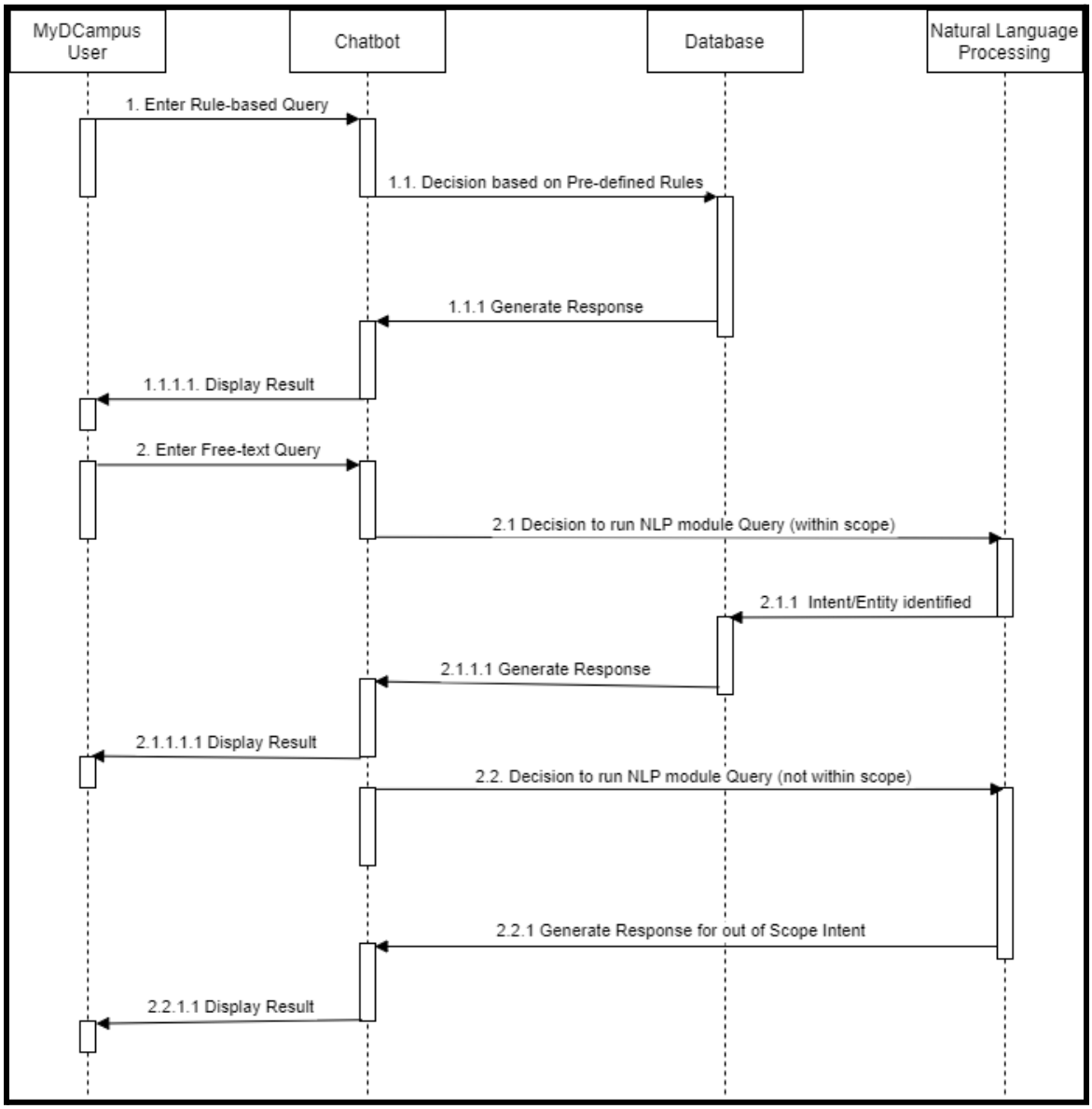


Figure 20. Sequence diagram of the proposed system

The operational framework illustrates what comprises the user's engagement with the chatbot system and the desired outcomes or outputs that would be established from the chatbot experience. As established from the previous survey results and literature reviews, the chatbot is to be designed to effectively cater the aspects of ease of use, time-efficiency, and centralization of information to provide a more effective online help experience. As such, the chatbot system module has to have the following aspects: (1) an appealing and visually available design and interface to attract users, (2) an easy to use and accessible query and feedback system to ensure ease of use, (3) NLP and rule-based functionalities to assist and ensure effective query responses, and (4) a functional database to store data used for the NLP model, inquiry responses, and other chatbot-related functionalities.

Another important module that contributes to a user's experience of using the chatbot is the users' existing attributes as a MyDCampus User. To be able to experience the chatbot system itself, the user must have knowledge that such a feature exists within the MyDCampus website. This could be established by either informing the users or through an effective design that is easily visible. Another attribute for the experience is the user's desire to resolve a DLSL-related query, such that they would be encouraged to utilize the system for their own benefit. The combination of this knowledge and willingness to use alongside the chatbot system would complete the user experience with the new online help system.

As the users interact and use the chatbot system to solve their DLSL-related concerns, various outcomes emerge from their experiences. The more users that experience the new chatbot system, the higher user engagement occurs towards the site's online help system. This leads towards more user queries that can be resolved as more users engage with the system. Another outcome would also be an improvement in the online help experience, with the incorporation of a new chatbot system that utilizes ease of use features as well as NLP and rule-based functionalities. The use of NLP technology causes the system to become better and precise the more it is used, as it could learn and improve its own knowledge base with more training data and experience.

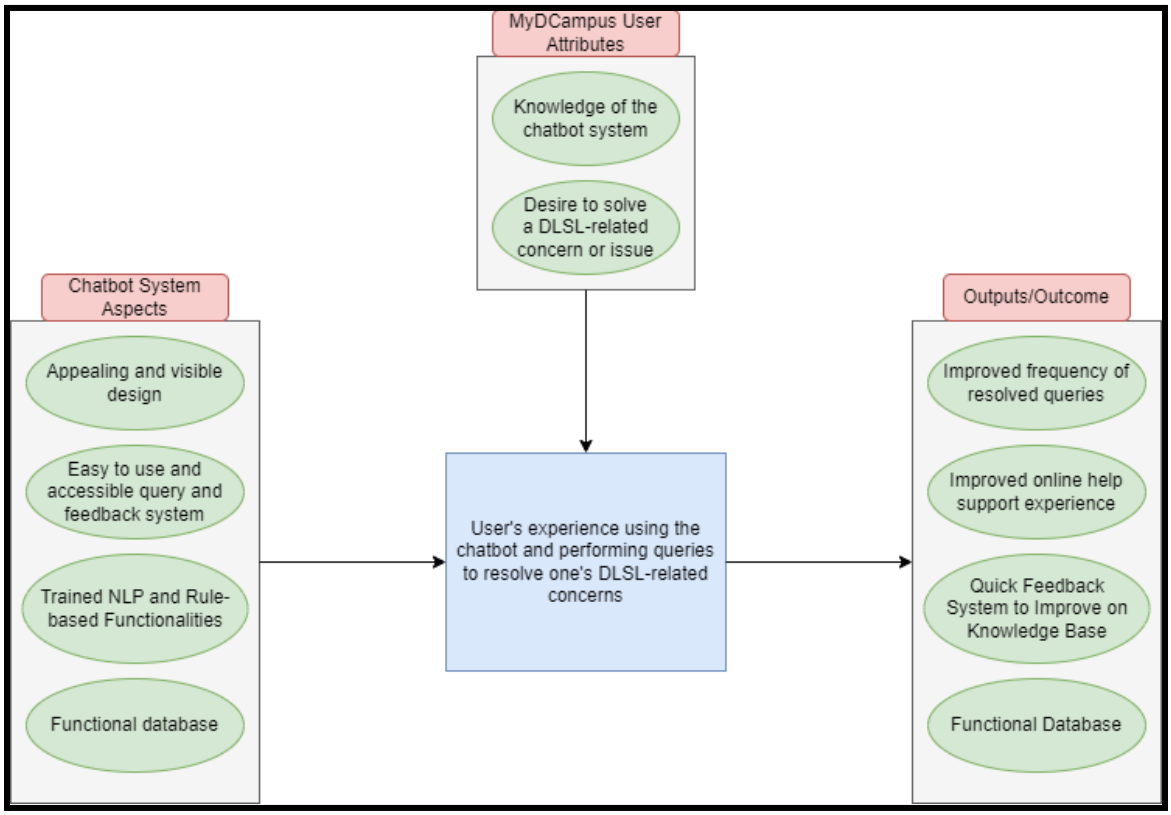


Figure 21. Operational Framework of the MyDCampus AI Chatbot System

User Interface (UI) and User Experience (UX) Design

In determining the placement of the chatbot icon, it is important to understand the chatbot's purpose. As the chatbot feature targets to be an online help service that is readily available but not the main highlight of the website, the design could follow the Gutenberg Rule. This rule is used to show a popular habit of users when browsing through a website, in which reading behavior follows a left-to-right and top-to-bottom order that forms a "Z" pattern of processing (*Sinha, 2021*). From this rule formed the Gutenberg Diagram, in which a website's visible content interface is divided into four quadrants, which are:

1. **Primary Optical Area** - the top left portion of the page, considered to be the user's primary focus as it is where the eyes usually automatically focus.
2. **Strong Fallow Area** - the top right portion of the page, a follow up to the left portion but less important.
3. **Weak Fallow Area** - the lower left portion of the page, considered to be the blind portion of the diagram in which the user does not give much importance.
4. **Terminal Area** - the lower right portion of the page, the part in which there is a break in user reading or page scan and where the user decides to take an action.

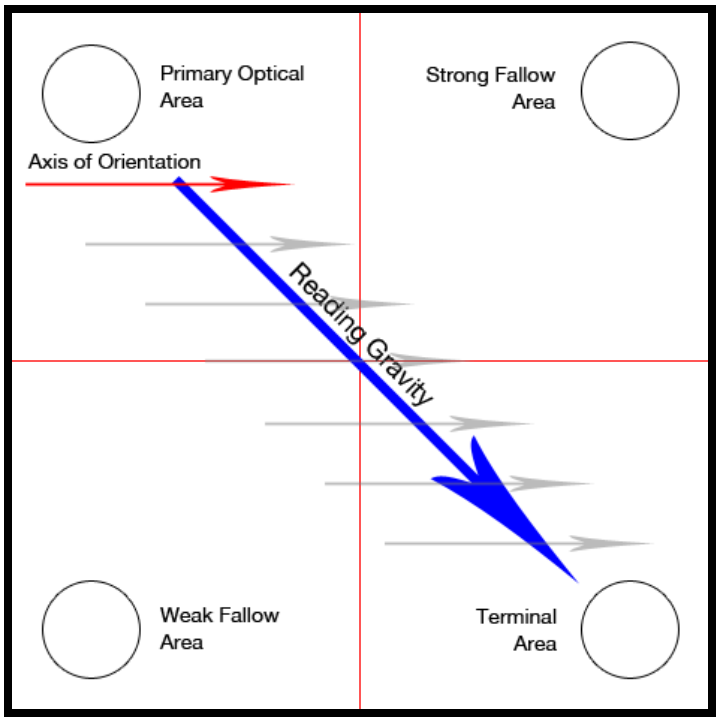


Figure 22. Reading Gravity in Gutenberg Diagram (Bradley, 2011)

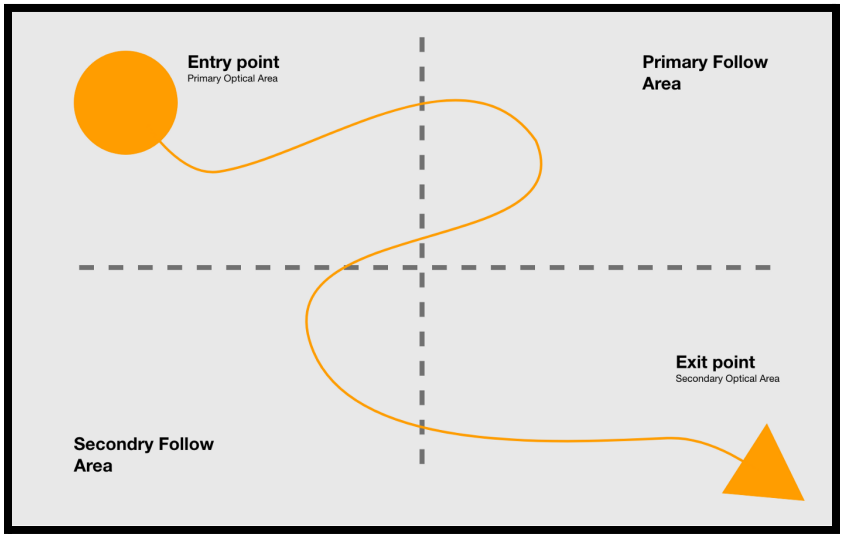


Figure 23. Z reading pattern in Gutenberg Diagram (Sinha, 2021)

Following such principle, the chatbot icon fits perfectly on the exit point of the visual interface, as it places itself in a non-obtrusive spot against the main content of the site but also within the perfect spot for call-to-action purposes. Alongside the icon, an alert message was added to boost the call-to-action feel as well as to maximize the use of the spot for improved accessibility and visibility.

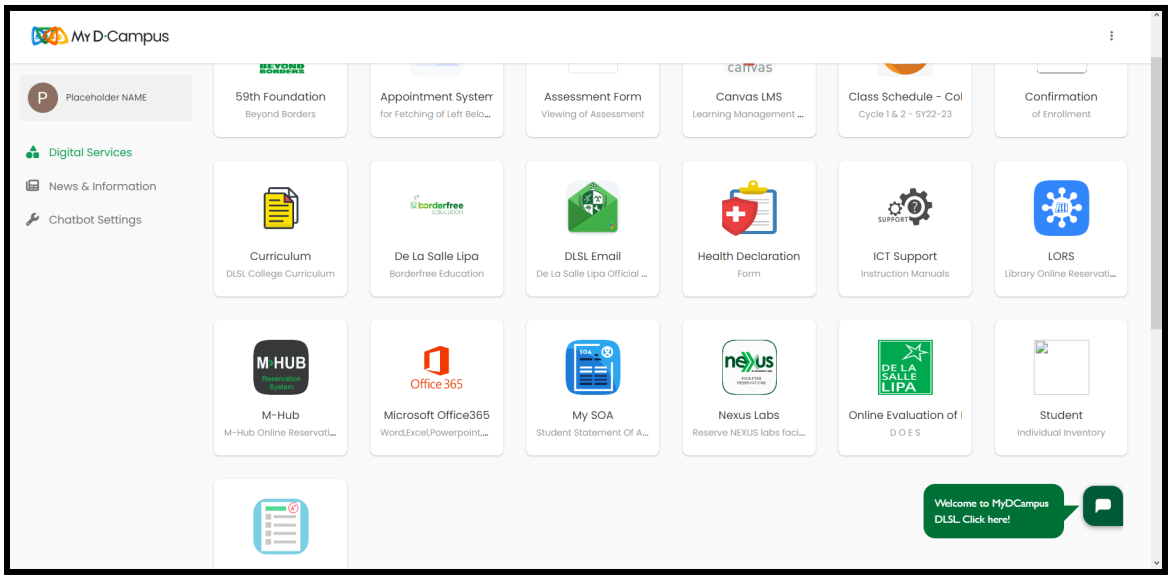


Figure 24. Bottom Right Position of the Chatbot Icon in the MyDCampus Site

When the chatbot icon is pressed, the chat window will appear on the right side of the website, to continuously reinforce the users' eyes to the side where the chatbot icon is located. The textbox and rule-based options are situated close to the position of the chatbot icon and will be large enough to be fairly visible and easy to interact with.

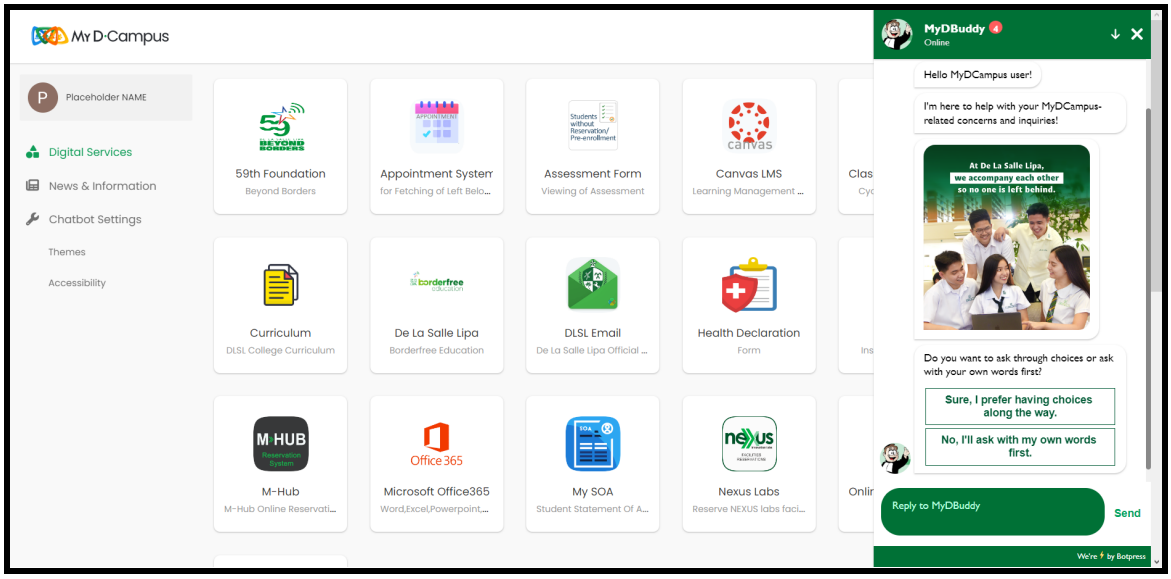


Figure 25. Chat Window Position in the Website

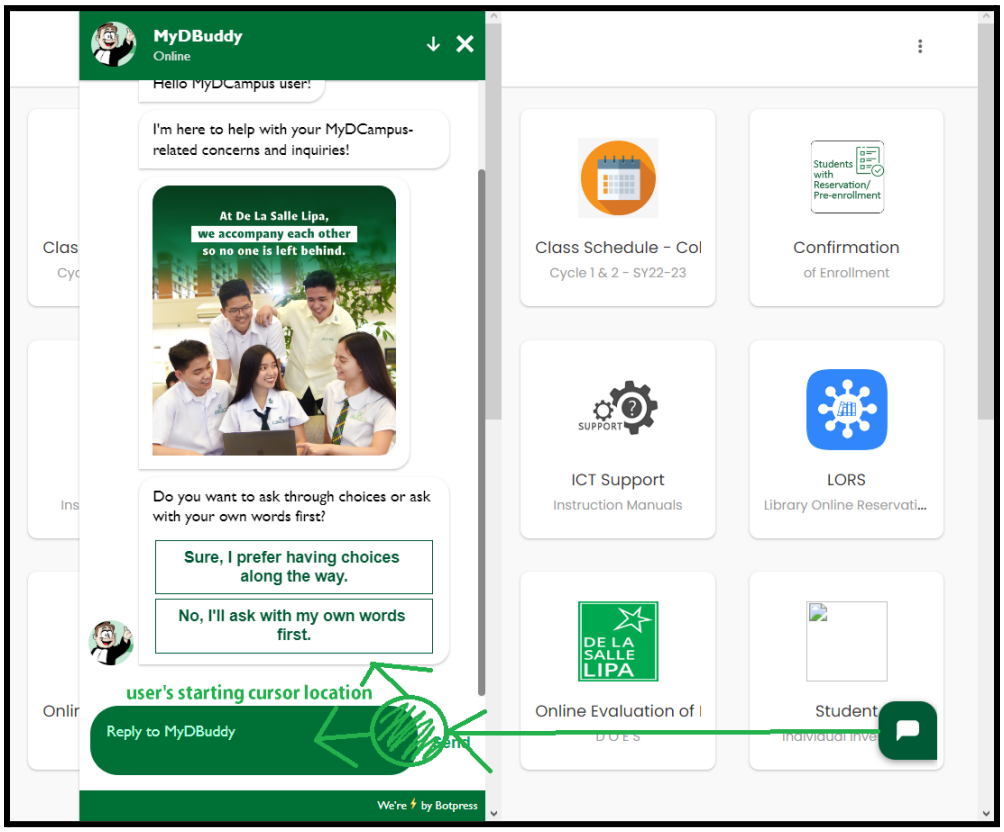


Figure 26. Starting Cursor Position after Clicking the Chatbot Icon

These design choices follow another UI rule called Fitts' Law which provides a model of human movement when considering interface design. The law states that there is a direct relationship between distance and time while there is an indirect or inverse relationship between the size of an object and the selection time. As such, optimizing the user's movement time requires having the primary options of the chatbot window to be from a small distance from the user's cursor starting point and should be in a large enough size to be selected easily.

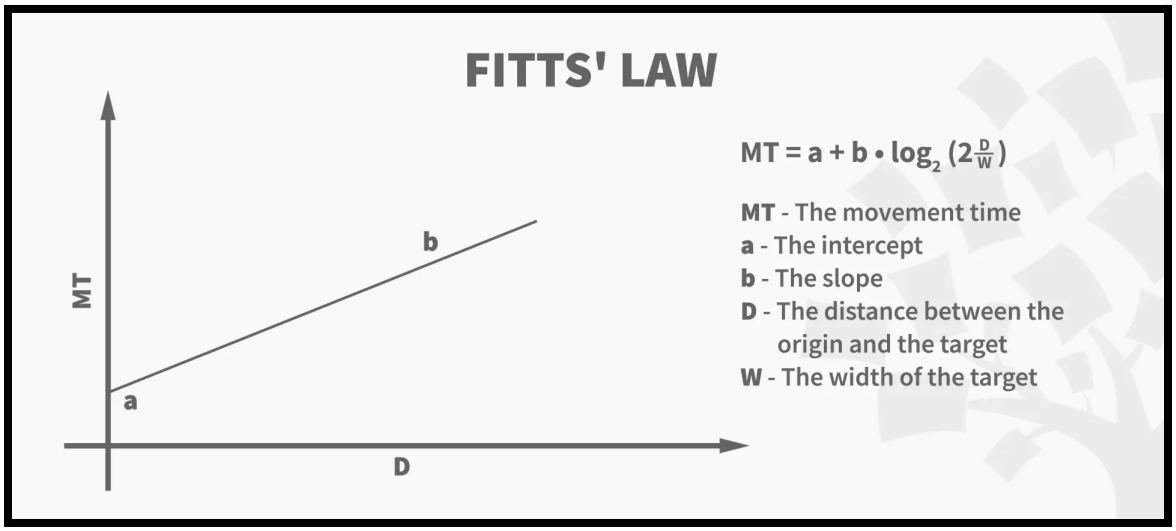


Figure 27. Fitts' Law (Interaction Design, 2019)

For the basic chatbot design, the rule-based options provided are formatted as ghost buttons, which are transparent and empty buttons that have a basic shape or form. This is to ensure that the options would not compete with the primary content of the window which is the chat display containing the chatbot dialogue. Other buttons that control the settings of the chatbot window

are on the topmost part and are designed to be as flat buttons to minimize distraction from the main content. The chatbot provides visuals and text like a human to be a more engaging and interactive experience. Messages would be broken down into smaller pieces to avoid message chunking.

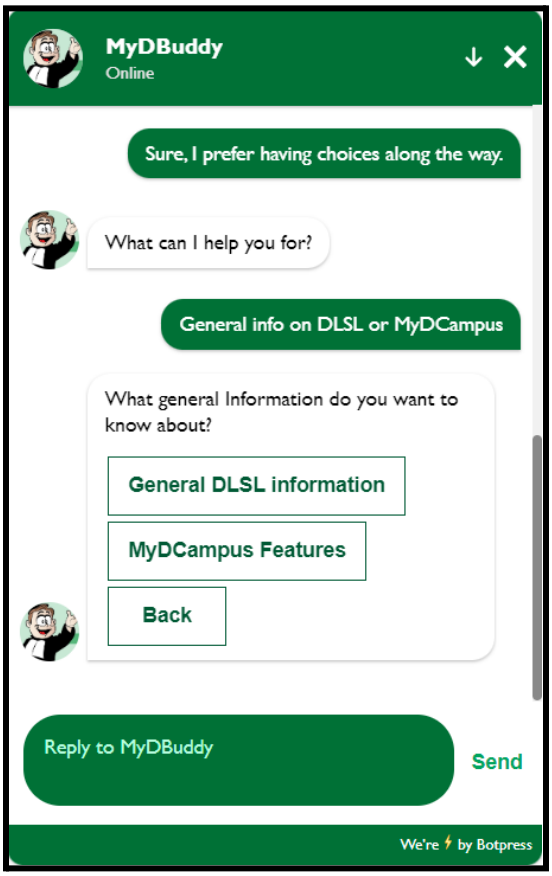


Figure 28. Chatbot Window Interface Design

To assist the user experience, the chatbot also featured the use of chatbot settings, which allowed the user to adjust theme and accessibility features to their personal preferences. By default, the theme and color to be used in the chatbot window follows the color standards of DLSL, using Pantone 349C

(*#046A38*) as the main color for the window header, footer, and textbox. Alternatively, it could be changed to a lighter touch of green with the standard CMY color shown in the figure below for all three parts of the chatbot as well. Other theme settings include making a neutral color for the textbox itself for visibility preferences, the capability to change between default and tall chatbox, as well as incorporating a dark theme look.

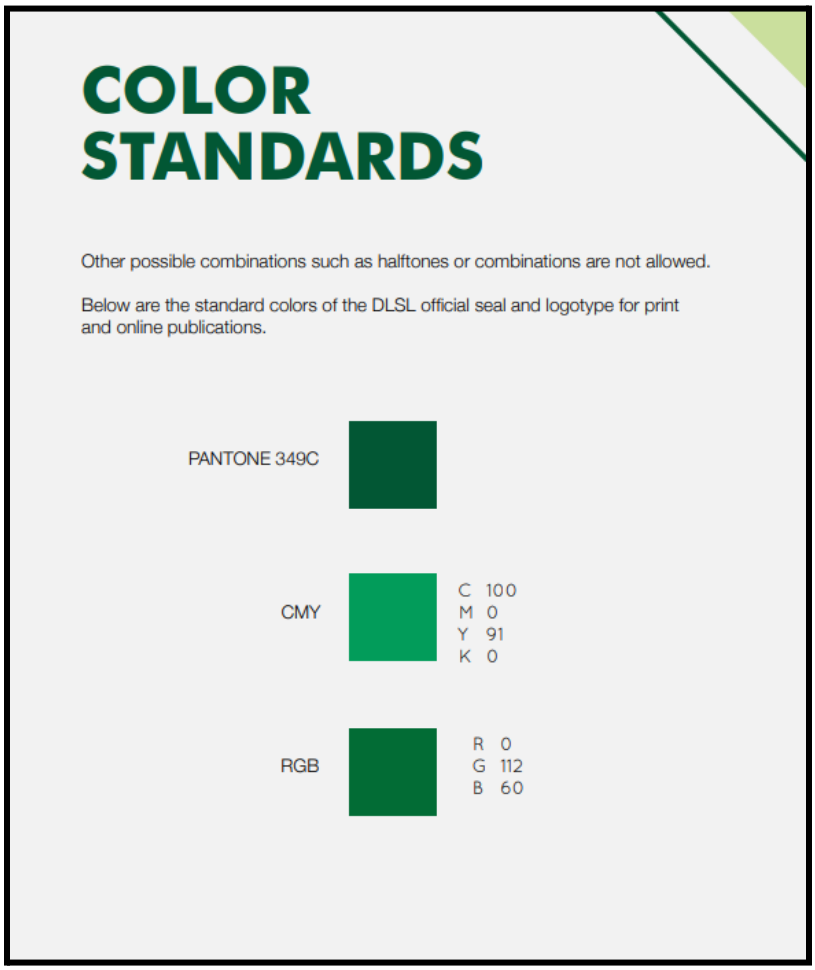


Figure 29. DLSL Color Standards

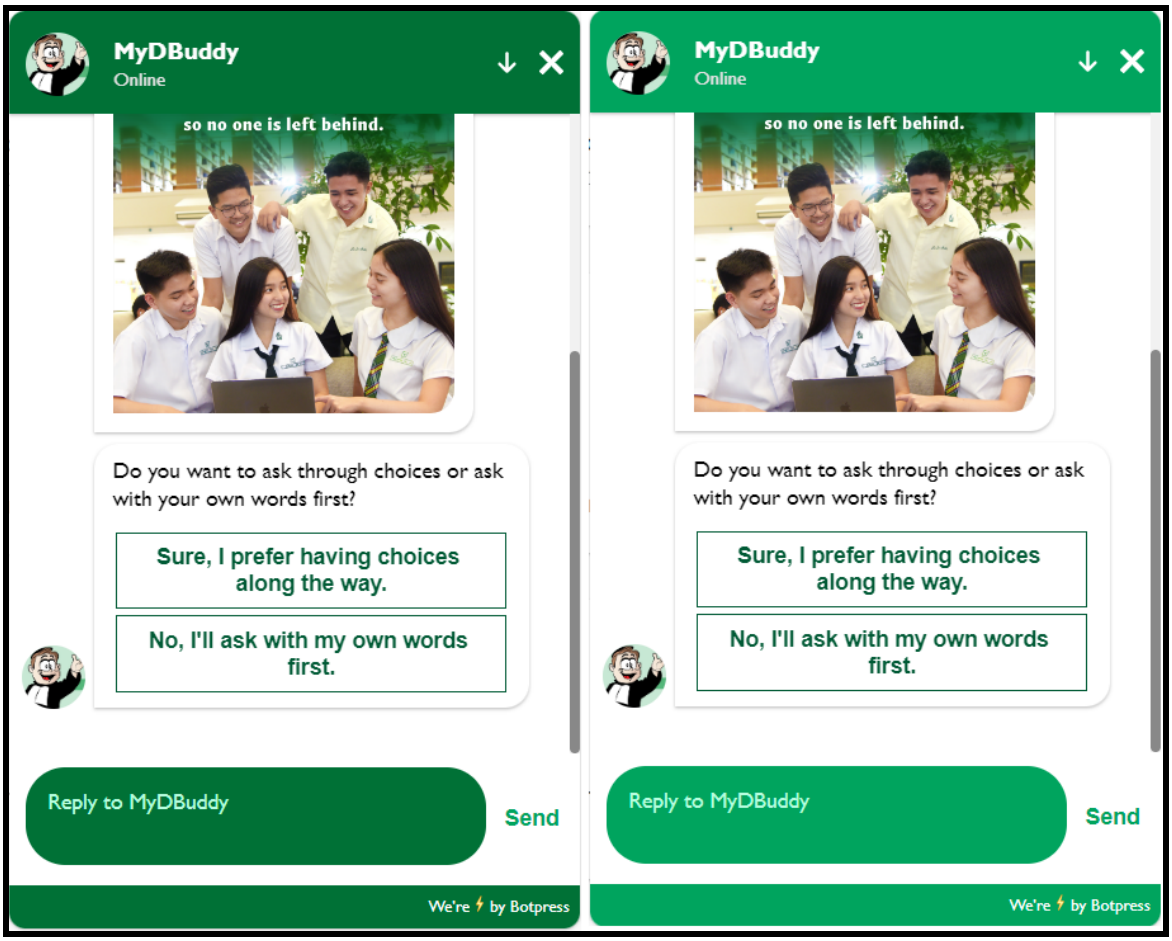


Figure 30. Chatbot UI Color Variations

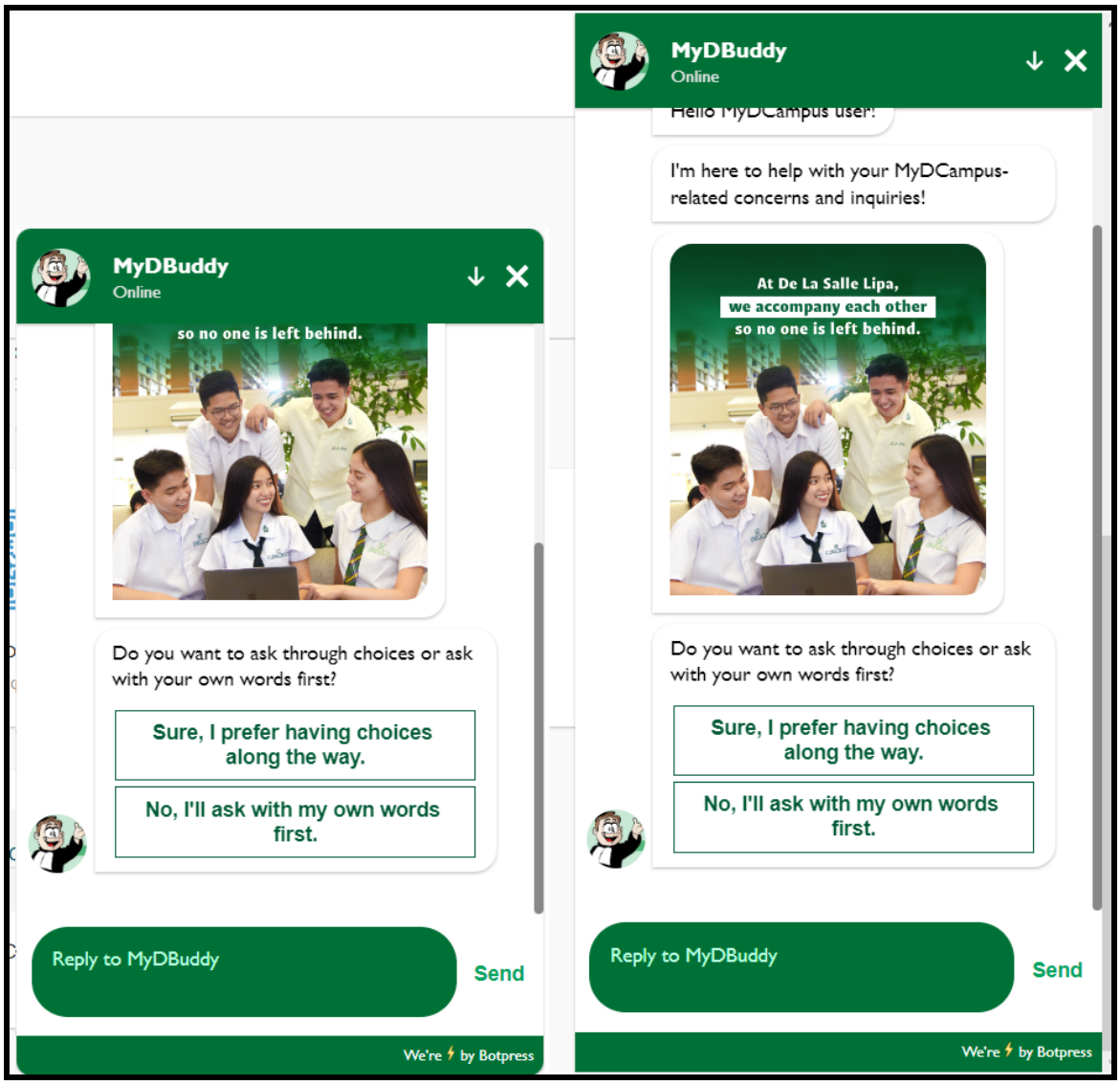


Figure 31. Chatbot Default and Tall Sizes

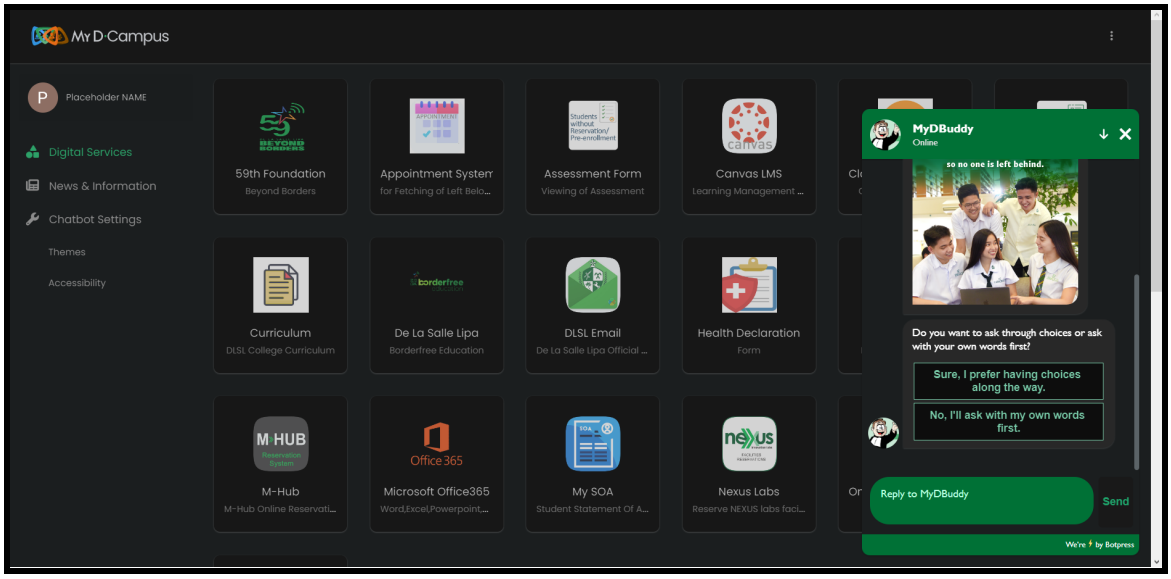


Figure 32. Chatbot Dark Mode Look

Aside from the color standards and theme settings, the chatbot can also be modified with two additional accessibility features. First is a zoom-in feature that increases the size of the default chatbot and all the contents inside it. This aims to assist individuals with poor eyesight. The zoom-in feature allows the user to increase the chatbot size in three different settings. The second feature provides a high-contrast view to the chatbot itself to improve legibility among people of low vision or photosensitivity. Both accessibility features can be used with each other as well as with other themes (except zoom-in for the tall chatbot theme).

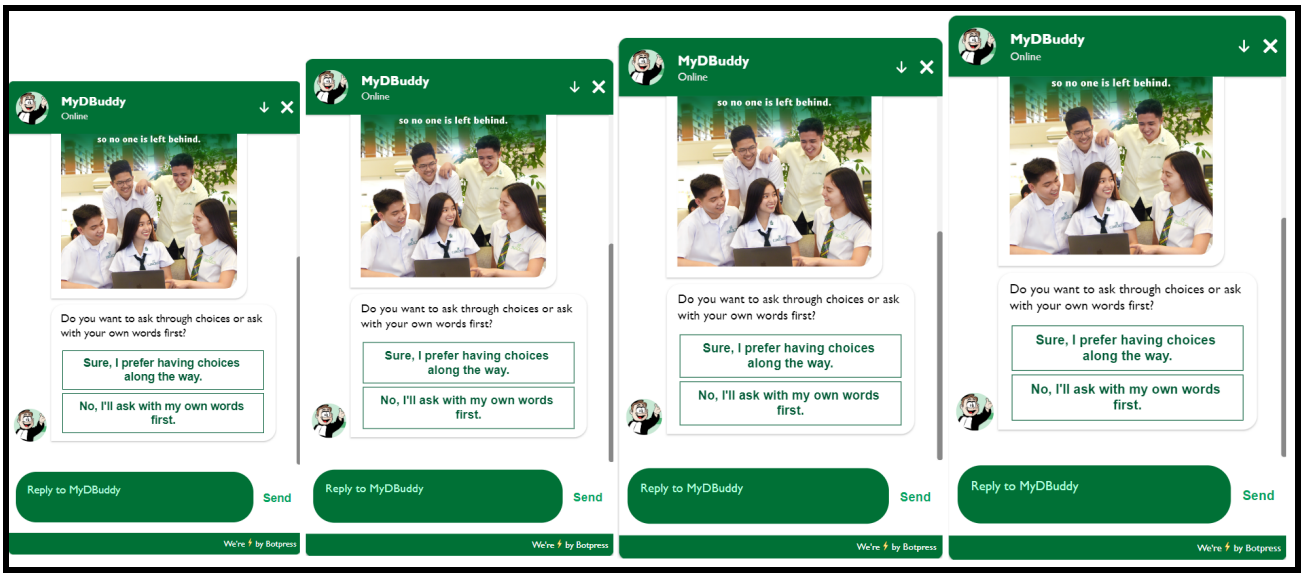


Figure 33. Chatbot Zoom-in Accessibility Feature

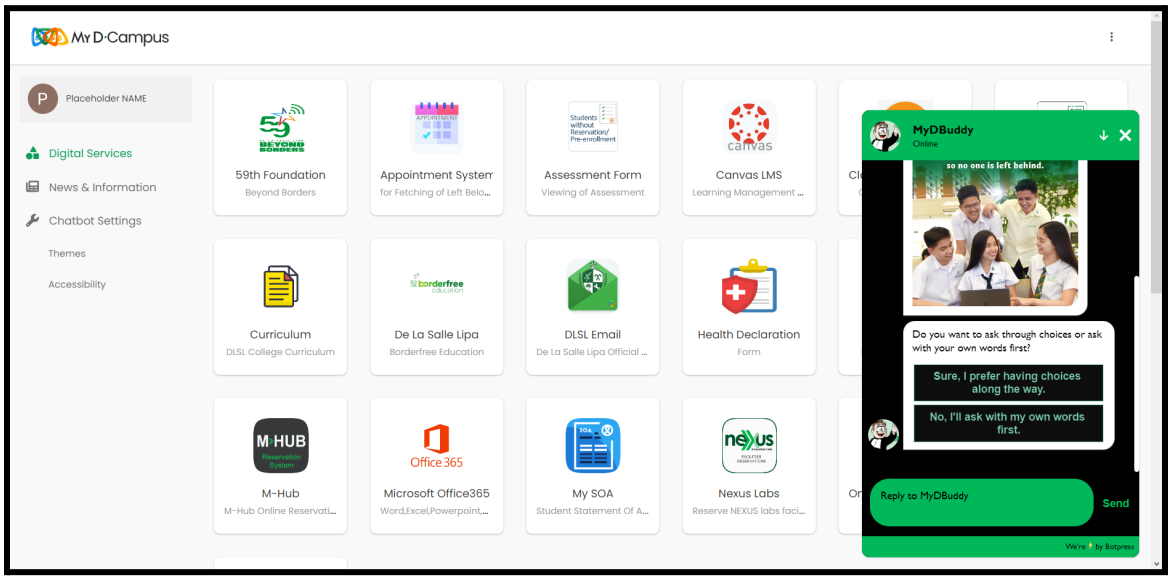


Figure 34. Chatbot High Contrast Accessibility Feature

Implementation Plan

The proposed chatbot system was mainly developed using the Botpress Framework. It utilized its open source version that is readily available through the Botpress Github repository. The software recommends having at least 4 GB RAM or above, a hard drive with at least 64 GB of free space or above, a 64-bit computer architecture, and a prerequisite node version 12.18.1 in the OS. Operating systems supported by Botpress include Windows 10, Mac OS catalina or BigSur, Ubuntu 18.04 or 20.04, Debian 8.11, Red Hat 7.5, and CentOS 7.5. Front-end development with the Botpress Framework is 100 percent JavaScript, a combination of React, Redux, and Bootstrap. The chatbot can be embedded in any modern web browser that supports JavaScript, such as Google Chrome, Firefox, Safari, Microsoft Edge, and Opera.

The database used for the knowledge base of the chatbot will be PostgreSQL, which is a free and open-source relational DBMS compatible with Botpress. Minimum hardware requirements to run PostgreSQL are a 1GHz processor, 2 GB of RAM, and 512 MB of HDD. Alongside this, back-end development can be extended with custom module and API integrations through Node.js. Botpress requires at least a Node.js version 8.2 or higher for back-end development.

The table below shows the software and hardware requirements to be able to use the chatbot system smoothly.

Table 1. Software Requirements

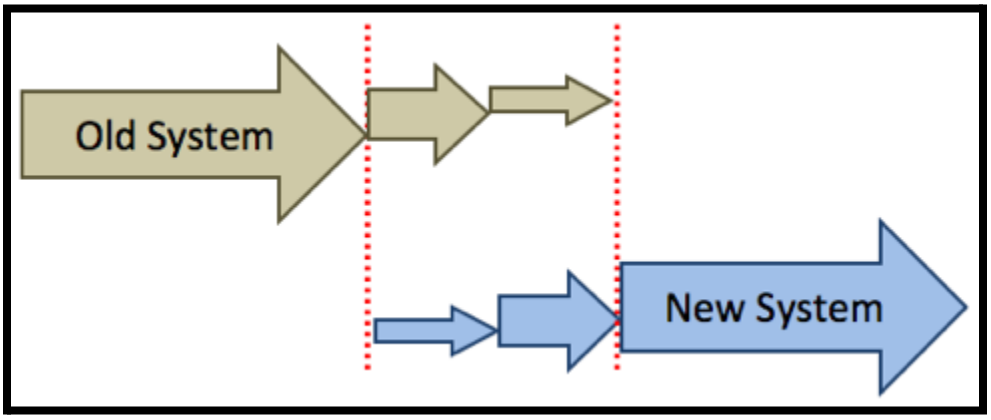
Software	Specifications
PC Platform	**OS:** ● Windows 7, Windows 8, Windows 8.1, Windows 10 or later ● OS X El Capitan 10.11 or later ● 64-bit Ubuntu 18.04+, Debian 10+, openSUSE 15.2+, or Fedora Linux 32+ **Web Browser:** ● Any Modern Web Browser (Google Chrome, Opera, Microsoft Edge, Firefox, Safari) with Javascript enabled

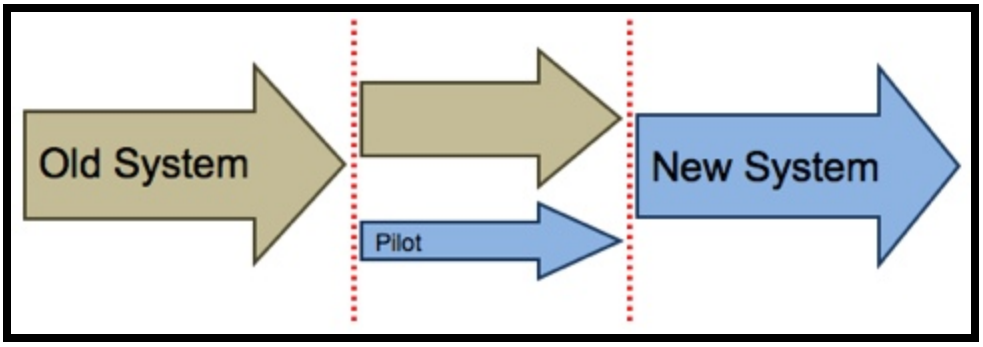
Table 2. Hardware Requirements

Hardware	Specifications
PC Platform	**Processor:** ● Intel Pentium 4 processor or later that's SSE3 capable **RAM:** ● 2 GB RAM or higher **Storage:** ● 100 MB of free space

The implementation or deployment method used for this chatbot system was a mixed implementation of both phased and pilot running approaches. Through this method, the chatbot was tested in partial builds to accomplish sprint test requirements, with each accomplished part per sprint being introduced and integrated to undergo another software testing. This approach allowed for all features of the new chatbot system to be fully tested in parts while minimizing the severity of possible mishaps that might occur from introducing the new system. This allowed the chatbot project to benefit from the Agile development process as it was made in small, functional versions that is slowly building up into the final version of the product.

Alongside this, the chatbot system was initially tested for only a small part or department of the overall system, with a small group of selected DLSL students and parents. This allowed the system to be easier to manage during development, as well as to segregate any possible issues to only a small section of possible users.





Figures 35 - 36. Phased and Pilot Running Implementation Methods (Copley, 2013)

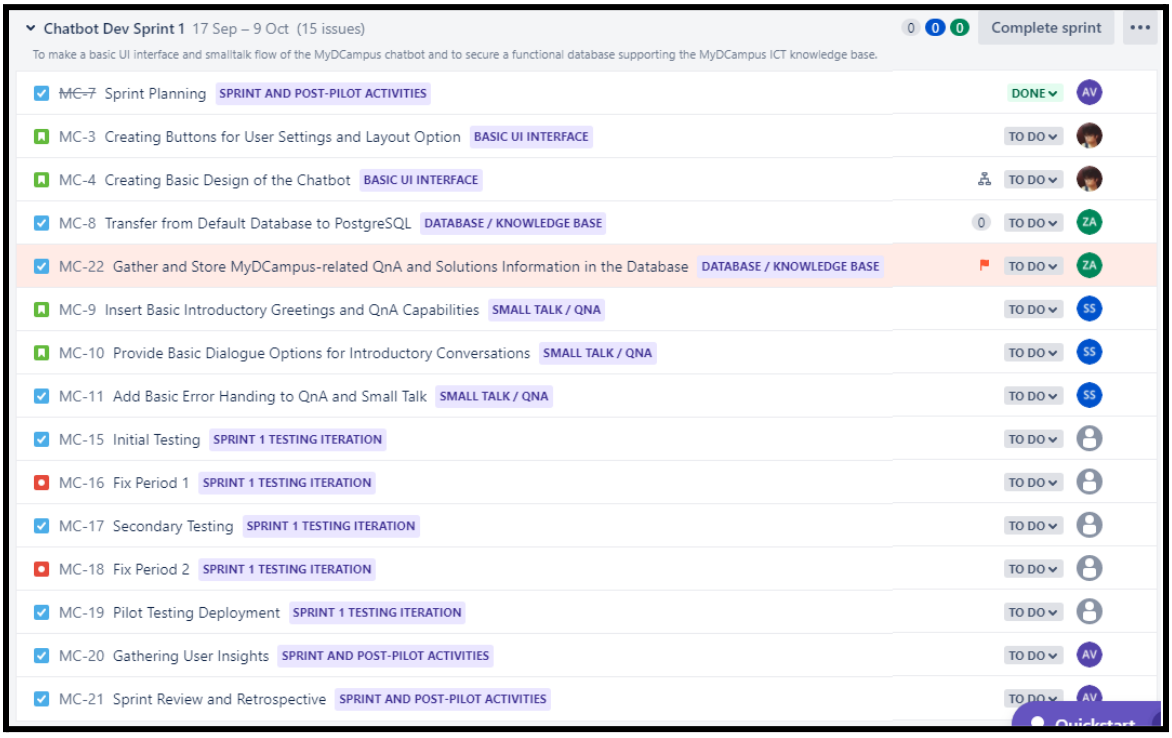
The project implementation followed through the Agile Scrum Methodology by incorporating Scrum sprints, involving iterative development cycles or sprints with the goal of delivering a specific target sprint goal. For this chatbot project, there were three main development sprints lasting for two to three weeks each, involving two iterations each for pre-testing and fix periods before deploying for pilot testing. Each sprint had a sprint planning task at the beginning to define the deliverable and how to achieve it, and a sprint review and retrospective task at the end of a sprint, to review completed work and determine whether additional changes are needed. The three main sprints of the chatbot development were the following:

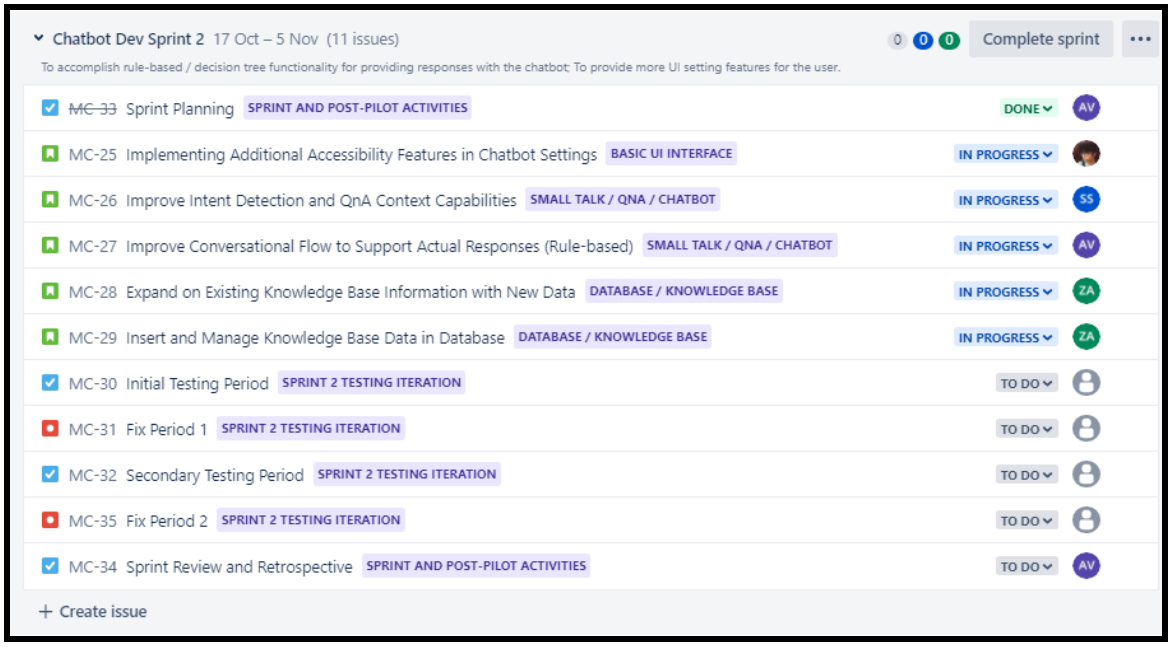
1. **UI Interface and Basic Small Talk Flow** - involved the creation of the initial interface and buttons, base theme of the chatbot, and the small talk QnA of the chatbot.
2. **Rule-Based / Decision Tree Functionality** - involved determining the general use cases, creating and defining the conversational

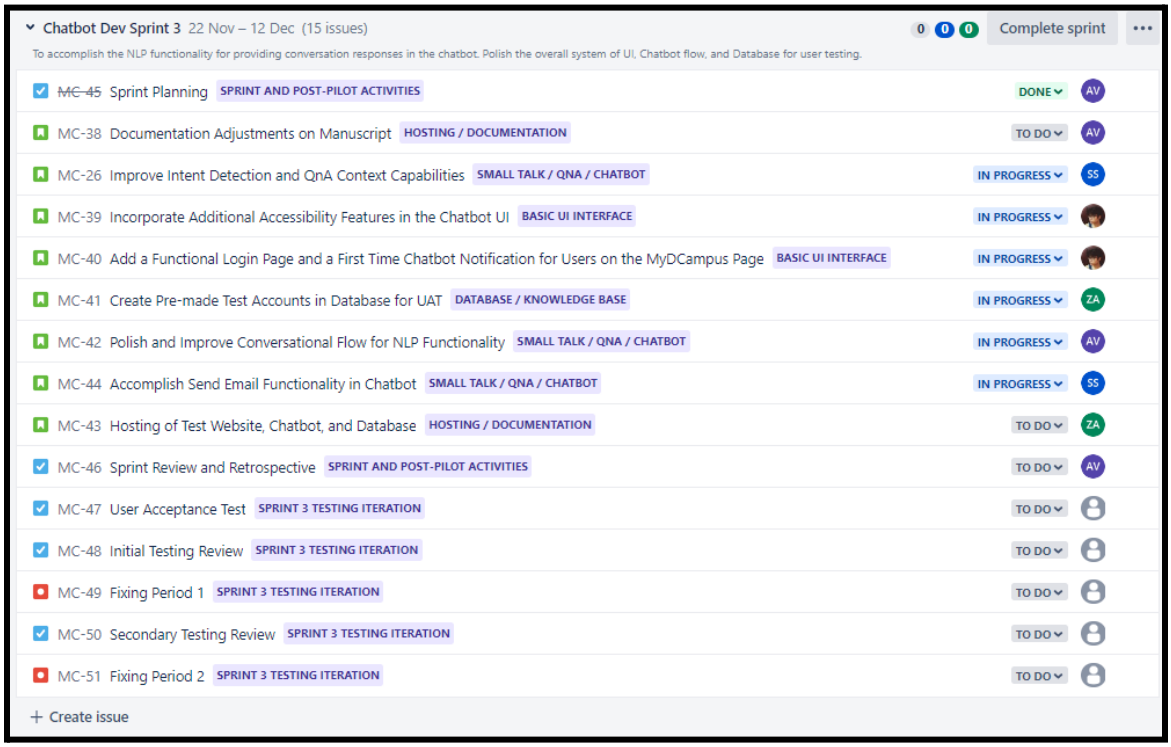
flow with appropriate transitions, actions, and predefined options. Additional UI improvements, accessibility features, and database management were also minor updates to this sprint.

3. **NLP Functionality** - involved determining the possible conversational free-text flow of users, finalizing the solution knowledge base, training NLP model with initial utterances, creating conversational flow and its transition nodes, and incorporating intent classification, slot filling, and entity extraction capabilities. UI and accessibility features were also minor updates to this sprint.

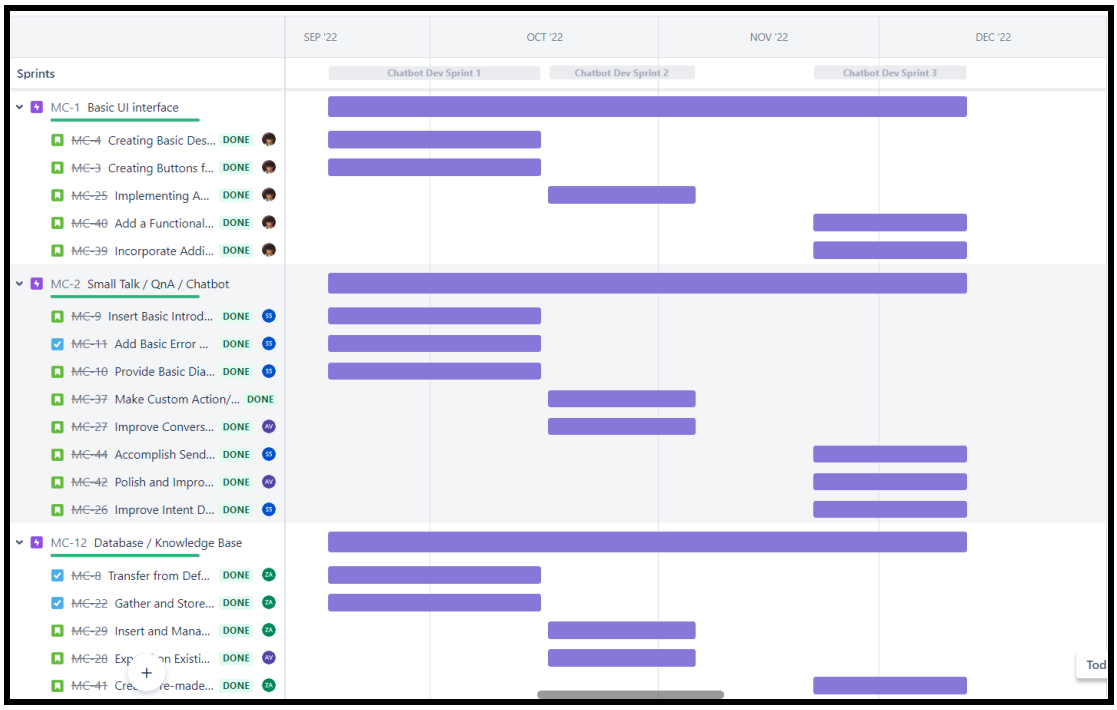
The sprint backlog and gantt chart of the project's Scrum Agile implementation is shown in the following figures below. The overall duration of the project lasted from September to December, with a total of 12 working weeks.

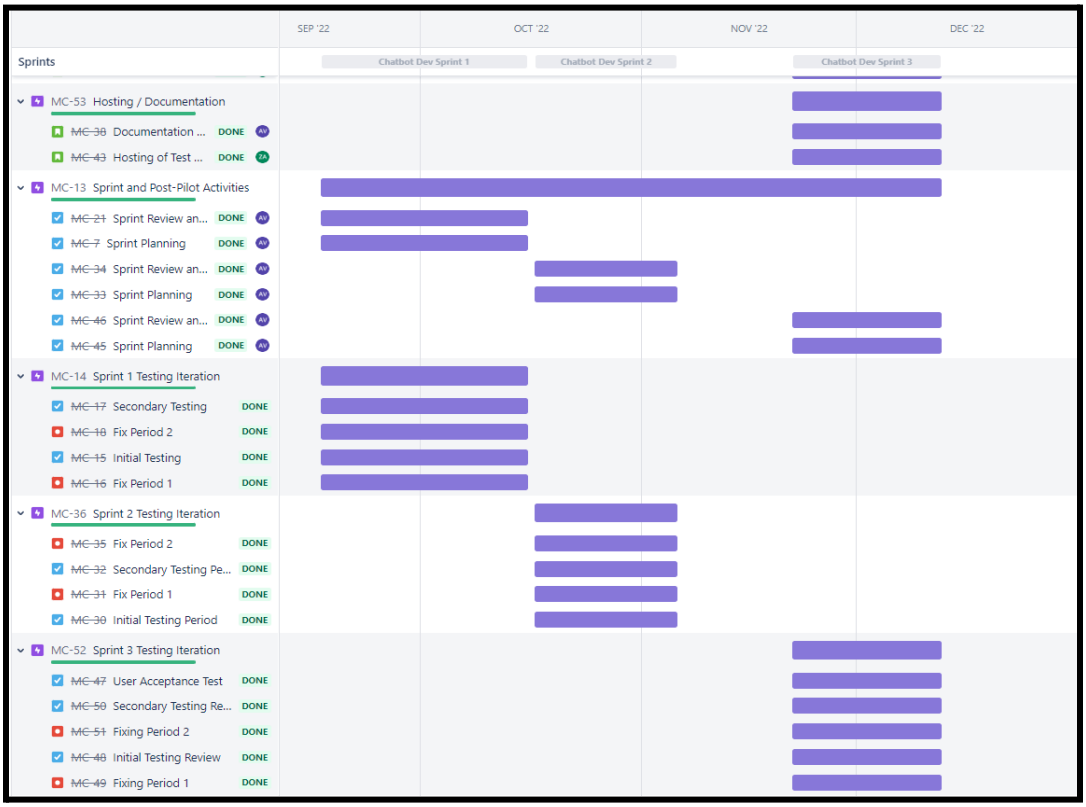






Figures 37 - 39. Sprint Backlog of the Chatbot Development





Figures 40 - 41. Gantt Chart of the Chatbot Development

To support the Agile implementation of the system, the project team utilized a Kanban Board, which is an agile project management tool that can effectively visualize work and manage workflow to maximize group performance and efficiency. Kanban is a scheduling system that focuses on establishing an upper limit to the work in progress flow to avoid overloading the system and to focus manpower towards a specific number of tasks at a time.

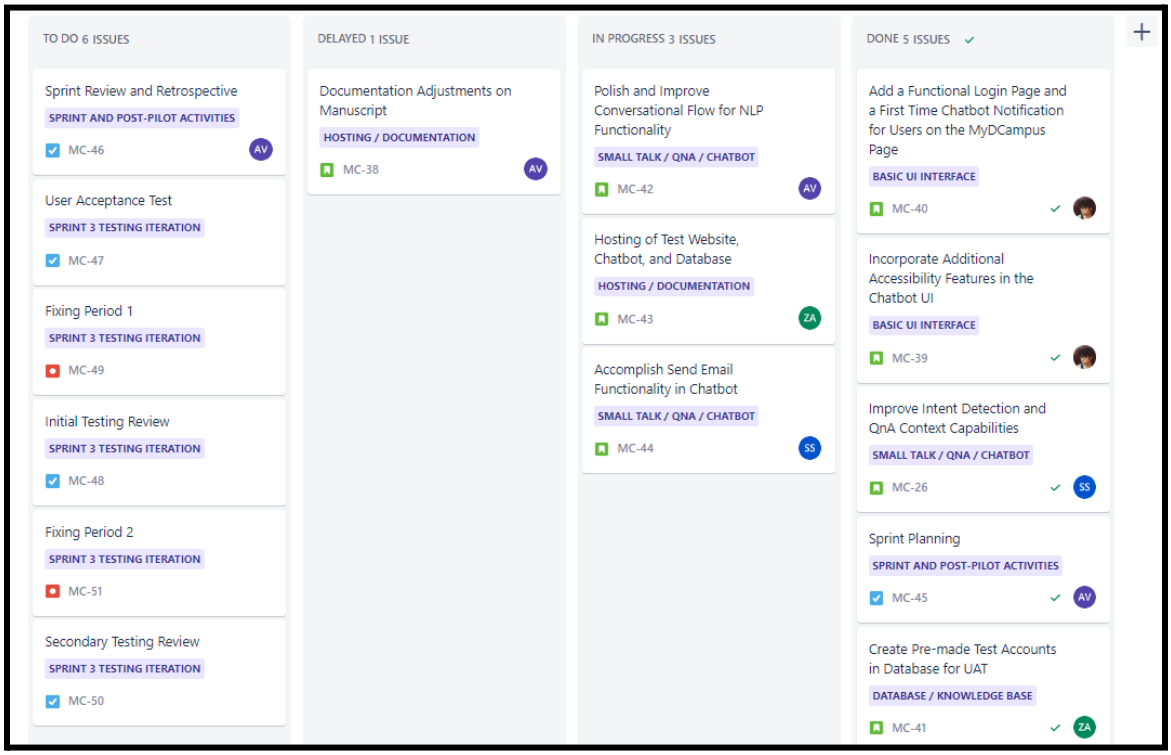


Figure 42. Kanban Board (Rehkopf, 2018; Millard, 2022)

To ensure that the implementation of the chatbot's NLP training data used for the model and rule-based features are accurate, the project utilizes existing Botpress features to ensure that the chatbot and its outputs are satisfactory and functional. Botpress has the following features to be used in development that assists in improving accuracy and validation of responses or outputs of the chatbot:

- Built-in spell checking capabilities on its industrial-grade NLU engine, allowing for quick and automatic misspelling checks and fixes to ensure that the downstream NLU performs more accurately
- Capable of implementing conversational detours to automatically and gracefully handle exceptions back to more well-established and stable paths
- Intelligent slot filling to fill up missing form fields
- Misunderstood module to capture inputs that the chatbot does not understand to be used in improving or expanding the bot's capabilities
- End-to-end conversation emulator, diagnostic report generation, and analytics for live testing of model and performance purposes
- Easy-to-train knowledge base through a simple train button option

In addition to these features of Botpress, software tests through the development's sprint testing periods and UAT were performed for the purpose of validating the accuracy of the NLP and Rule-based modules, as well as the

overall quality, performance, and user satisfaction with the chatbot. The sprint testing process followed the given software tests below where an approved rating would display the chatbot's accuracy as satisfactory and its model data as valid. After the sprints, a final accuracy check was performed through a user acceptance test that evaluates both chatbot and user experience.

The chatbot also provides email functionality to further extend the support, particularly with any requests, inquiries, or other concerns that are out of scope for the ongoing chatbot version. Emails accepted by the chatbot are not limited to DLSL accounts and considers all valid email addresses, as parents are one of the major user groups catered by the site and might not use a DLSL email. For this case, a custom action named EmailValidate.js is implemented in the conversation flow in order to validate whether the email input is a valid email. Sending an email provides the user with a receipt or carbon copy of the email sent, in which ICT support could respond and give feedback to.

The maintenance of the system would follow day to day monitoring of the chatbot analytics and user feedback. This would allow the development team to perform hotfixes on bugs or issues discovered that need immediate attention. At the same time, it will allow for the identification points of the system to be addressed in the future, such as possible upgrades, remakes, or adjustments. Alongside this, a biweekly check is performed to assess the overall performance or condition of the chatbot system, alongside regularly updating the NLP model with new training data, updating conversational flow when needed, and adding

new smalltalk alongside the latest new DLSL information and query solutions to the database.

Monitoring of sent messages will be through the use of the Misunderstood module. This would retain all the out of scope user input identified from chatbot conversations that can be used to train intents or filter out invalid input data. These messages can be filtered by date range, as well be classified under four categories, whether the misunderstood message is new, pending, done, or ignored.

Extraction of chatbot reports can be performed through the Analytics module, which can be filtered by channel source whether to retrieve data from the web channel or an API channel, as well as the date range of the conversations. The result can be exported in the CSV and JSON format, which can be used in collaboration with data processing softwares or tools to extract insights and information from the chatbot interactions.

Software Tests

Listed below are the unit, integration, and system testing descriptions, including the module names, number of modules, and number of test cases.

Table 03: Unit Test

Unit Testing	
Software/Title	MyDCampus Chatbot
Version	1.0
Number of Modules:	4
Number of Test Cases:	14
MODULES	**MODULE ID**
TextView	001
Buttons	002
TextBox	003
ImageView	004

Table 04: Integration Test

Integration Testing	
Software/Title	MyDCampus Chatbot
Version	1.0
Number of Modules:	2
Number of Test Cases:	8
MODULES	**MODULE ID**
Rule-based System	005
NLP System	006

Table 05: System Test

System Testing	
Software/Title	MyDCampus Chatbot
Version	1.0
Number of Modules:	1
Number of Test Cases:	8
MODULES	**MODULE ID**
Chatbot System Build	007

User Acceptance Test

Part 1. Respondent Information

Please put a check(✔) mark on the box of your choice

1. What is your age group?

- Under 18
- 18 - 24
- 25 - 30
- 31 - 40
- 40+

2. What is your gender?

- Male
- Female
- Prefer not to say

3. What kind of MyDCampus User are you?

- Student
- Parent
- DLSL Faculty

4. Do you have existing physical hindrances or difficulties?

- Yes
- No

5. (optional) If Yes, what physical hindrances are you experiencing?

- Color Blindness

- Poor Eyesight
- Dyslexia
- Other..

6. How would you rate your experience using technology or computers?

- High proficiency
- Above average proficiency
- Average proficiency
- Below Average proficiency
- Low proficiency

Part 2. System Evaluation

Please put a check (✔) mark in the appropriate value against each item (5 - Strongly Agree, 4 - Agree, 3 - Neutral, 2 - Disagree, 1 - Strongly Disagree):

No	Question	1	2	3	4	5
Chatbot Evaluation						
1	The system offers enough interactivity					
2	The system is easy to use					
3	It is easy to know what to do at each moment.					
4	The amount of information that is displayed on the screen is adequate.					

5	The arrangement of information on the screen is logical.					
6	The chatbot is helpful.					
7	The chatbot is interactive.					
8	The chatbot reacts in a consistent way.					
9	The chatbot complements the activities without distracting or interfering with them.					
10	The chatbot provides adequate non-verbal feedback.					
User Satisfaction Evaluation						
1	I think that I would like to use this system frequently.					
2	I found the system unnecessarily complex.					
3	I thought the system was easy to use.					
4	I think that I would need the support of a technical person to be able to use this system.					
5	I found the various functions in this system well integrated.					
6	I thought there were too many inconsistencies in this system.					

7	I would imagine most people would learn to use this system very quickly.					
8	I found the system very cumbersome to use.					
9	I felt very confident using the system.					
10	I needed to learn a lot of things before I could get going with this system.					

Data Analysis

The user acceptance test has been prepared with two sections - a chatbot evaluation survey (*adapted from Griol & Callejas, 2013*), and a user satisfaction evaluation (*adapted from Brooke, 1996*). Reliability testing has been performed for the two sections, both with 10 questions, through the use of a free statistical software called Jamovi. The chatbot evaluation survey recorded an alpha coefficient value of 0.906, which is rated high internal consistency and reliability. The user satisfaction survey recorded a value of 0.867, which is also a high reliability rating, with its subsets on positive and negative user experience recording values of 0.824 and 0.754 respectively. The view of usability with the surveys used in this UAT is reflected in the current international standard ISO 9241-11 (Ergonomics of human-system interaction) and in the Esprit project MUSiC (Measuring Usability of Systems in Context), which is a project built on

top of a large scale European project HUFIT (Human factors and Information Technology) (*Bevan, 1995*).

Table 6. Reliability Testing

Reliability Statistics		
Section	**Cronbach's Alpha**	**N of Items**
Chatbot Evaluation Survey	.906	10
User Satisfaction Survey (Overall)	.867	10
User Satisfaction Survey (Positive)	.824	5
User Satisfaction Survey (Negative)	.754	5

The user acceptance test will utilize the following scale below:

Table 7. Likert Scale

Description	Value
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

Table 8. Interpretation of Likert Scale Values

Range of Weighted Mean	Interpretation
4.51 – 5.00	The value represents that the respondents strongly agree on the case.
3.51 – 4.50	The value shows that the respondents agree on the case.
2.51 – 3.50	The value shows that the respondents have a neutral viewpoint on the case.
1.51 – 2.50	The value shows that the respondents disagree on the case.
1.50 and below	The value shows that the respondents strongly disagree on the case.

Table 9. Interpretation of Correlation Size Values

Size of Correlation	Interpretation
0.00 - 0.199	Very weak / negligible correlation
0.20 - 0.399	Weak / low correlation
0.40 - 0.599	Moderate / medium correlation
0.60 - 0.799	Strong / high correlation
0.80 - 1.000	Very strong / Very high correlation

Chapter 4

RESULTS AND DISCUSSION

Implementation of Algorithms

The following algorithms were used to implement the conversational functionalities of the MyDCampus Chatbot:

1. **Intent Classification (and Detection)** is used in order for the chatbot to recognize or detect user intent. The algorithm utilizes a set of utterances, such as phrases and sentences, to train itself in recognizing phrases or statements with similar meanings which can be formed using different words and sentence structures. Recognized intents are stored in flow metadata as event.nlu.intent.[[name]] variable and can be applied to be used on a flow condition or a content action. Examples of intents used are “academic” for academic-related MyDCampus information, “contact-dlsl” referring to DLSL contact details, and “back” for returning to a previous part of the conversation. **Out of Scope Recognition** occurs if the input does not correspond to any existing intent in the NLP model, classifying it as a “none” intent that can be used for catching misunderstandings.
2. **Slot Identification** utilizes the key concept of slots to perform flow transactions and actions associated with the intent. Slots are a key

piece of parameter information needed to complete an intent, such as whether the kind of query the user wants is a DLSL or a MyDCampus-related one for inquiring about general information. Entities can also be used to further customize the needed parameters in a slot. When using this algorithm, **Slot Tagging** is performed where each word in the user input would be tagged by the bot engine and a correctly identified intent with the appropriate slot detail will be extracted. The slot can be accessed in the event.nlu.slots variable using the slot name as the key. If the required slot is not identified, **Slot Filling** would occur in which the chatbot would ask the user to input the needed slot information manually.

3. **Entity Extraction** allows the extraction of known entities from phrases or statements and normalizing it into more regular, structured information such as a specific DLSL or MyDCampus feature, or method of contacting DLSL. For the chatbot's purposes, custom DLSL-related entities are used as slots for intent classification in order to further specify the details of the user's intentions. The entity data can be found in the event.nlu.entities variable of the flow metadata and can be used for flow conditions and actions, similar to intents. To detect entities more effectively, **Fuzzy Matching** is applied to approximate text values for words of

4 characters or more when misspelled, allowing the chatbot to tolerate slight spelling errors in inputted words.

Software Test Results

Results from the test show that the MyDCampus chatbot has successfully passed the different unit test cases that were made by the chatbot developers. Table 10 presents the test cases that were used for unit testing.

Table 10. Unit Test Cases Results

Test Case	Result
Send text to the text window	Passed
Type email address to appear in text window	Passed
Press the chatbot icon	Passed
Press the settings option	Passed
Press DLSL Colors 1 and DLSL Colors 2 options	Passed
Press Neutral Textbox option	Passed
Press Tall Chatbox option	Passed
Press Toggle dark theme option	Passed
Press Zoom-in chatbot option	Passed
Press the High Contrast option	Passed
Press the query option	Passed
Press the exit button	Passed
Type a long input into the textbox	Passed
Make the chatbot send an image response	Passed

Table 11 displays the results of the integration test of the MyDCampus chatbot. The components of rule-based and NLP modules were integrated and then tested to check whether each module works properly.

Table 11. Integration Test Results

Test Case	Result
Receive options for rule-based query	Passed
Asking a query through options	Passed
Navigate through the conversation with *back*, *more or previous choices*, and *I can't find my solution* options	Passed
Receive options for free-text query	Passed
Performing casual smalltalk with the chatbot	Passed
Asking the chatbot about a DLSL-related or MyDCampus concern	Passed
Asking the chatbot an out of scope query	Passed
Navigate through the conversation flow by saying *back* and *restart*	Passed

Table 12 shows the result of system testing in which every part of the chatbot is functioning as a whole system and can be checked for its entire appearance, understandability, reliability, interactivity, and responsiveness.

Table 12. System Test Results

Test Case	Result
Testing Website Embedding	Passed
Check for first-time user alert message from chatbot	Passed
Check for proactive greeting from chatbot	Passed
Refresh website after conversation	Passed
Test navigation between rule-based and NLP modules based on source	Passed
Test send email feature from either NLP or rule-based flows	Passed
Changing chat interface theme and accessibility features	Passed
Test Chatbot with various queries	Passed

User Acceptance Test Results

The user acceptance test was performed by 25 DLSL-affiliated respondents who have tested the chatbot software beforehand, with a total of 19 (76%) students from ages 18 - 24 and 6 (24%) parents from ages 40 and above. The chatbot was hosted in a local machine in which the respondents accessed through Ngrok, a tool that produces a secure link that connects the local network ports to the internet. The respondents were asked to access the link in a web browser either through a desktop computer or a mobile phone. A brief orientation about the chatbot software was given and the respondents were allowed to test the chatbot in their own specific ways. The chatbot was also actively maintained

by the developers during the UAT period every time the respondents discover software bugs or errors.

Demographic Information

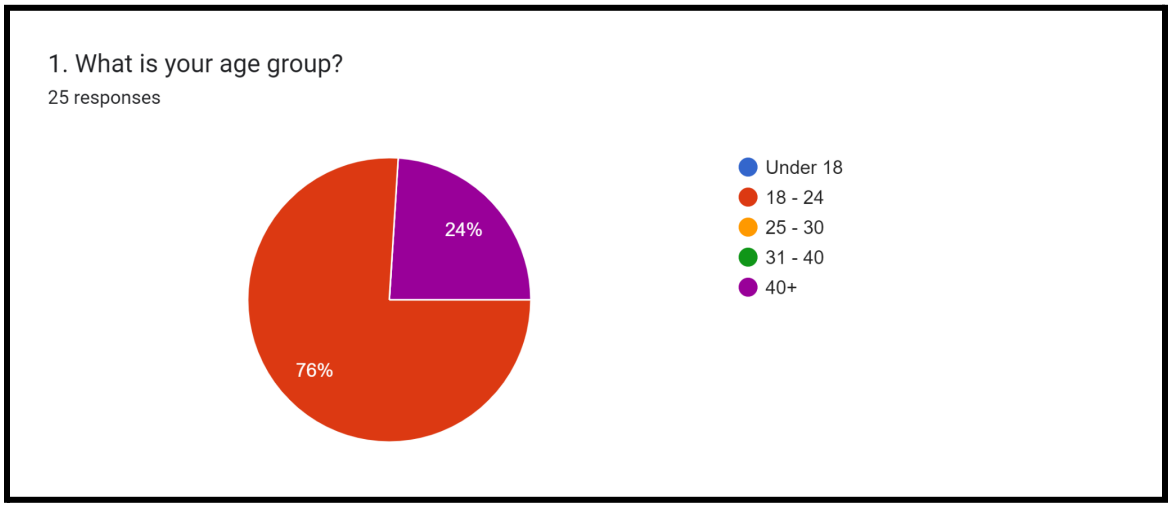


Figure 43. Graph Summary of Respondents According to Age

Table 13. Frequency Distribution Table of Respondents According to Age

Age	Frequency	Percentage	Ranking
Under 18	0	0 %	3
18 - 24	19	76 %	1
25 - 30	0	0 %	3
31 - 40	0	0 %	3
40+	6	24 %	2
Total	25	100 %	

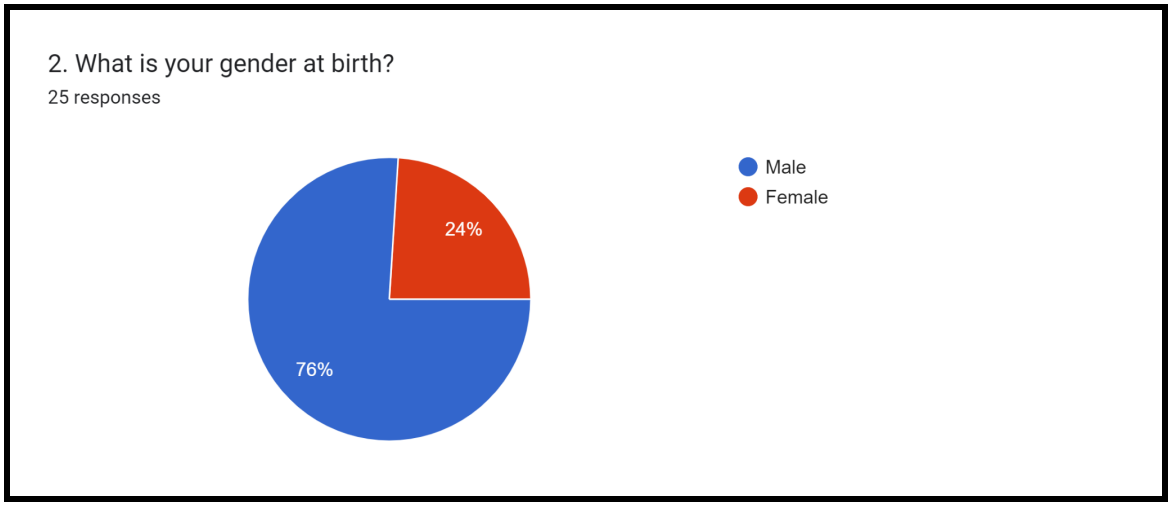


Figure 44. Graph Summary of Respondents According to Gender

Table 14. Frequency Distribution Table of Respondents According to Gender

Gender	Frequency	Percentage	Ranking
Male	19	76 %	1
Female	6	24 %	2
Total	25	100 %	

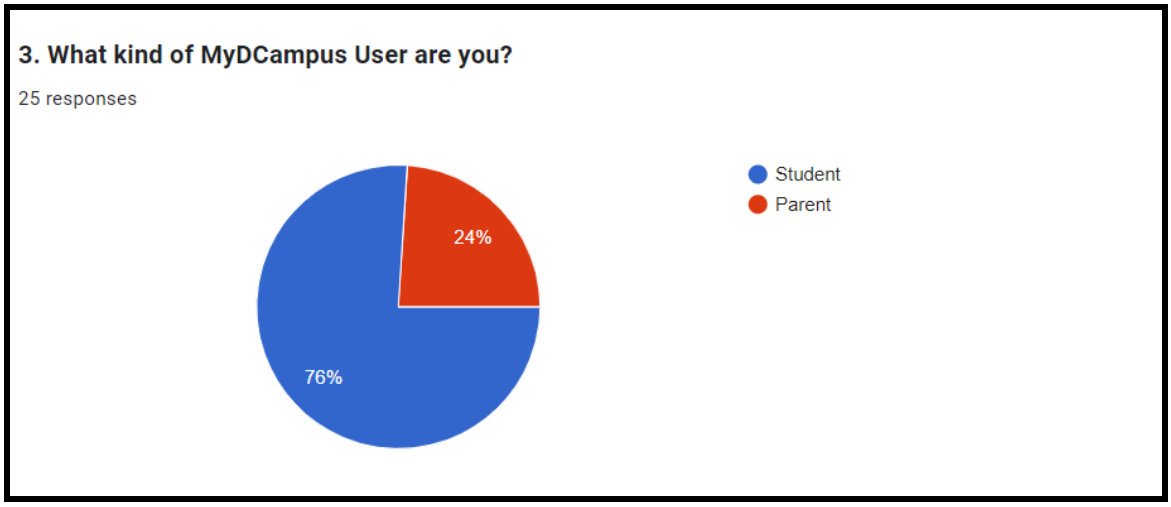


Figure 45. Graph Summary of Respondents According to Type of MyDCampus User

Table 15. Frequency Distribution Table of Respondents According to Type of MyDCampus User

MyDCampus User	Frequency	Percentage	Ranking
Student	19	76 %	1
Parent	6	24 %	2
Total	25	100 %	

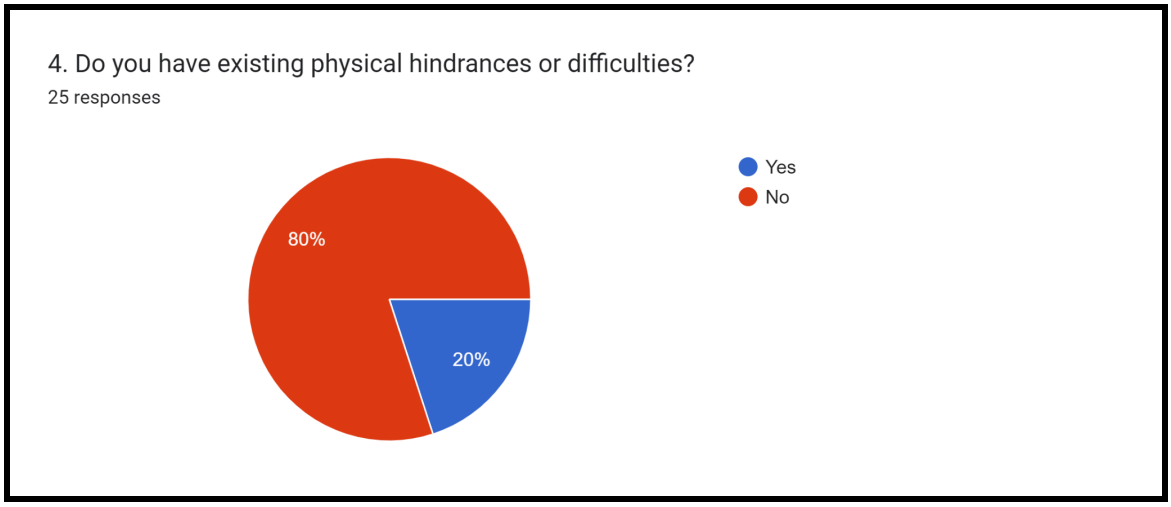


Figure 46. Graph Summary of Respondents According to Physical Hindrances

Table 16. Frequency Distribution Table of Respondents According to Physical Hindrances

Physical Hindrances	**Frequency**	**Percentage**	**Ranking**
Yes	5	20 %	2
No	20	80 %	1
Total	25	100 %	

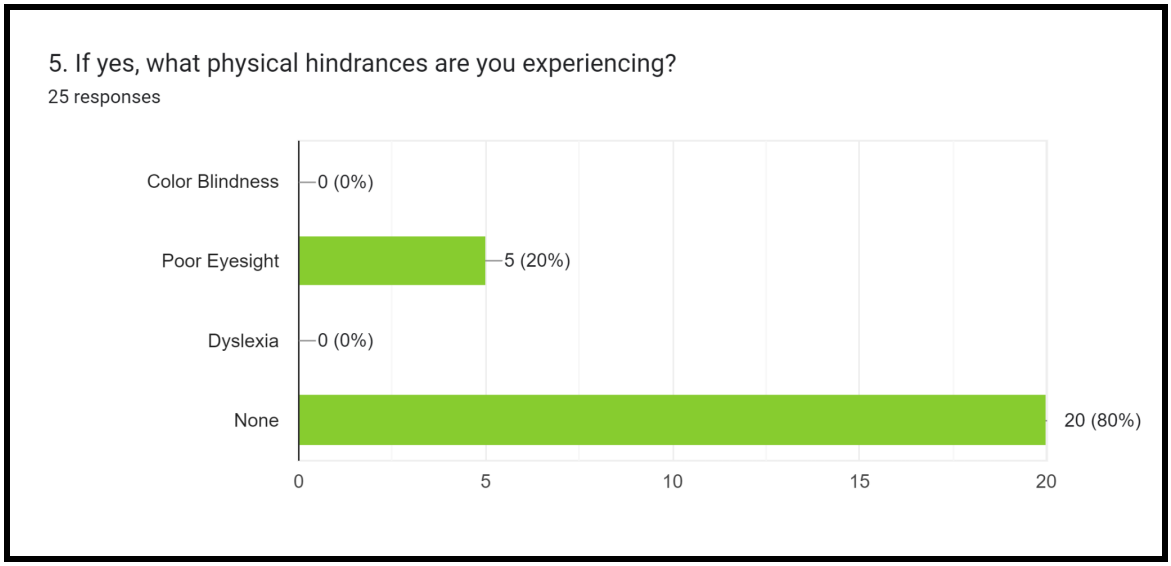


Figure 47. Graph Summary of Respondents According to Existing Physical Hindrances

Table 17. Frequency Distribution Table of Respondents According to Existing Physical Hindrances

Existing Physical Hindrances	Frequency	Percentage	Ranking
Color Blindness	0	0 %	3
Poor Eyesight	5	20 %	2
Dyslexia	0	0 %	3
None	20	80 %	1
Total	25	100 %	

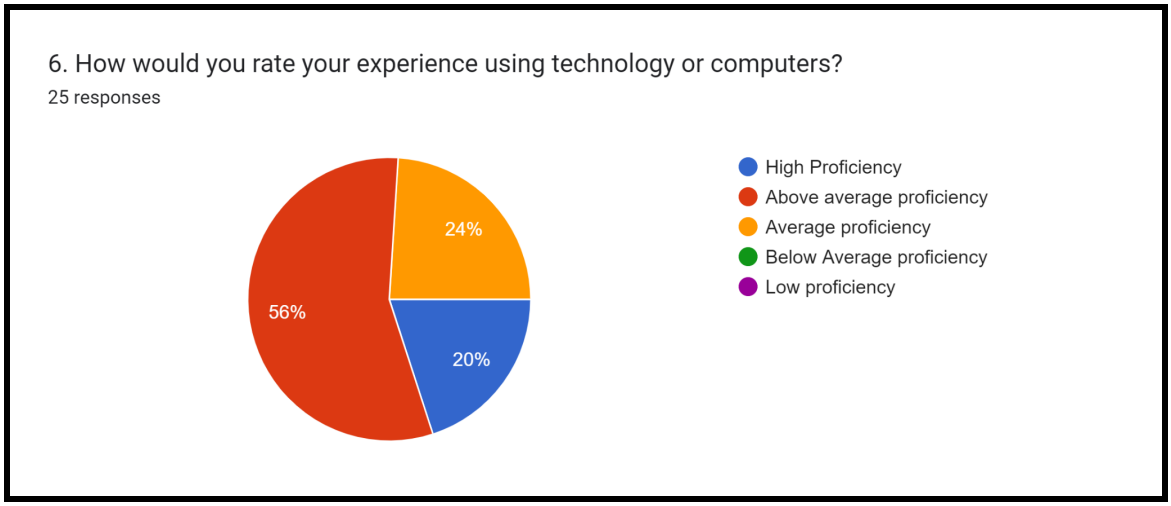


Figure 48. Graph Summary of Respondents According to Experience using Technology or Computers

Table 18. Frequency Distribution Table of Respondents According to Experience using Technology or Computers

Experience using Technology	**Frequency**	**Percentage**	**Ranking**
High Proficiency	5	20 %	3
Above Average Proficiency	14	56 %	1
Average Proficiency	6	24 %	2
Below Average Proficiency	0	0 %	4
Low Proficiency	0	0 %	4
Total	25	100 %	

System Evaluation

Table 19. Chatbot Evaluation Results

Chatbot Evaluation	Weighted Mean	Verbal Interpretation	Rank
The system offers enough interactivity.	4.6	**Strongly Agree**	3
The system is easy to use.	4.68	**Strongly Agree**	1
It is easy to know what to do at each moment.	4.48	**Agree**	5
The amount of information that is displayed on the screen is adequate.	4.48	**Agree**	5
The arrangement of information on the screen is logical.	4.64	**Strongly Agree**	2
The chatbot is helpful.	4.6	**Strongly Agree**	3
The chatbot is interactive.	4.56	**Strongly Agree**	4
The chatbot reacts in a consistent way.	4.68	**Strongly Agree**	1
The chatbot complements the activities without distracting or interfering with them.	4.56	**Strongly Agree**	4
The chatbot provides adequate non-verbal feedback.	4.2	**Agree**	6

Table 20. User Satisfaction Results

User Satisfaction Evaluation - Positives	Weighted Mean	Verbal Interpretation	Rank
I think that I would like to use this system frequently.	3.96	**Agree**	4
I thought the system was easy to use.	4.16	**Agree**	3
I found the various functions in this system well integrated.	4.4	**Agree**	2
I would imagine most people would learn to use this system very quickly.	4.48	**Agree**	1
I felt very confident using the system.	4.48	**Agree**	1
User Satisfaction Evaluation - Negatives	**Weighted Mean**	**Verbal Interpretation**	**Rank**
I found the system unnecessarily complex.	2.04	**Disagree**	5
I think that I would need the support of a technical person to be able to use this system.	1.4	**Strongly Disagree**	1
I thought there were too many inconsistencies in this system.	1.6	**Disagree**	3
I found the system very cumbersome to use.	1.52	**Disagree**	2
I needed to learn a lot of things before I could get going with this system.	1.88	**Disagree**	4

Table 21. Mean Total and Verbal Interpretation of UAT Criterion

Criteria	Mean Total	Verbal Interpretation
Chatbot Evaluation	4.548	**Strongly Agree**
User Satisfaction Evaluation - Positives	4.296	**Agree**
User Satisfaction Evaluation - Negatives	1.688	**Disagree**

The overall average obtained from the respondents regarding the quality and performance of the MyDCampus chatbot has resulted in a value of 4.548, which indicates that the respondents strongly agree that the quality and capability of the MyDBuddy Chatbot itself is significantly great overall.

In terms of positive user satisfaction, the mean total resulted in a value of 4.296, signifying that the respondents agree that the use of the chatbot is satisfactory enough to address their user needs and preferences.

For the negative aspect of user experience, respondents have given a total average score of 1.688, showing disagreement towards the chatbot incorporating significant negatives in its quality and design towards user satisfaction.

From the following results, it could be seen that the chatbot software itself is a satisfactory project for the respondents and is open for more improvements towards maximizing positive user satisfaction attributes while minimizing negative ones.

Quality Factors for Chatbot User Experience

Appearance

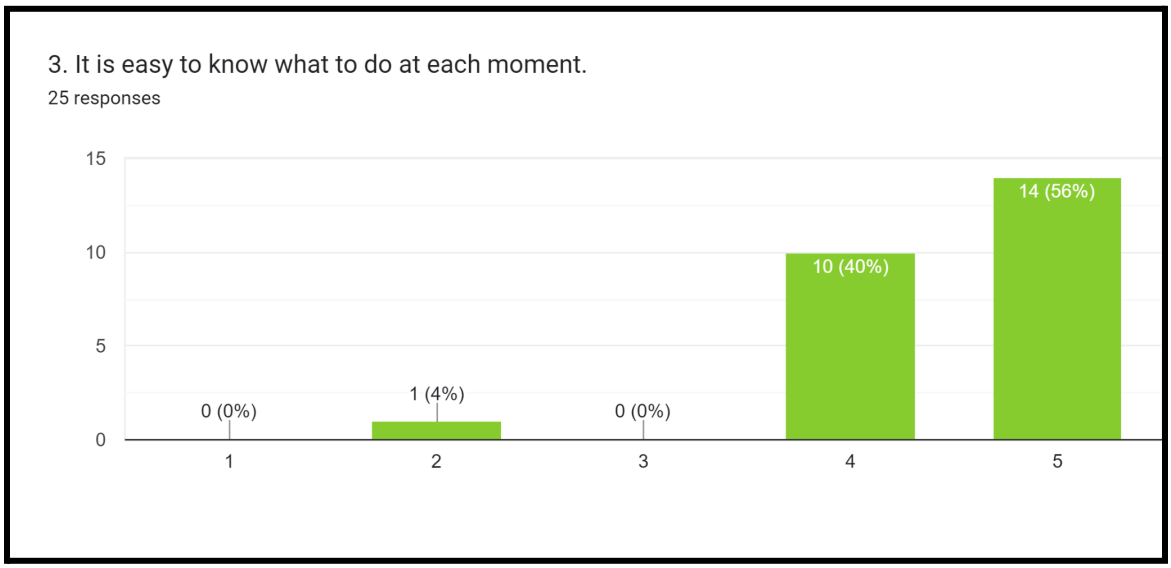


Figure 49. It is easy to know what to do at each moment

The following results demonstrate that the majority (96%) of DLSL-affiliated respondents think that it is easy to know what to do at any point of the chatbot testing process, with an average rating of 4.48. This displays the effectiveness of the design implementation of the MyDCampus chatbot and its application of HCI principles. The users are able to know what to do due to the user-friendly approach and intuitive design of the chatbot at any moment of its utilization.

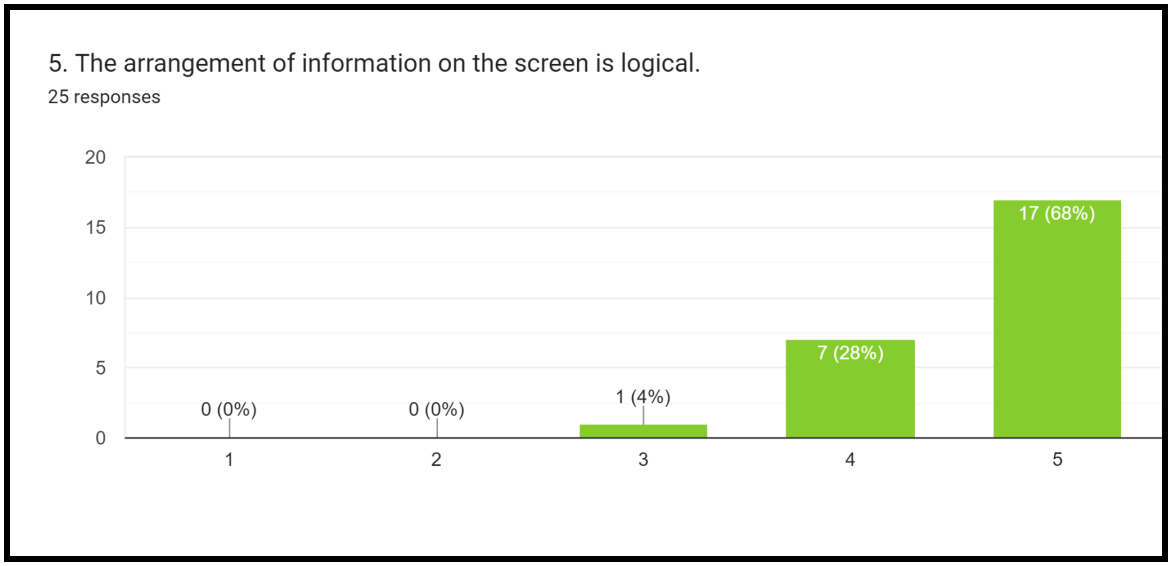


Figure 50. The arrangement of information on the screen is logical

Ninety six percent (96%) of the respondents have rated the arrangement of information in the chatbot interface as effectively logical and easy to follow through, with a total average score of 4.64. Based on this, it can be concluded that the chatbot's design of delivering chatbot information is easily digestible and readable enough to cause little to no reading issues from the respondents.

Understandability

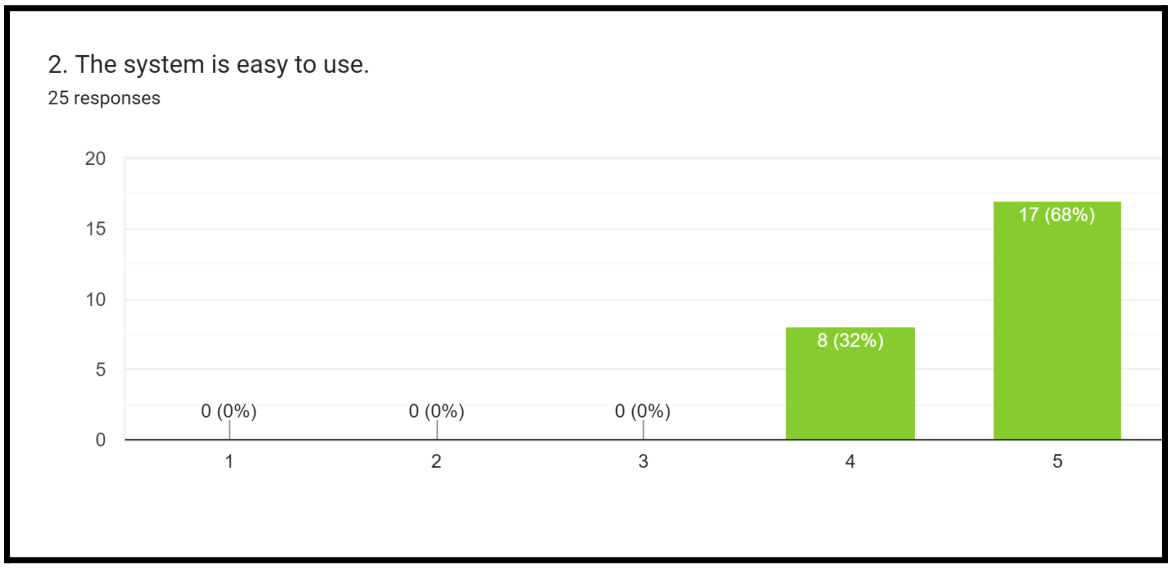


Figure 51. The system is easy to use

The ease of use of the chatbot has shown to be agreed upon by all respondents of the survey, attaining an average score of 4.68. This shows that the chatbot's capability to understand human intents or interactions for it to be able to interact normally and properly with the users is at a significant level of effectiveness.

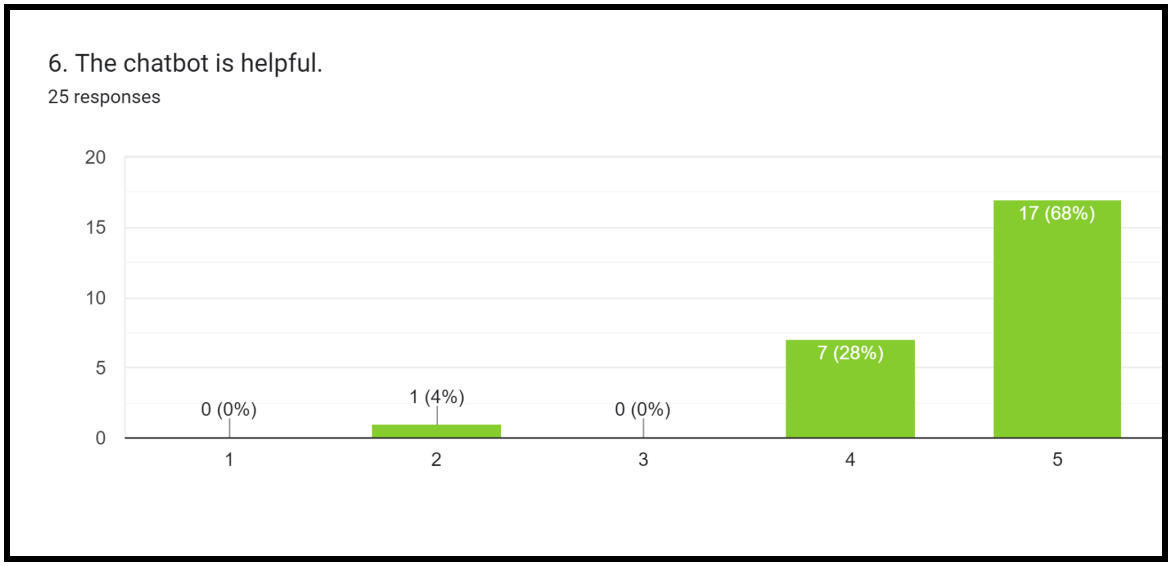


Figure 52. The chatbot is helpful

Ninety six percent (96%) of the respondents agree upon the helpfulness of the chatbot as an online help service, with an average score of 4.6. This displays the intelligibility of the MyDCampus chatbot as it can understand human dialogue or input and use that information to provide appropriate solutions to help its users.

Reliability

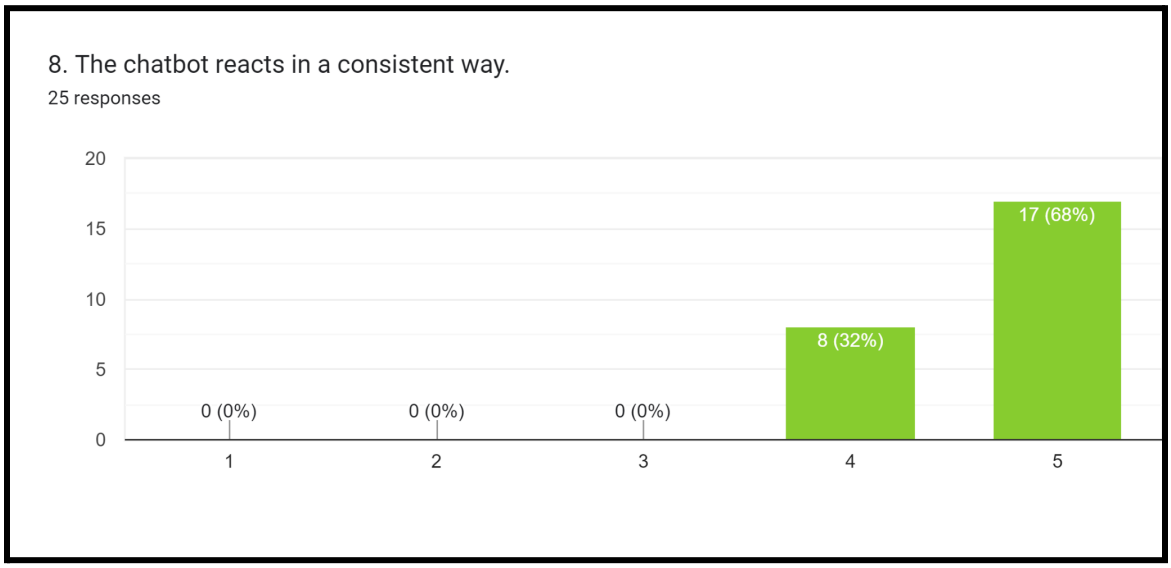


Figure 53. The chatbot reacts in a consistent way

In terms of consistency, all respondents agree that the chatbot reacts to the user inquiry appropriately and invariably, having an average total of 4.68. Hence, users can expect the MyDCampus chatbot to be reliable in providing credible, meaningful, and high quality responses whenever they utilize the service.

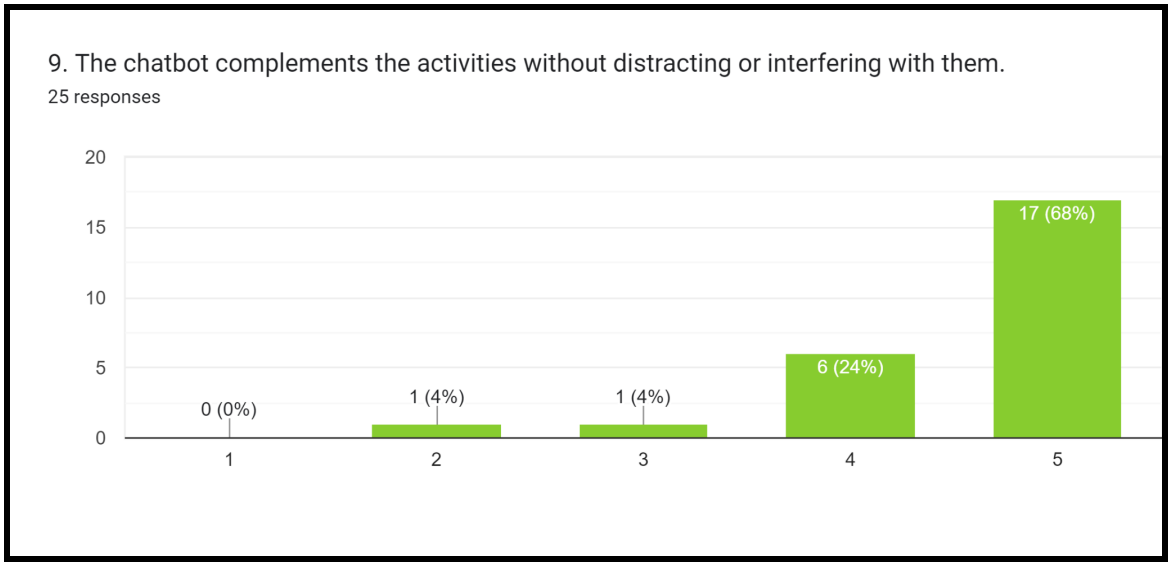


Figure 54. The chatbot complements the activities without distracting or interfering with them

Ninety two Percent (92%) of the respondents agree on the chatbot being able to complement the existing features on the MyDCampus site without feeling like a distraction or interference, with an average rating of 4.56. This proves that it can be seen by the users that the MyDCampus chatbot is reliable enough to be overall useful to the user while not being significantly intrusive enough that it can affect or influence user trust and use longevity.

Interactivity

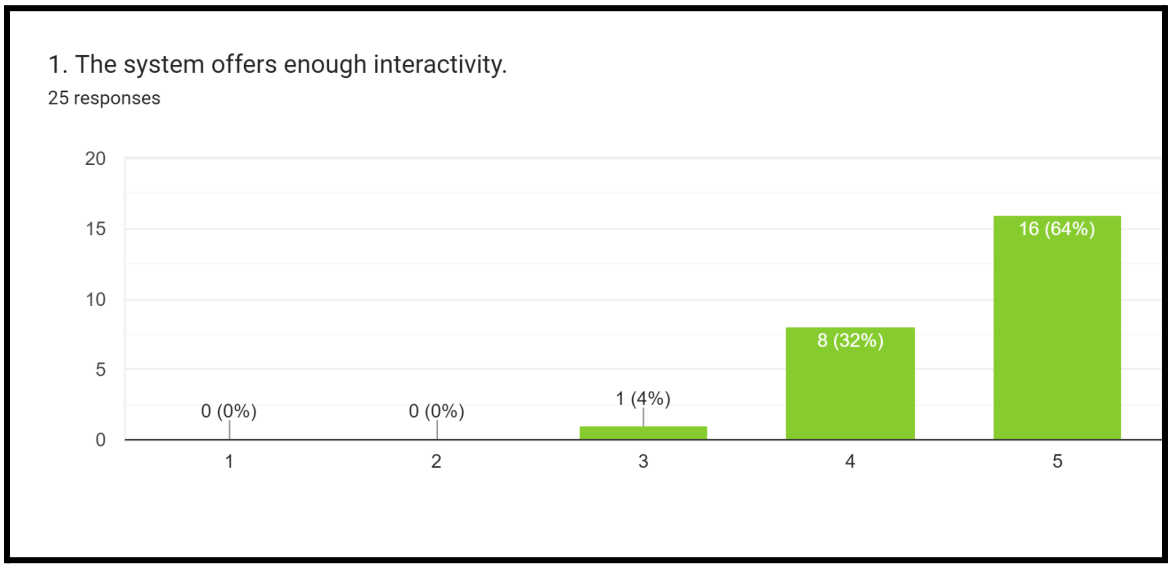


Figure 55. The system offers enough interactivity

In terms of having available interactive features or uses, 96% of the respondents agree that the chatbot consists of enough interactivity features for their own use, with an average score of 4.6. This means that the design of the interactive aspects of the chatbot is satisfactory to users enough for their chatbot related needs and preferences.

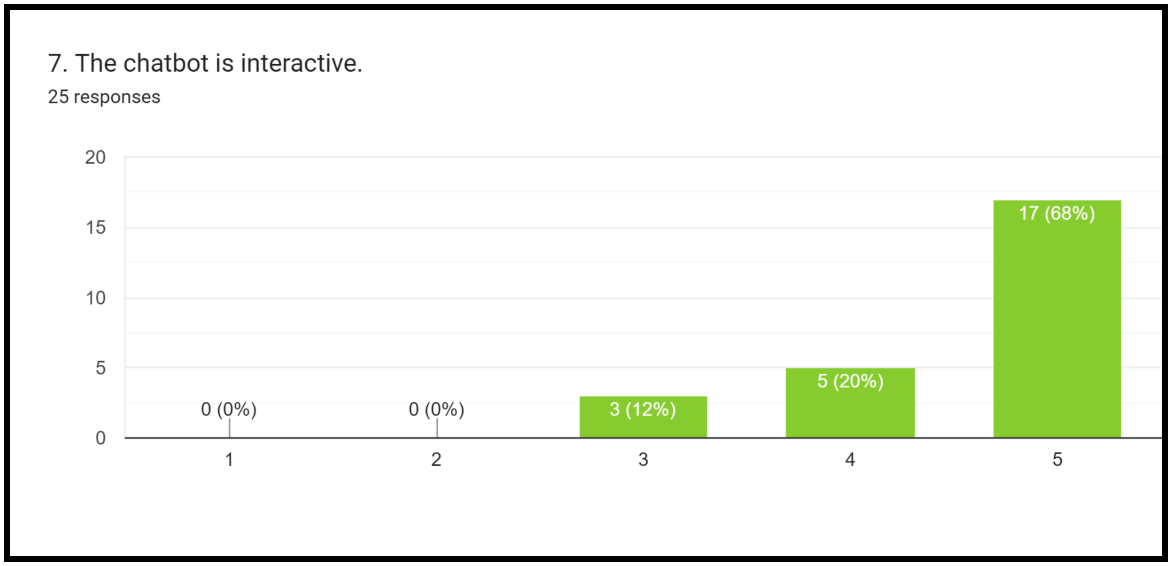


Figure 56. The chatbot is interactive

About 88% of respondents think that the chatbot is interactive enough for them to receive enough stimulation that feels like a human or an intelligent help support service, having a mean total of 4.56. This suggests that the perception of the users towards the MyDCampus chatbot is more often seamless and smooth and not heavily mechanical or non-emotive.

Responsiveness

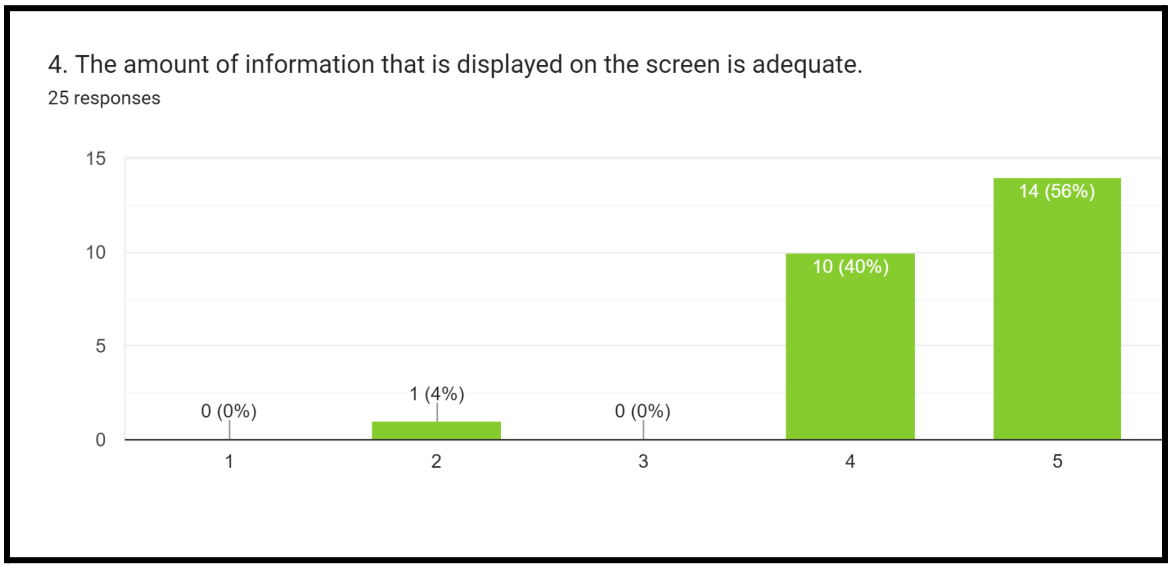


Figure 57. The amount of information that is displayed on the screen is adequate

Ninety six (96%) of the respondents agree on the chatbot being able to respond adequately to their queries, with an average total of 4.48. This displays the effectiveness of the chatbot to respond to user queries and provide outputs accordingly. The adequacy of the response helps in decreasing the possible user inconvenience that could be experienced, making the chatbot a better service overall.

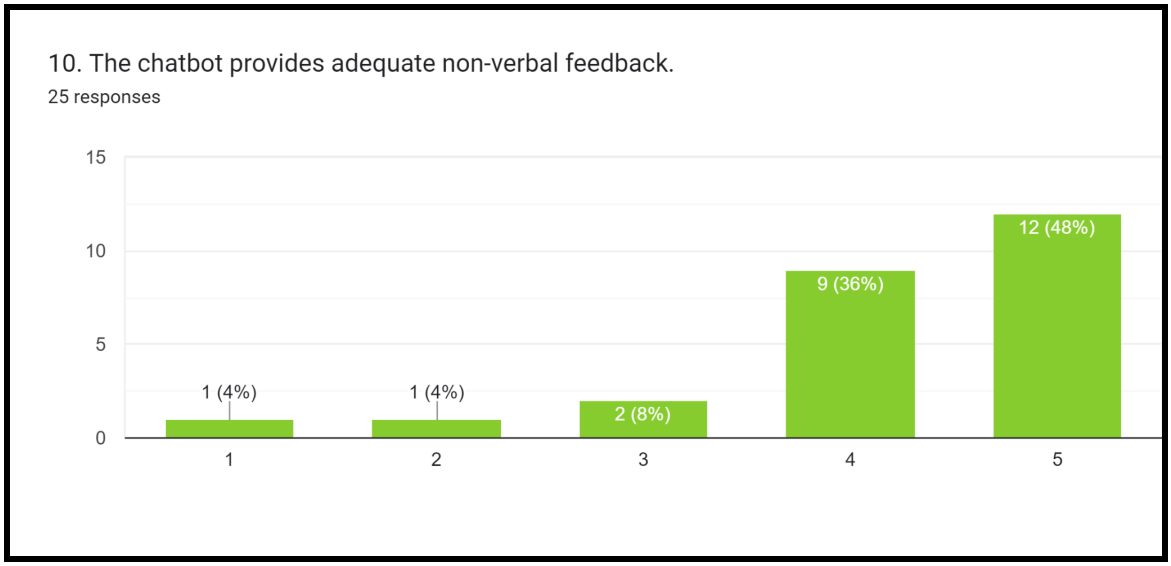


Figure 58. The chatbot provides adequate non-verbal feedback

About 84% of the respondents agree that the chatbot is able to provide the right amount of non-verbal feedback while using it. This item recieved an average total of 4.2. The data shows that the chatbot indicators, sounds, and other visual aids have been enough for most users to be satisfied and engaged with the conversation. However, there is still room for improvement towards the non-verbal aspect of the chatbot communication, as 16% of the respondents feel neutral or disagree about its adequacy during the conversation flow.

User Demographic on Chatbot Quality Factors

Table 22. Transformed Values of Categorical User Demographic Variables

Age	Transformed Values
18 - 24	0
40+	1
Gender	
Female	0
Male	1
Type of MyDCampus User	
Parent	0
Student	1
Physical Hindrances	
No	0
Yes	1
Existing Physical Hindrances	
None	0
Poor Eyesight	1
Experience with Technology	
Average Proficiency	0
Above Average Proficiency	1
High proficiency	2

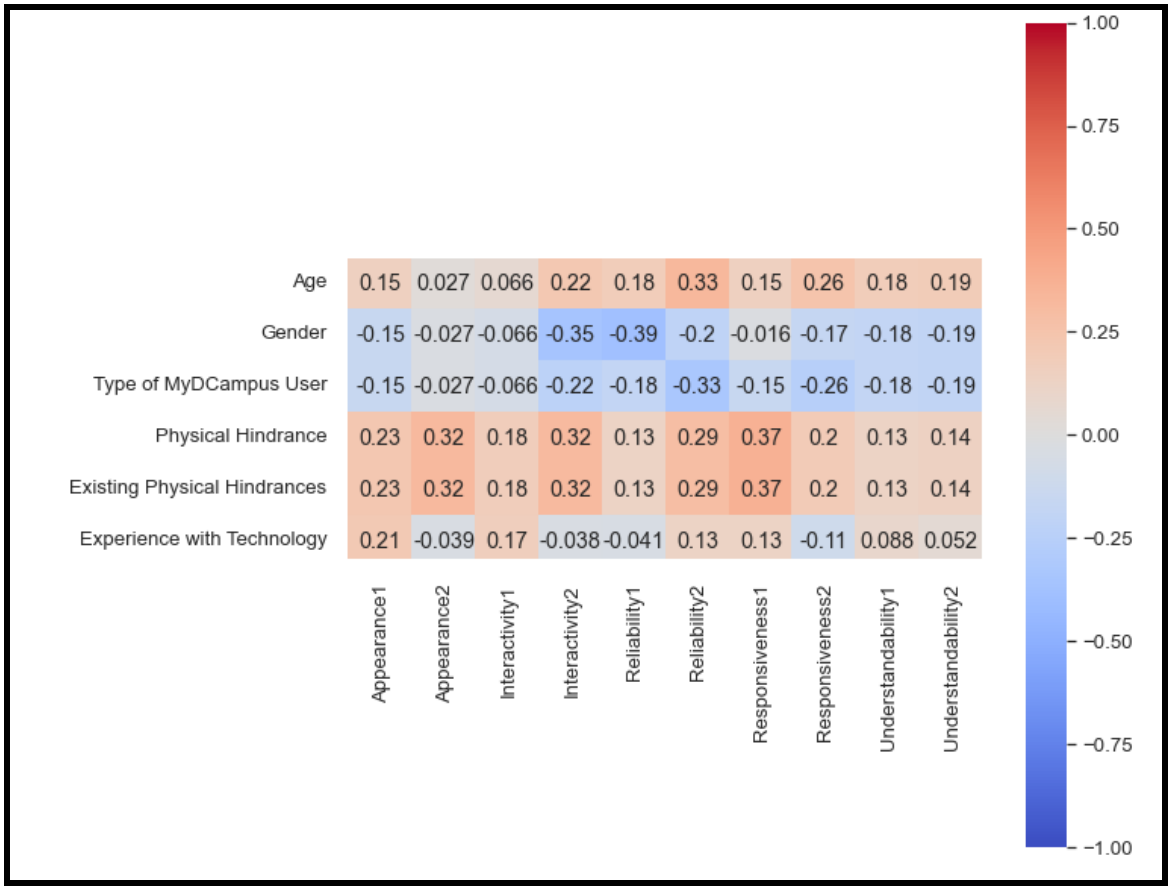


Figure 59. Correlation Heatmap of User Demographics and Quality Factors for Chatbot User Experience

In Figure 57, a heatmap is displayed which shows the correlation between the moderating variables of user demographic and the chatbot evaluation responses that represent the chatbot's five quality factors of appearance, interactivity, reliability, responsiveness, and understandability. It could be seen that the demographics which have a comparatively significant positive correlation to the quality factors involve the user's possible physical hindrances which affects the user's perception of appearance ("*It is easy to know what to do at*

each moment" - 0.23, "The arrangement of information on the screen is logical." - 0.32), interactivity ("*The chatbot is interactive" - 0.32)*, reliability ("*The chatbot complements the activities without distracting or interfering with them" - 0.29)*, and responsiveness ("*The amount of information that is displayed on the screen is adequate" - 0.37, "The chatbot provides adequate non-verbal feedback" - 0.2)*, all with weak positive correlation. Considering that most respondents of the UAT did not have any existing physical hindrances, it could be concluded that users who are not physically challenged were able to appreciate the quality factors of the chatbot more. From such, striving for more accessible design and functionalities is crucial to maximize the acceptability of the chatbot system.

The user's age has also shown a fair amount of weak positive correlations on interactivity ("*The chatbot is interactive" - 0.22)*, reliability (*"The chatbot complements the activities without distracting or interfering with them" - 0.33)*, and responsiveness (*"The chatbot provides adequate non-verbal feedback" - 0.26)*. This indicates that the older the user demographic of the chatbot, there is a more visible appreciation or acceptance of the chatbot when it has the capability to be reliable and interactive.

Aside from this, there are minor weak positive correlation with the user's experience with technology towards one's perception of appearance ("*It is easy to know what to do at each moment" - 0.21)*, indicating that users who are familiar with technology and how it generally looks like are more capable of knowing what to do with the chatbot service at any given moment.

In terms of negative correlation, gender and type of MyDCampus user have shown to have the most significance comparatively. For gender, there is a weak negative correlation on interactivity ("*The chatbot is interactive*" - *-0.35*) and reliability ("*The chatbot reacts in a consistent way" - -0.39, "The chatbot complements the activities without distracting or interfering with them" - -0.2)*. The results may indicate that males may have more negative perceptions on the chatbot's interactivity and reliability compared to female respondents. However, due to an imbalance of user respondents in terms of gender, such an assumption does not hold as much validity at the moment.

For the type of MyDCampus user, there are weak negative correlations on interactivity (*"The chatbot is interactive" - -0.22)*, reliability (*"The chatbot complements the activities without distracting or interfering with them" - -0.33)*, and responsiveness (*"The chatbot provides adequate non-verbal feedback", --0.26)*. It could be assumed from the results that it could be due to the fact that MyDCampus students can be more critical over the interactivity, reliability, and responsiveness of the chatbot service for their DLSL and MyDCampus related needs. However, similar to the case with gender correlations, there is an imbalance in user respondents that could have caused a degree of bias towards student opinions.

Chapter 5

CONCLUSION AND RECOMMENDATION

Summary of Findings and Accomplishments

This paper aims to develop and provide a functional and satisfactory online help service in the MyDCampus website that would help centralize DLSL and MyDCampus related information and inquiry solutions as well as to make that information more accessible to MyDCampus users. The researchers of this paper have successfully developed the chatbot software that adequately performs the objectives stated within the First Chapter of the study. Alongside this, the Related Literature and Studies of Chapter Two helped the proponents of the project in formulating the conceptual framework of the paper, which built the foundation for the development of the chatbot service itself.

With the design and methodology established in Chapter Three, alongside the software and tools used for development, the proponents were able to utilize algorithms such as Intent Classification, Slot Identification, and Entity Extraction to accomplish the needed functionalities and objectives to finish the chatbot's development. These algorithms assisted in determining the right user intents and entities essential for conveying the right information between chatbot and user, which allowed it to achieve the appropriate chatbot quality and user satisfaction requirements.

The software test of the chatbot resulted in an overall success with a “PASSED” rating across all software test cases. Alongside this, the UAT resulted with a “STRONGLY AGREE” rating of 4.548 for the chatbot evaluation, “AGREE” rating of 4.296 on the positive user satisfaction evaluation, and “DISAGREE” rating of 1.688 on the negative user satisfaction evaluation.

Conclusion

From the results of software test cases and UAT, it can be concluded that DLSL-affiliated students and parents perceived the MyDCampus chatbot project to be a positive addition and experience to the MyDCampus site. The existence of a chatbot system in the site proved to enhance the quality of MyDCampus site as a dashboard service, by having a chatbot that centralizes DLSL and MyDCampus related information as well as being an accessible help service to every user. This positive acceptance can also be attributed to the achievement of satisfactory ratings towards the quality factors of appearance, understandability, reliability, interactivity, and responsiveness in the chatbot design and implementation, as stated on the conceptual framework. Although there is a significant positive reception among the majority of user respondents, it is also clear from the UAT results that there is still plenty of room for improvement, particularly towards enhancing the user experience for better user satisfaction. From the following details, the proponents of the paper can conclude that the MyDCampus chatbot service performed and received well, has achieved its

objectives as a proof of concept, and is open for any future improvements in its online help capabilities.

Recommendations

Following the conclusions of the MyDCampus chatbot development and testing, the proponents of the paper recommend the following:

1. Expand the respondents in size and demographic type, considering that the UAT for this paper only included a number of 25 DLSL-affiliated respondents, with only 19 students and 6 parents. This means that the research data is not a complete representation of DLSL-affiliated users. A larger, more varied, and well-balanced sample size would be valuable in strengthening the general perception of DLSL-affiliated individuals or users to the chatbot system itself.

2. Considering the limitations indicated in chapter one, future researchers or developers taking on the same chatbot system task can try to attempt to expand the system to other DLSL outlets as well, such as through the main DLSL site itself, or incorporated through social media or messaging mediums. Furthermore, the proponents also recommend to pursue the capability of retaining user specific details, which would be valuable in making every user's chatbot experience unique and personalized to their preferences.

3. It is also recommended by the proponents that any related future project should try to utilize software or tools that have unlocked paid features in order to maximize the potential of the chatbot system for user satisfaction. This is due to the project being limited only to Botpress' non-enterprise features and

could not utilize features such as multi-language, human in the loop, and enterprise-grade support and security.

4. Incorporate more accessibility and quality of life features, such as voice recognition, text-to-speech functionalities, and an alternative Filipino language option for future developments with the chatbot system. This allows further expansion and improvement on the communication capabilities of the MyDCampus chatbot and be more adaptable handling different user conditions and inputs.

5. Extend analytics capabilities by building a dedicated dashboard that retrieves and monitors conversation data from the chatbot, such as user engagement, active session counts, most frequently used or interacted workflows and QnA, conversation messages, and error handling or understanding feedback information. This would allow more personalized monitoring and information gathering most valuable to the development team.

APPENDIX A

Survey for the Evaluation of the MyDCampus website and its ICT support and the Concept and Perception on an AI Chatbot System

Thank you for deciding to participate in our survey, which will revolve around the MyDCampus site and its ICT Help Support website feature, and the concept and perception on an AI chatbot system. The results of this survey will serve to provide us insights for our research in Thesis and its project requirements, which is titled "An AI Chatbot System for Tech Support in the MyDCampus Website of De La Salle Lipa using Expert System and Natural Language Processing Techniques". This survey will only take several minutes of your time. All survey data that will be procured from this survey will be only used for the purposes of the study and will be kept confidential. We would greatly appreciate your honesty on answering our questionnaire.

* Required

1. Respondent Information
   Email *
   Age *
   Mark only one
   - Under 18
   - 18-24
   - 25-30
   - 31-40
   - 40+

   Type of User *
   Mark only one
   - Grade School Student
   - Junior High School Student
   - Senior High School Student
   - College Student
   - Parent/Guardian
   - Dlsl faculty staff/member

   Existing physical hindrances/difficulties if present: *
   Check all that apply
   - Color Blindness
   - Hard at reading small text/poor eyesights
   - Poor hearing
   - Difficulty moving arms

- Dyslexia
- None
- Other:

How would you rate your experience using technology or computers? *
Mark only one

- I can use technology with ease, with little to no issues
- I can use computers mostly without support from others
- I can use computers decently, but sometimes need help from others
- I have a hard time using computers, and would often ask for support from others
- I require constant assistance when using computers

2. About MyDcampus
How frequent have you used the MyDCampus website?*
Mark only one

- Atleast once a day
- Atleast once in 3-4 days
- Atleast once in a week
- Atleast once in 2-3 weeks
- Atleast once a month
- Rarely, only when needed

How easy is it to navigate around the website?*
Mark only one

- I have little to no troubles with browsing the website
- I mostly can browse the website without needing help and support
- I can navigate decently, but sometimes would need help and support
- I have a hard time browsing the site and I would often look for help and support
- I require constant assistance when using the site

How easy is it to differentiate options from another when you first open the website?
Mark only one

- I have little to no issue differentiating options from each other
- I mostly can differentiate or distinguish options without needing help and support
- I can differentiate decently, but sometimes would need help and support
- I have a hard time differentiating between options and I would often ask for help and support

- I require constant assistance when differentiating or choosing between options

Rate how easy it is to find the option you want every time to visit the website.*
Mark only one
- I can find the option I want immediately everytime I visit the website
- I can find the option I want with minimal difficulty everytime I visit the website
- I can find the option I want in a decent amount of time but sometimes would need help and support
- I have a hard time finding the option I want to check when visting the website and I would often need to ask for help and support
- I require constant assistance in finding the option I want in the website

Rate how easy it is to tell what each option's purpose is when first seeing it.*
Mark only one
- I can easily see what an option is for when i first see it
- I can mostly find what an option is for without any help and support
- I can find the meaning decently, but sometimes I would need help and support
- I have a hard time finding what the options are for, and I would often need help and support
- I require constant assistance to know what the options in the site mean

Rate how straightforward is it to see where to check for help and support on the website?*
Mark only one
- I have little to no trouble finding where to get help and support guides in the website
- I can find where to get help and support guides in the website for the most part
- I can find the help and support, but I usually take time to know where
- I have a hard time finding where to get help and support in the website
- I don't know where to check help and support in the website

What are the 5 option(s) you frequently choose / use the most in the MyDCampus website?*
Check all that apply

- Appointment / Reservation systems
- Assessment Form / Enrollment / SOA
- Canvas LMS
- Cirriculum
- De La Salle Website
- DLSL Email
- ICT Support
- Library Online Subscription
- Microsoft Office 365 Services
- News & Events
- Term Break Assessments
- Viewing of Grades
- Other:

What kind of issues have you encountered in the MyDCampus site?

(check all that apply)*

- Confusing Interface
- The options always look confusing to search through
- I often don't understand what plenty of the options are for
- The options or services in the site often does not work or function properly
- It is difficult for me to find help and support to my problems
- There is no way of communicating to ICT support regarding site issues in the website
- I have no issues with the site so far / I have not used the ICT help site
- Other:

3. About the ICT FAQ page
How frequently do you visit and use the ICT help support?*
Mark only one

- Atleast once a week
- Atleast once every 2-3 weeks
- Atleast once every 1-2 months
- Atleast once every semester
- I have not yet used the ICT help support

How easy is it to navigate around the ICT help support website and searching solutions in it?*
Mark only one

- I have no issues navigating and using the ICT website
- I mostly have no issues navigating and using the ICT website

- I can navigate the ICT website enough for solutions, but i still get confused sometimes
- I have a hard time navigating and finding the solution I need ini the ICT website, the website is confusing to look at
- I require constant assistance in order to navigate and get my solutions in the ICT website
- I have not yet used the ICT help support

Rate the ease of use of the ICT help support website*
Mark only one

- The ICT help support website is very easy to use
- The ICT help support website is mostly easy to use
- The ICT help support is easy to use but sometimes get confusing
- The ICT help support is often difficult to use
- I need constant assistance when trying to use the ICT help support site
- I have not yet used the ICT help support

Rate the frequency of your DLSL related questions being answered by the ICT help support site*
Mark only one

- There are always solutions to my questions everytime I use the ICT help support site
- Most of the time I get solutions for my questions in the ICT help support site
- The site provides answers to my questions time to time, but many times I can't find the solution
- I always don't get solutions to my questions in the ICT help support site
- The site has never given me answers to the questions I had
- I have not yet used the ICT help support

Check the following concerns you have checked / used the ICT help desk for*
Check all that applies

- DLSL Email related issues / Student Account issues
- Wi-Fi issues
- Canvas related issues
- MyDCampus portal issues
- Office 365 issues
- I haven’t gotten issues for me to need ICT help and support / I have not used the ICT help site
- Other:

Rate how useful or effective the ICT help desk in addressing your issues.*
Mark only one

- Always useful and effective
- Mostly useful and effective
- Average usefulness and effectiveness
- Somewhat useful and effective
- Never useful and effective
- I have not yet used the ICT help support

Did you have issues related to DLSL services or MyDcampus site that was not addressed in the ICT help support or you don't know how to address/solve?*
Mark only one

- Yes
- No

If you answered "yes" in the previous question, please specify those issues. If "no", write N/A*
Write your answer

How easy is it to follow the instructions among the solutions in the ICT helpdesk website?*
Mark only one

- The instructions in the solutions of the ICT help support are very clear and easy to follow
- The instructions in the solutions of the ICT help support are mostly easy to follow
- The instructions are decent and can be followed, although sometimes difficult to
- The instructions are often difficult to follow
- I require constant assistance to do the instructions
- I have not yet used the ICT help support solutions or site

Check the following issues that made following instructions difficult for you:*
Check all that applies

- Lack of the use of Filipino as language of instruction
- Lack of accessibility or ease of use features to make following instructions easier for me
- Lack of interactivity in the instruction
- Instruction looks messy to follow
- Lack of video tutorial for the instruction
- The instructions are outdated
- Instruction images are too small to see/not clear enough

- I have not used the ICT help site or its instructions
- Other:

When using the ICT help desk, how long does it usually take you in attempting the solution you are looking for?*
Mark only one

- Very quickly, only a few seconds
- 1-2 minutes
- 5-10 minutes
- 10+ minutes
- I have not used the ICT help site

Rate your satisfaction on how ICT support provides its solutions to you*
Mark only one

- High Satisfaction
- Above Average Satisfaction
- Average Satisfaction
- Low Satisfaction
- Minimal Satisfaction
- I have not tried ICT support yet

3. About Rule Based Chatbots for the MyDCampus website
How familiar are you with chatbot tech support systems?*
Mark only one

- Never used one before
- Have some experience with them
- Frequently use them for help and support whenever they are present in a site
- Other:

Do you have any previous experience interacting with chatbot tech support?*
Mark only one

- Yes
- No

How would you rate your experience with AI chatbots?*
Mark only one

- High Satisfaction
- Above Average Satisfaction
- Average Satisfaction
- Low Satisfaction
- Minimal Satisfaction
- I have not tried chatbots yet

How would you rate the usefulness of chatbots in addressing your concerns?*
Mark only one

- High Usefulness
- Above Average Usefulness
- Average Usefulness
- Low Usefulness
- Minimal Usefulness
- I have not tried chatbots yet

What is your initial impression of this type of automated customer support system?*
Mark only one

- I am still skeptical about it
- I am interested and might give it a try
- I will definitely take advantage of this
- Other:

What do you think the most about implementing an AI chatbot in the MyDCampus website to address site and DLSL related concerns?*
Mark only one

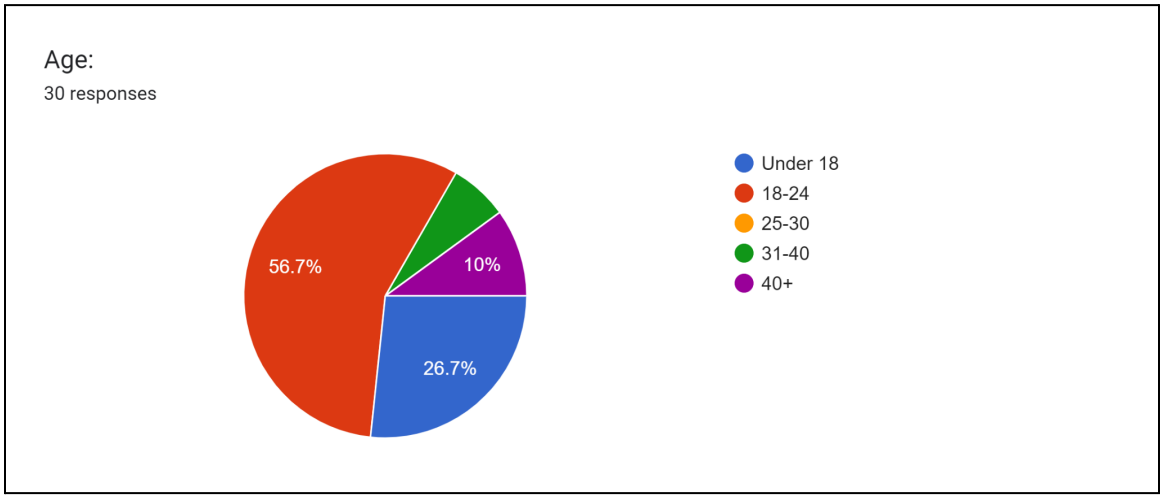
- Great, it would be very helpful for everyone's general help and support use
- Great, it would help make the site's help and support be more inclusive and accessible for people who are physically challenged and/or needs assistance in using technology
- I think it would be significantly helpful for others but I don't see myself using it often
- I don't think it would make much of a difference, as the current DLSL support system is enough
- I think it is an okay feature to add
- Other:

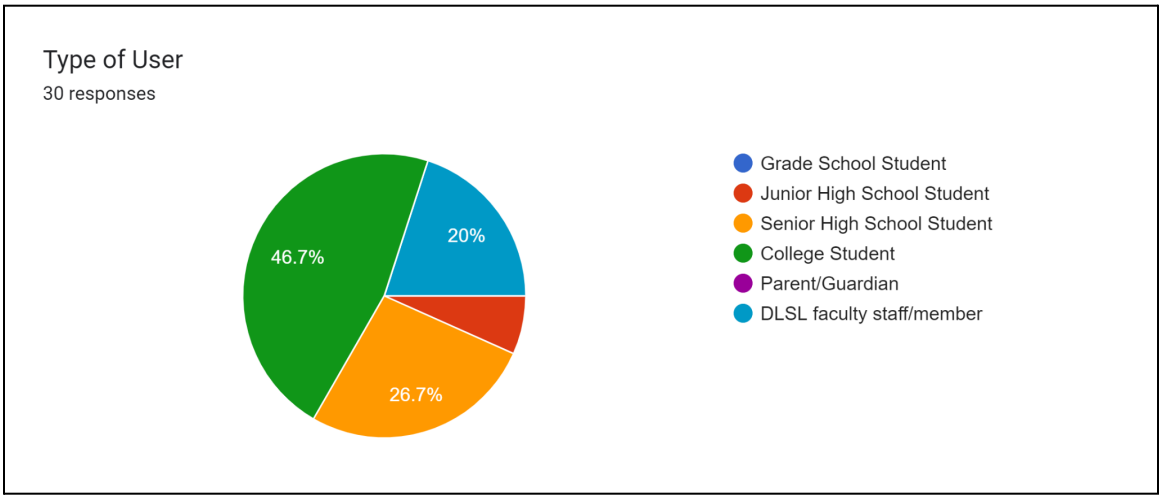
Would you prefer to use a chatbot over the current ICT help desk system?*
Mark only one

- Yes, I would prefer it over the current one
- No, I am fine with the current ICT support
- I'm fine with both existing and collaborating/integrating with each other to maximize the service for users
- Other:

APPENDIX B

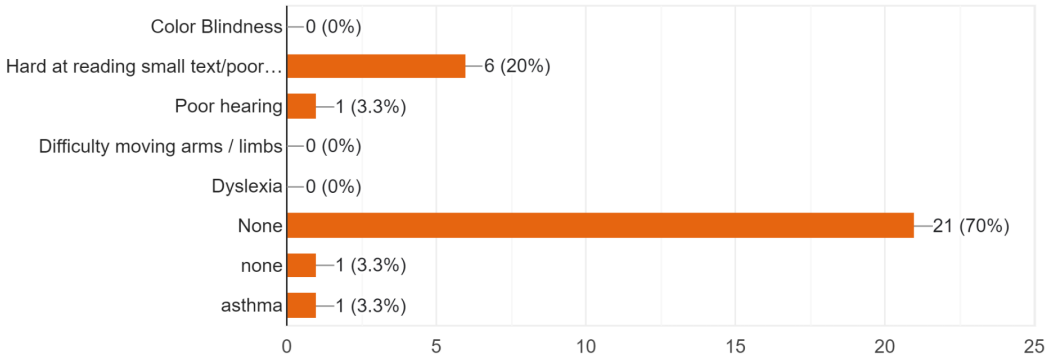
Requirements Analysis Survey Results





Existing physical hindrances/difficulties if present:

30 responses

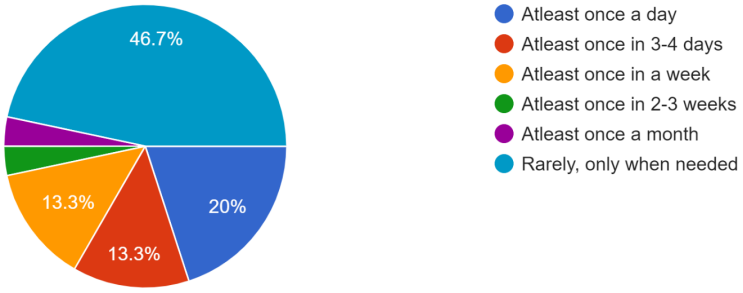


How would you rate your experience using technology or computers?

30 responses

How frequent have you used the MyDCampus website?

30 responses

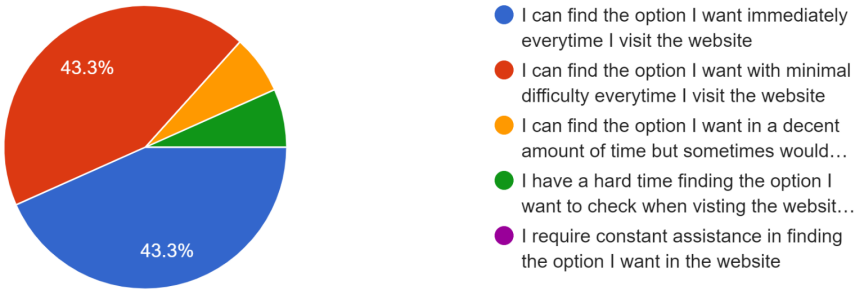


How easy is it to differentiate options from another when you first open the website?

30 responses

Rate how easy it is to find the option you want every time to visit the website.

30 responses

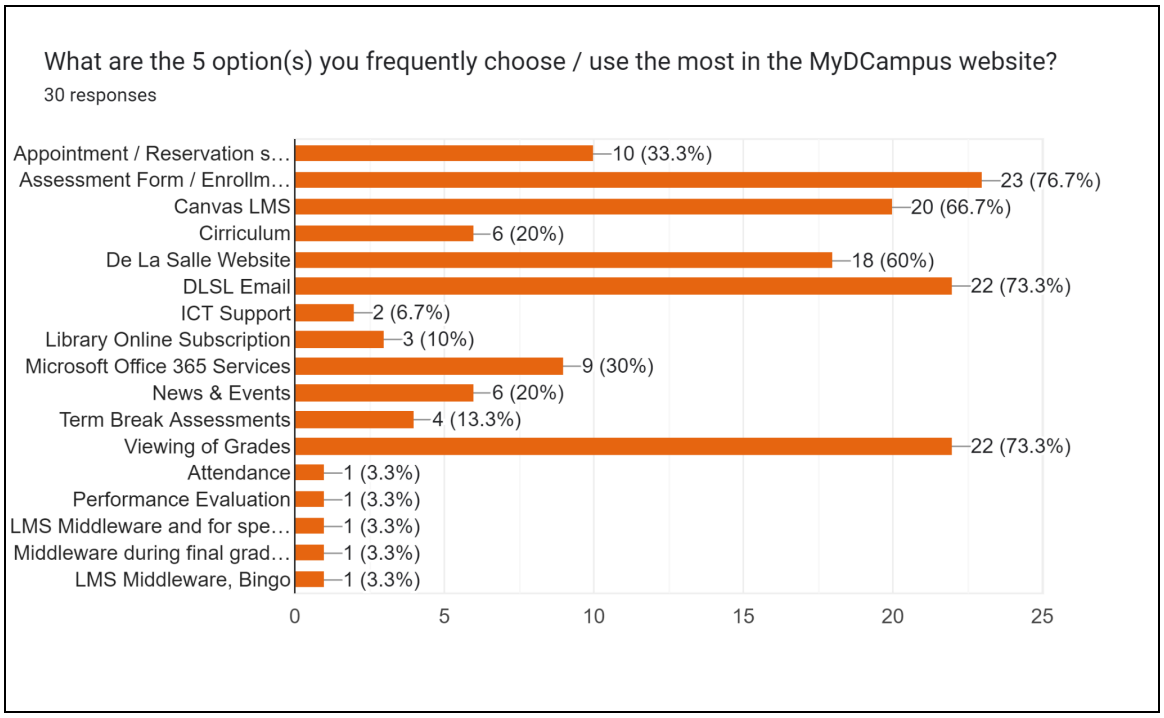


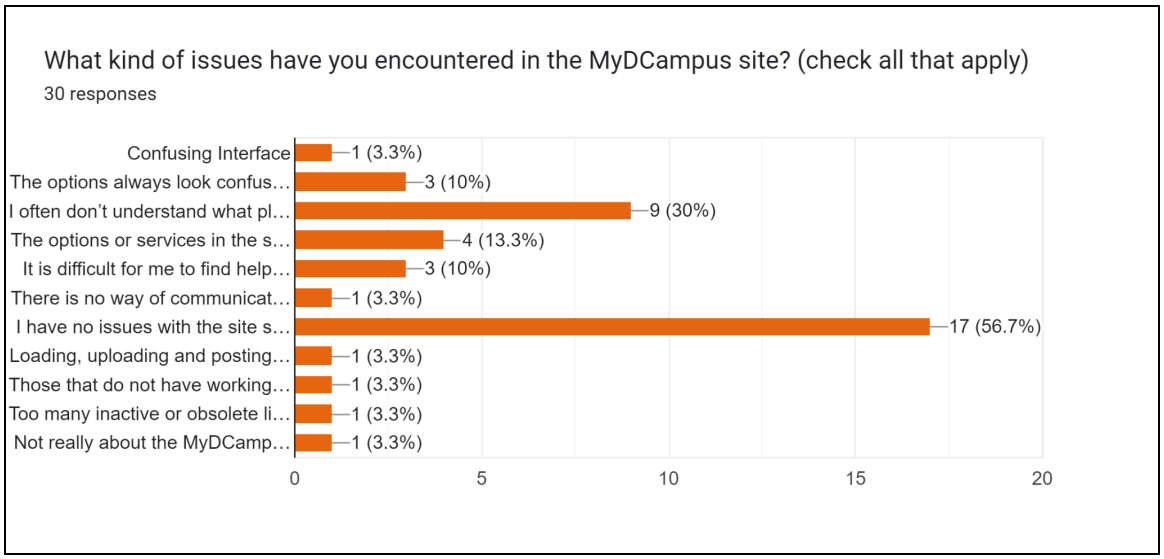
Rate how easy it is to tell what each option's purpose is when first seeing it.

30 responses

Rate how straightforward is it to see where to check for help and support on the website?

30 responses


What are the 5 option(s) you frequently choose / use the most in the MyDCampus website?
30 responses
Appointment / Reservation s…
Assessment Form / Enrollm…
Canvas LMS
Cirriculum
De La Salle Website
DLSL Email
ICT Support
Library Online Subscription
Microsoft Office 365 Services
News & Events
Term Break Assessments
Viewing of Grades
Attendance
Performance Evaluation
LMS Middleware and for spe…
Middleware during final grad…
LMS Middleware, Bingo
10 (33.3%)
23 (76.7%)
20 (66.7%)
6 (20%)
18 (60%)
22 (73.3%)
2 (6.7%)
3 (10%)
9 (30%)
6 (20%)
4 (13.3%)
22 (73.3%)
1 (3.3%)
1 (3.3%)
1 (3.3%)
1 (3.3%)
1 (3.3%)
0
5
10
15
20
25


What kind of issues have you encountered in the MyDCampus site? (check all that apply)
30 responses
Confusing Interface
The options always look confus…
I often don't understand what pl…
The options or services in the s…
It is difficult for me to find help…
There is no way of communicat…
I have no issues with the site s…
Loading, uploading and posting…
Those that do not have working…
Too many inactive or obsolete li…
Not really about the MyDCamp…
1 (3.3%)
3 (10%)
9 (30%)
4 (13.3%)
3 (10%)
1 (3.3%)
17 (56.7%)
1 (3.3%)
1 (3.3%)
1 (3.3%)
1 (3.3%)
0
5
10
15
20

How frequently do you visit and use the ICT help support?

30 responses

How easy is it to navigate around the ICT help support website and searching solutions in it?

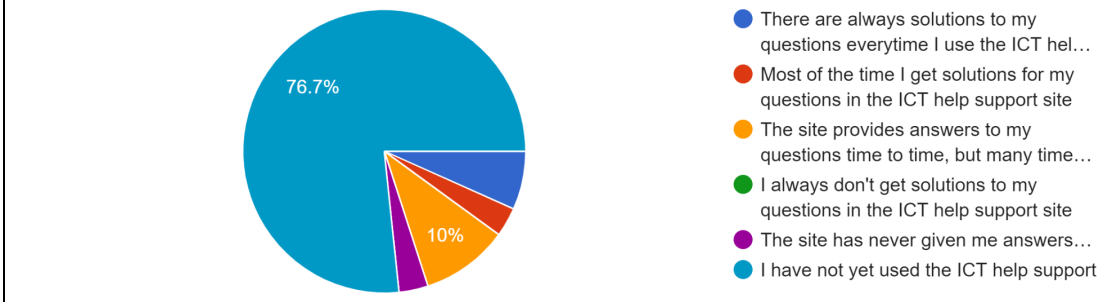
30 responses

Rate the ease of use of the ICT help support website

30 responses

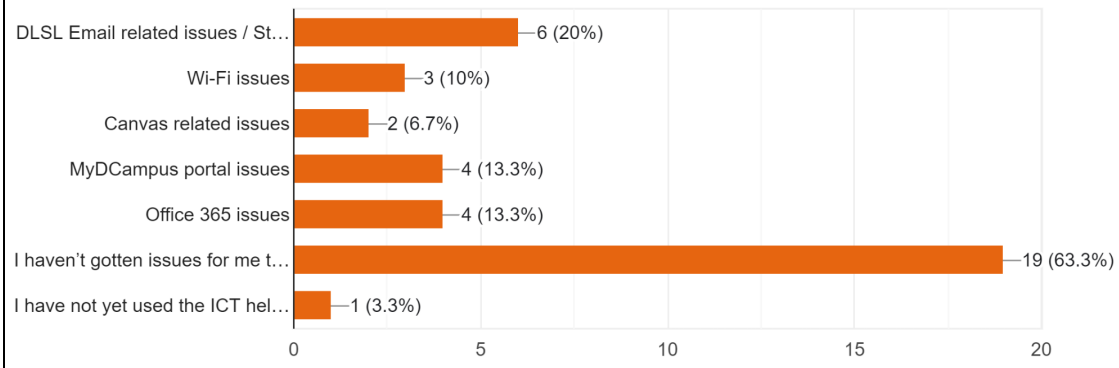
Rate the frequency of your DLSL related questions being answered by the ICT help support site

30 responses



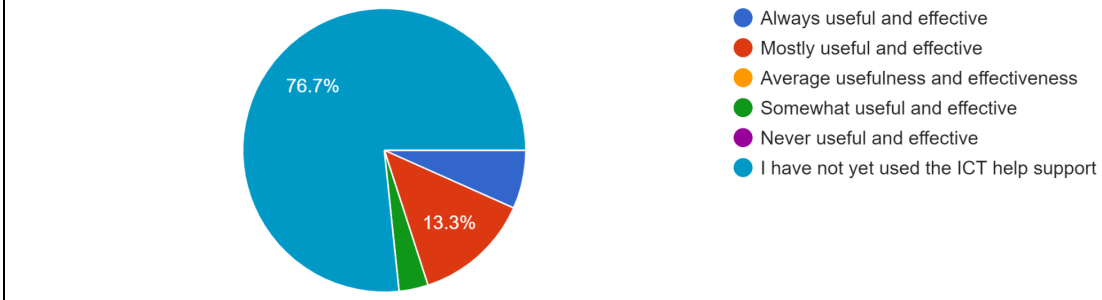
Check the following concerns you have checked / used the ICT help desk for

30 responses



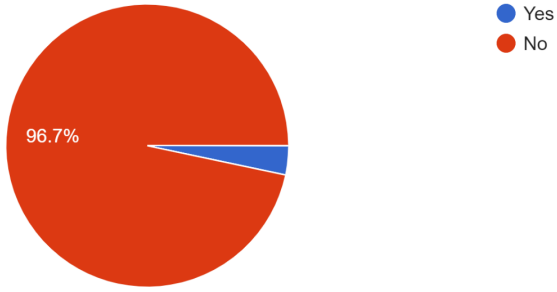
Rate how useful or effective the ICT help desk in addressing your issues.

30 responses



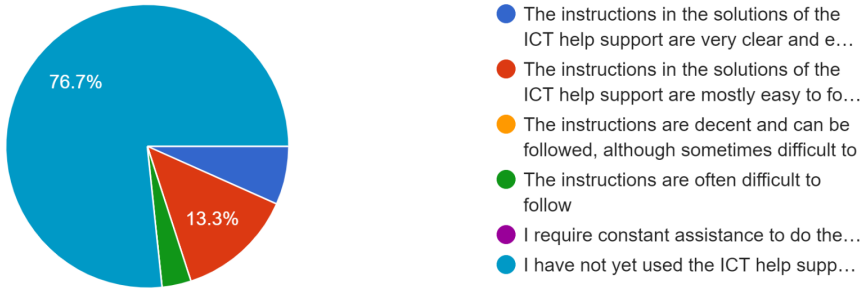
Did you have issues related to DLSL services or MyDcampus site that was not addressed in the ICT help support or you don't know how to address/solve?

30 responses



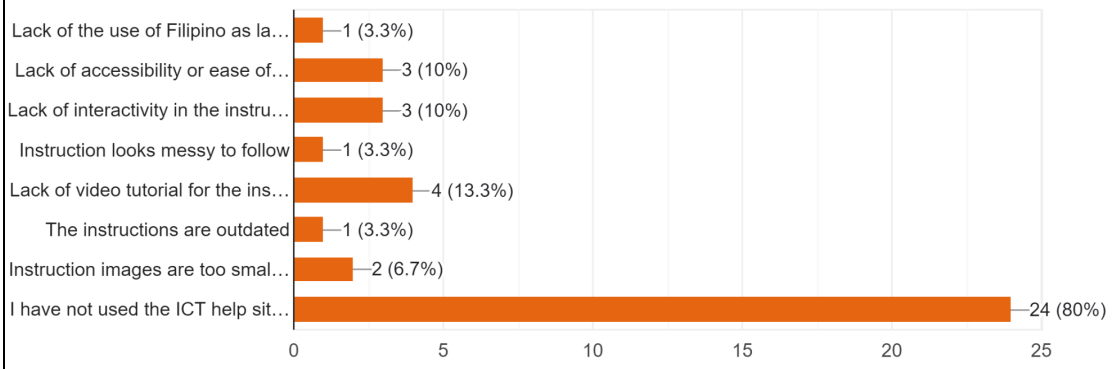
How easy is it to follow the instructions among the solutions in the ICT helpdesk website?

30 responses



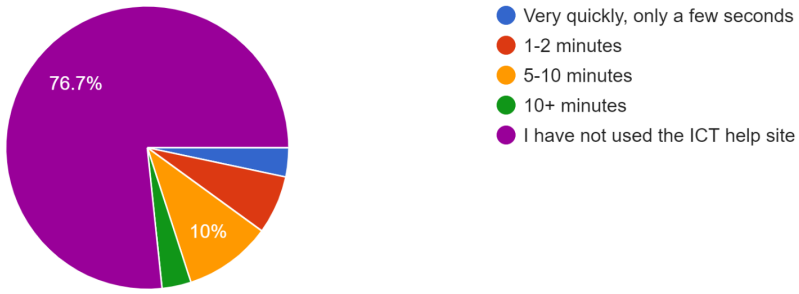
Check the following issues that made following instructions difficult for you:

30 responses



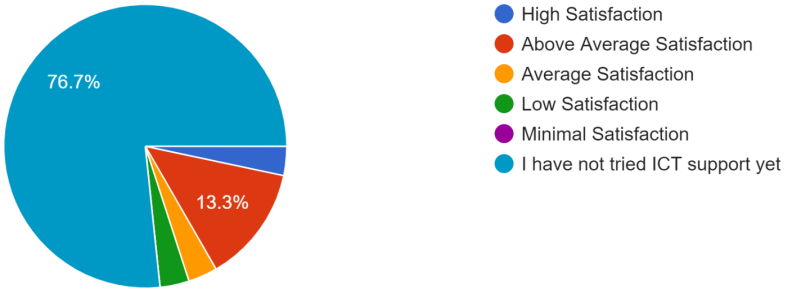
When using the ICT help desk, how long does it usually take you in attempting the solution you are looking for?

30 responses



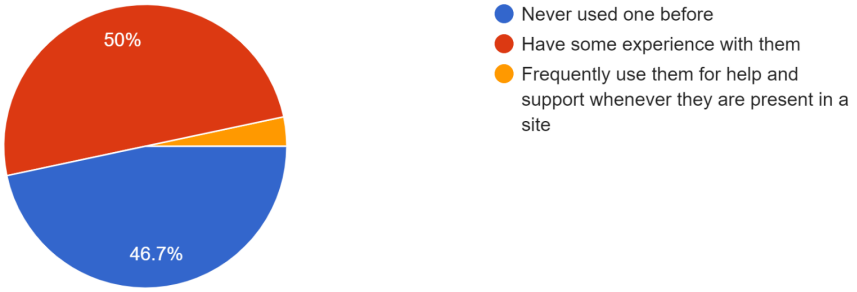
Rate your satisfaction on how ICT support provides its solutions to you

30 responses



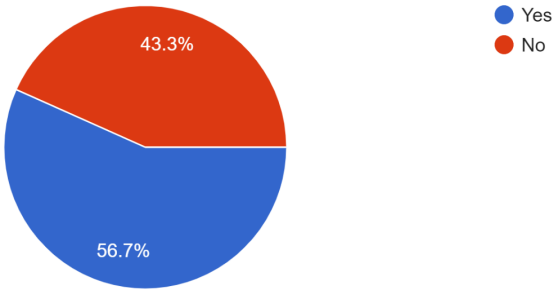
How familiar are you with chatbot tech support systems?

30 responses



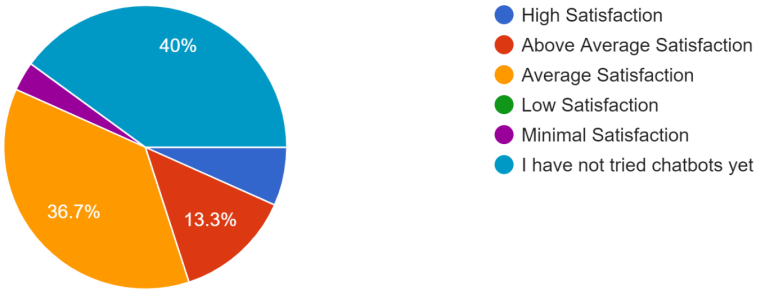
Do you have any previous experience interacting with chatbot tech support?

30 responses



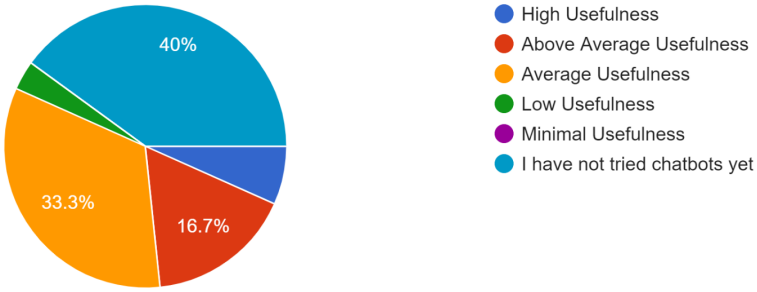
How would you rate your experience with AI chatbots?

30 responses



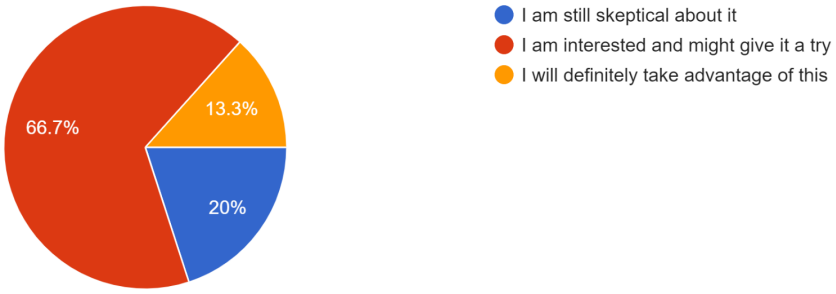
How would you rate the usefulness of chatbots in addressing your concerns?

30 responses



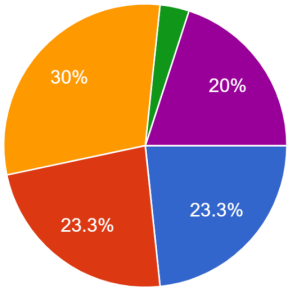
What is your initial impression of this type of automated customer support system?

30 responses



What do you think the most about implementing an AI chatbot in the MyDCampus website to address site and DLSL related concerns?

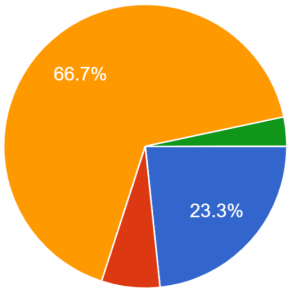
30 responses



- Great, it would be very helpful for everyone's general help and support use
- Great, it would help make the site's help and support be more inclusive and ac…
- I think it would be significantly helpful for others but I don't see myself using it o…
- I don't think it would make much of a difference, as the current DLSL suppo…
- I think it is an okay feature to add

Would you prefer to use a chatbot over the current ICT help desk system?

30 responses



- Yes, I would prefer it over the current one
- No, I am fine with the current ICT support
- I'm fine with both existing and collaborating/integrating with each other to maximize the service for users
- I want both like in Globe using chatbot and a IT assistant.

APPENDIX C

Unit Test Cases

Test Case ID	Module ID	Test Scenario	Test Steps	Test Data	Expected Result
1	001	Send text to the text window	1. Press the chatbot icon to open the chat window 2. Input text in the textbox and press enter	Displayed text inside the chat window view	The text window / display of the chatbot shows the text input of the user and chatbot respectively.
2	001	Type email address to appear in text window	1. Press the chatbot icon to open the chat window 2. Input email address in the textbox and press enter	Displayed email address in hyperlink format	The email address is visible and no visual bug conflicts with chatbot theme
3	002	Press the chatbot icon	1. Press the chatbot icon to open the chat window	Click on the chatbot icon	The chatbot interface window will be displayed on the right side of the webpage
4	002	Press the settings option	1. Press the chatbot icon to open the chat window	Click on the settings button	Choices for chatbot settings will be displayed, displaying

			2. Press the settings button		themes and accessibility options
5	002	Press DLSL Colors 1 and DLSL Colors 2 options	1. Open chatbot window and press settings button 2. Press DLSL Colors 2 option and then DLSL Colors 1 option next	Click on the DLSL color options	Chatbot window colors swap between two color variations
6	002	Press Neutral Textbox option	1. Open chatbot window and press settings button 2. Press Neutral Textbox option	Click on the Neutral Textbox option	Chatbot window textbox changes from default look to neutral look
7	002	Press Tall Chatbox option	1. Open chatbot window and press settings button 2. Press Tall Chatbot option	Click on the Tall Chatbot option	Chatbot window changes from default size to tall setting
8	002	Press Toggle dark theme option	1. Open chatbot window and press settings button 2. Press Toggle dark theme option	Click on the Toggle dark theme option	MyDCampus dashboard and chatbot window interface changes from default theme to dark theme

9	002	Press Zoom-in chatbot option	1. Open chatbot window and press settings button 2. Press Zoom-in chatbot option 1-3 times 3. Press the option a 4th time	Click on Zoom-in chatbot option	Chatbot window interface will be zoomed in depending on the number of clicks between 1-3; resets at the 4th click
10	002	Press the High Contrast option	1. Open chatbot window and press settings button 2. Press High Contrast option	Click on High Contrast option	Chatbot window changes from default theme to high contrast look
11	002	Press the query option	1. Press the chatbot icon to open the chat window 2. Input a chat in the textbox and enter 3. Press a query option provided	Click on a query option	The option is functional and the chatbot provides a response

12	002	Press the exit button	1. Press the chatbot icon to open the chat window 2. Press the exit button	Click on the exit button	The chatbot window minimizes and only the chatbot icon is left
13	003	Type a long input into the textbox	1. Press the chatbot icon to open the chat window 2. Input text in the textbox	Unsent text in the textbox	The text box can visibly hold the all the text input correctly
14	004	Make the chatbot send an image response	1. Press the chatbot icon to open the chat window 2. Input query that results into an image response	Displayed image in the chat window	The chat window is able to display and hold the image response at the correct place and size

APPENDIX D

Integration Test Cases

Test Case ID	Module ID	Test Scenario	Test Steps	Test Data	Expected Result
01	005	Receive options for rule-based query	1. Open the chatbot window 2. Press "*Sure, I prefer having choices along the way.*" option	Specific button press for rule-based query	The chatbot will greet back and provide rule-based options in the chat window
02	005	Asking a query through options	1. Open the chatbot window and press "*Sure, I prefer having choices along the way.*" option 2. Follow through a conversation flow by selecting multiple choices	Values from a selection of multiple options	The chatbot will progressively show and give the user options based on their previous choices, which will lead to displaying the solution response based on user

					choice
03	005	Navigate through the conversation with *back*, *more or previous choices*, and *I can't find my solution* options	1. Perform a normal conversation flow using predefined options 2. Press *back*, *more choices*, *previous choices*, and *I can't find my solution* choices when available	Specific navigational choice selection	Pressing *back* returns to a different previous set of questions; pressing *more/previous* choices proceeds to the other set of solutions; pressing *I can't find my solution* leads to asking user for alternative options
04	006	Receive options for free-text query	1. Open the chatbot window 2. Press "*No, I'll ask with my own words first.*" option	Specific button press for free-text query	The chatbot will greet back and provide instructions for free-text query in the chat window; the user will be

					able to type in the textbox
05	006	Performing casual smalltalk with the chatbot	1. Open the chatbot window and press "*No, I'll ask with my own words first.*" option 2. Input casual talk entry like "*how are you"* or "*tell me a joke"* into the textbox and enter	Free-text input from the user	The chatbot will provide a casual feedback to the user's input
06	006	Asking the chatbot about a DLSL-related or MyDCampus concern	1. Open the chatbot window and press "*No, I'll ask with my own words first.*" option 2. Input DLSL or MyDCampus related text input into the textbox and press enter	Intent and entity data from user input	The chatbot will provide a related response that corresponds to the identified and classified intent and extracted entity; slot filling would occur if no

					entity is found
07	006	Asking the chatbot an out of scope query	1. Open the chatbot window and press "*No, I'll ask with my own words first.*" option 2. Input out of scope query into the textbox and press enter	Input data from the user	The chatbot will provide a catch response for out-of-scope intents and allow the user to retry their input again; the input will be flagged and added into the misunderstood module logs for review
08	006	Navigate through the conversation flow by saying *back* and *restart*	1. Open the chatbot window and press "*No, I'll ask with my own words first.*" option 2. Input and enter any within scope query in the chatbot	Back or *restart* intent from user input	The chatbot will bring back the user to the start of the whole chatbot conversation with the back intent or bring the user back to the start of

			3. Input *restart* or *back* in the textbox and press enter.		the NLP conversation with restart intent

APPENDIX E

System Test Cases

Test Case ID	Module ID	Test Scenario	Objective	Test Steps	Test Data	Expected Result
1	007	Testing Website Embedding	To determine if the chatbot is properly connected to the website	1. Open the MyDCampus website 2. Check the bottom right corner of the site if the chatbot icon is present 3. Press the chatbot icon to open	Status of the Chatbot system in the website	The chatbot icon and interface are present and functional
2	007	Check for first-time user alert message from chatbot	To alert a first-time user of the MyDCampus user of the chatbot feature	1. Open the MyDCampus website as a new user	Status of the alert message in the website	The chatbot alert message is shown beside the icon

3	007	Check for proactive greeting from chatbot	To provide a welcoming and interactive experience to users	1. Open the MyDCampus website and open the chatbot window	Press input on chatbot icon	The chatbot will send a proactive greeting message to the user
4	007	Refresh website after conversation	To check whether the previous session will expire	1. Open the MyDCampus website and open the chatbot window. 2. Perform either rule-based or NLP conversation. 3. Refresh the website and open the chatbot window again,	Input text in the chatbot and press input on chatbot icon	Old session messages from chatbot will be cleared and conversation will return to initial settings
5	007	Test navigation between rule-based and NLP modules based on source	To see whether the user can return from the appropriate query method on nodes shared by	1. Open the MyDCampus website and open the chatbot window 2. Perform a conversation with rule-based flow until *I can't find my solution* choice appears and select the choice	Input text in the chatbot and press inputs on choices	The chatbot will redirect the user back to rule-based or NLP query depending on the source of

			both rule-based and NLP queries	3. Select on "*Okay, I'll just try searching for my solution again.*" or "*I'd like to check out the previous choices again.*" options to return to previous rule-based list of choices or return to start. 4. Perform free-text conversation and arrive at a recommendation of solution choices, then select "*I can't find my solution"*. 5. Repeat step 3 to return to the start of the free-text conversation.		the conversation flow
6	007	Test send email feature from either NLP or rule-based	To determine whether the user will be able to send an email to	1. Open the MyDCampus website and open the chatbot window 2. Inquire about send	Input email and content details and press input on choices	The chatbot will successfully send the email to the

		flows	the ICT email address	email process on either rule-based or NLP query 3. Input email address, concern details, and header information then select the confirm option		ICT email address and users will receive a receipt in their email account; chatbot will provide user options for repeating the process or ask for DLSL contact details when send email process fail
7	007	Changing chat interface theme and accessibility features	To determine if the chatbot theme and accessibility features can be configured in real time	1. Press the chatbot icon to open the chat window 2. Press the settings button on the topmost part of the interface 3. Select a theme option	Click on settings and theme option	The chatbot look will be configured based on the chosen theme

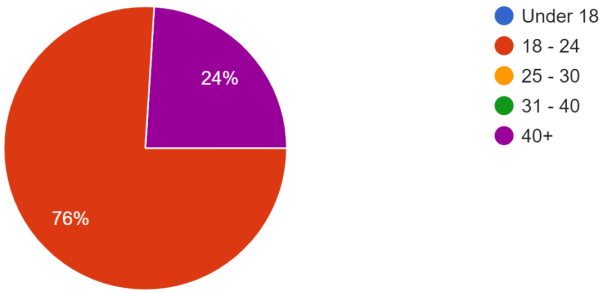
8	007	Test Chatbot with various queries	To determine if the chatbot is able to perform as expected	1. Press the chatbot icon to open the chat window 2. Use different choices and type various queries and questions into the textbox and enter	Various chatbot responses	The chatbot is able to determine the best possible answer

APPENDIX F

User Acceptance Test Results

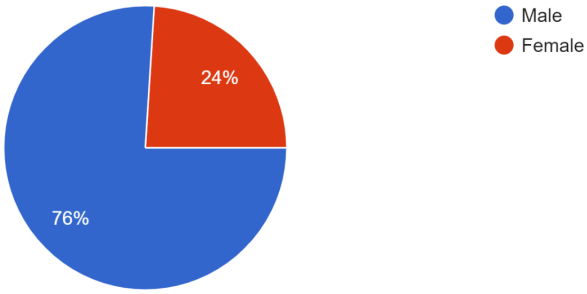
1. What is your age group?

25 responses



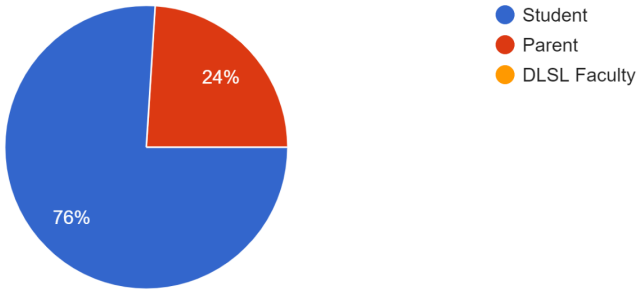
2. What is your gender at birth?

25 responses



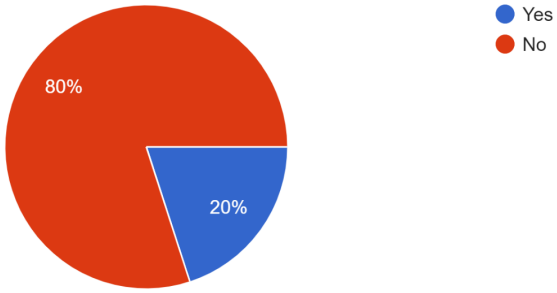
3. What kind of MyDCampus User are you?

25 responses



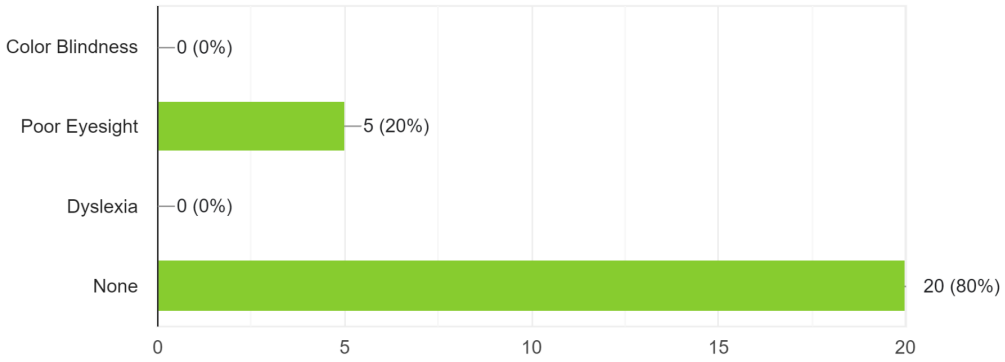
4. Do you have existing physical hindrances or difficulties?

25 responses



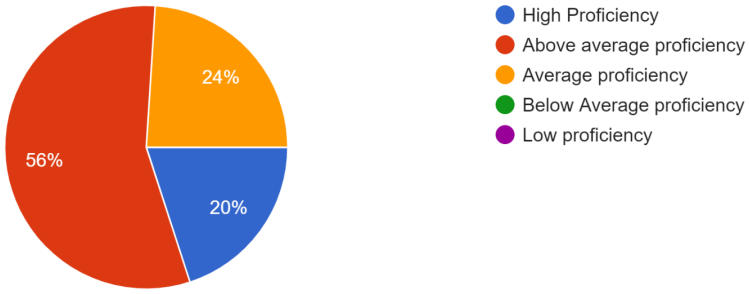
5. If yes, what physical hindrances are you experiencing?

25 responses



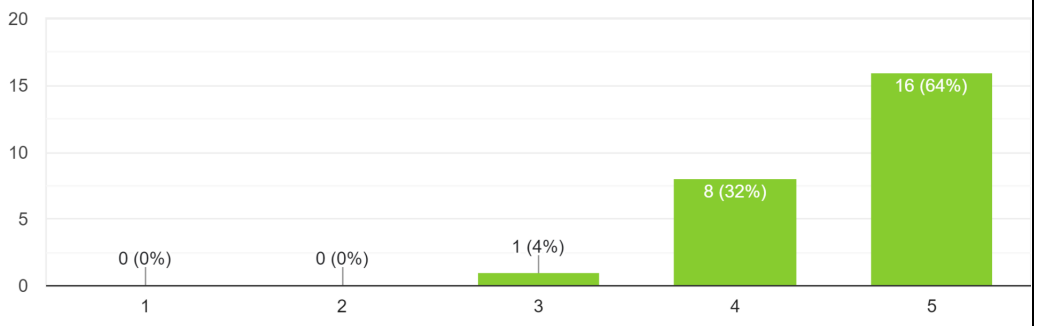
6. How would you rate your experience using technology or computers?

25 responses



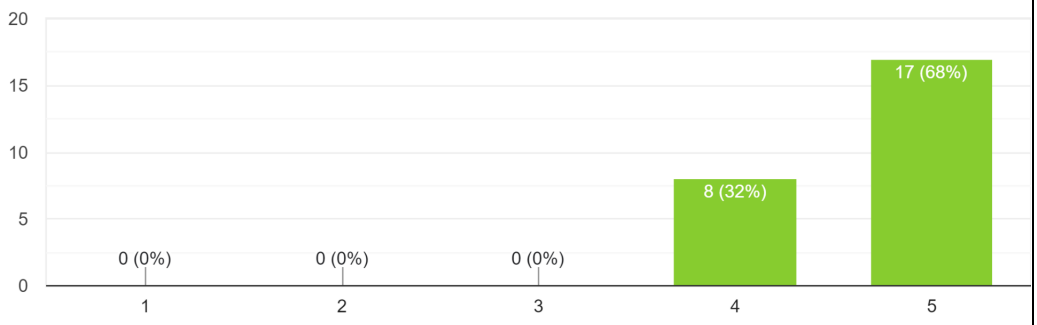
1. The system offers enough interactivity.

25 responses



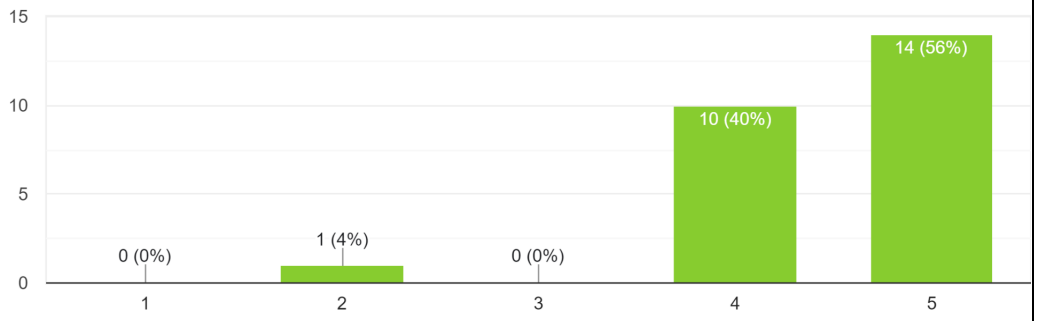
2. The system is easy to use.

25 responses



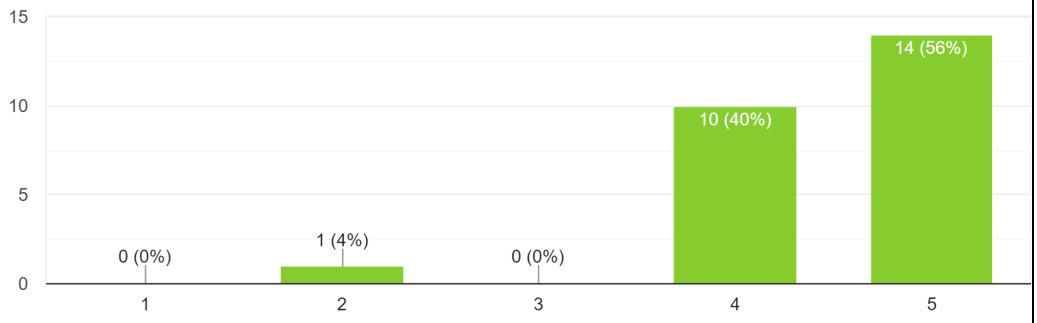
3. It is easy to know what to do at each moment.

25 responses



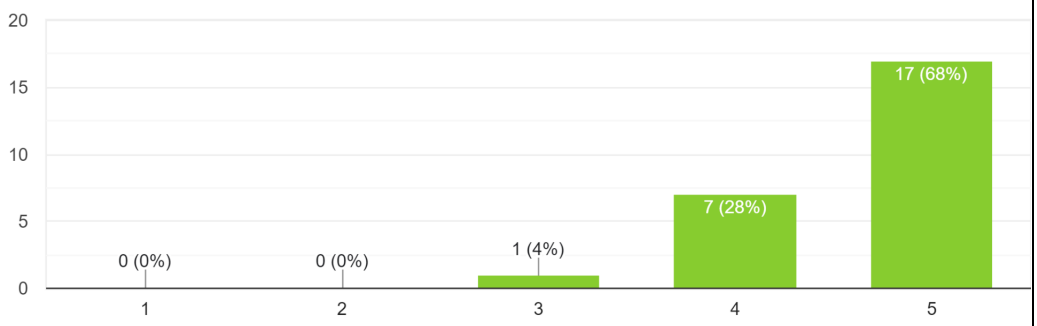
4. The amount of information that is displayed on the screen is adequate.

25 responses



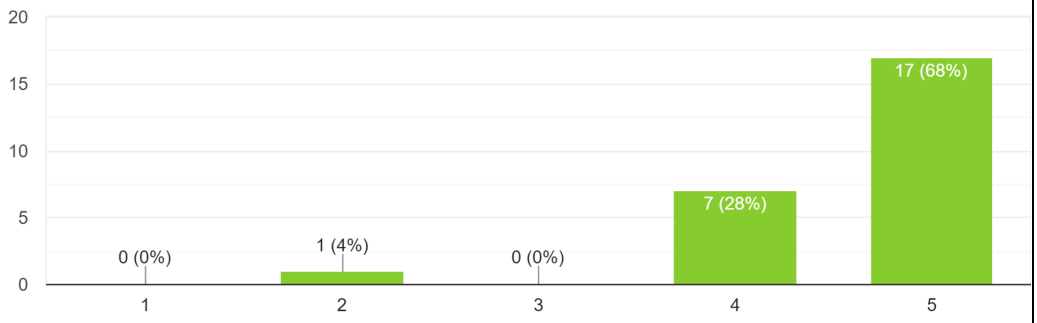
5. The arrangement of information on the screen is logical.

25 responses



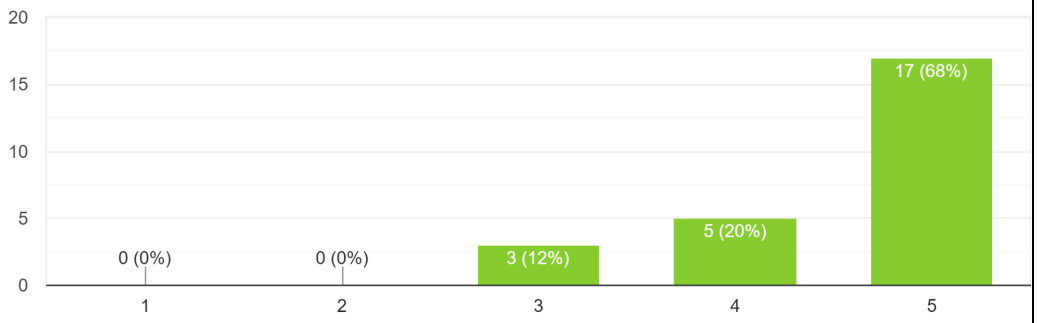
6. The chatbot is helpful.

25 responses



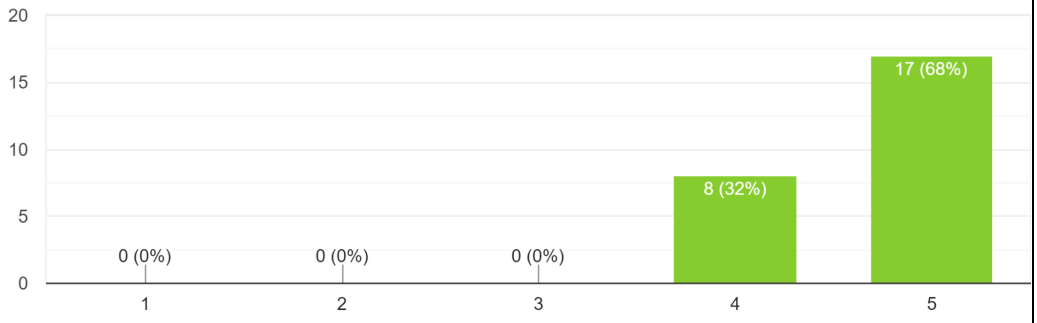
7. The chatbot is interactive.

25 responses



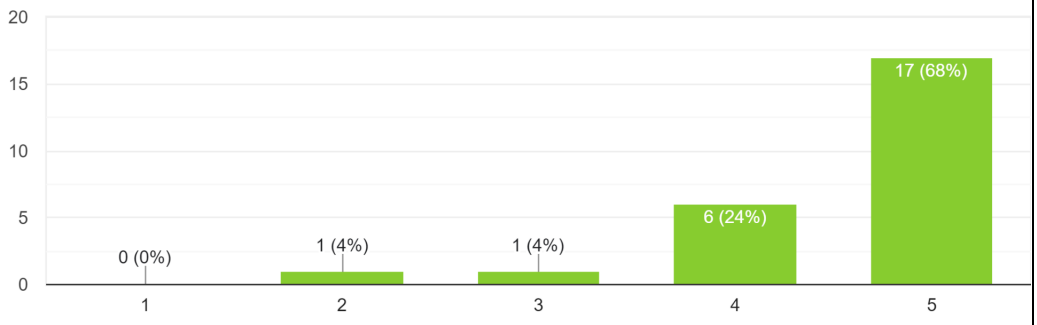
8. The chatbot reacts in a consistent way.

25 responses



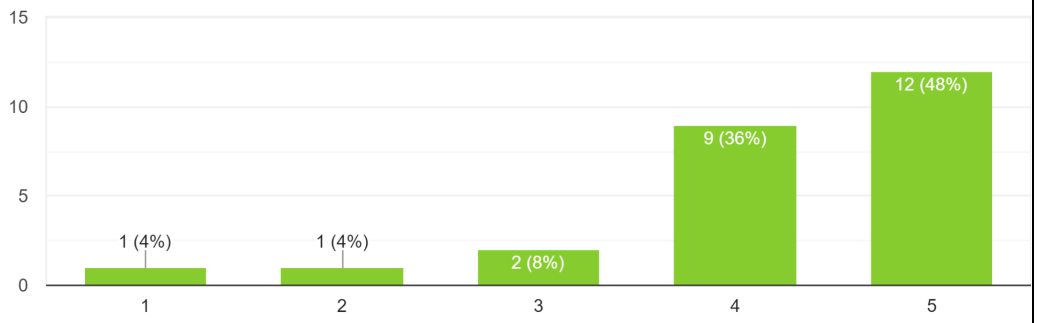
9. The chatbot complements the activities without distracting or interfering with them.

25 responses



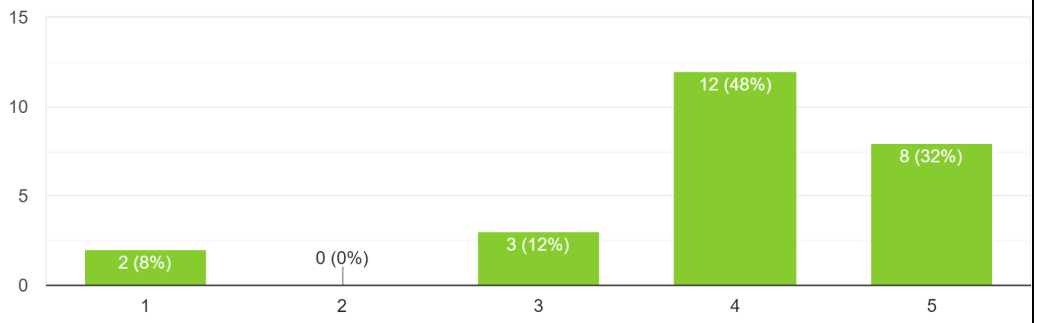
10. The chatbot provides adequate non-verbal feedback.

25 responses



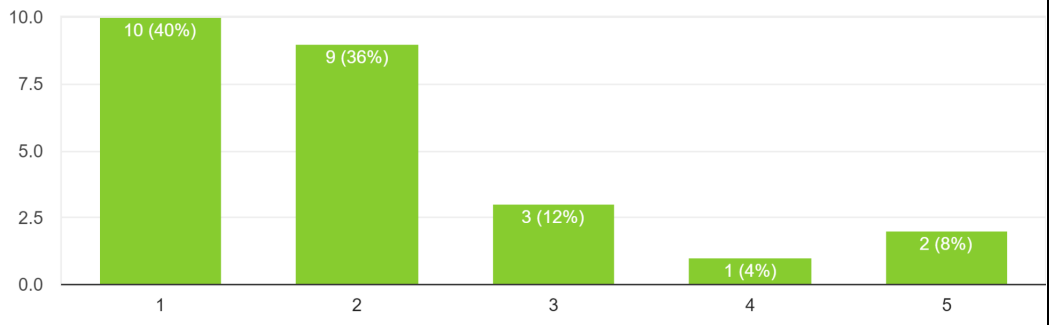
1. I think that I would like to use this system frequently.

25 responses



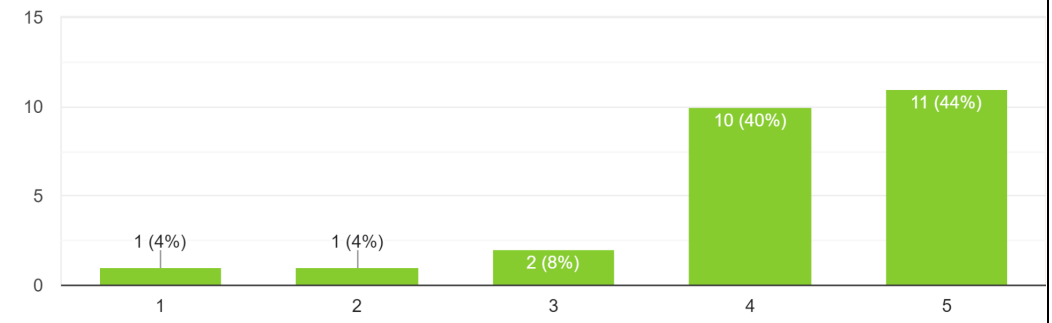
2. I found the system unnecessarily complex.

25 responses



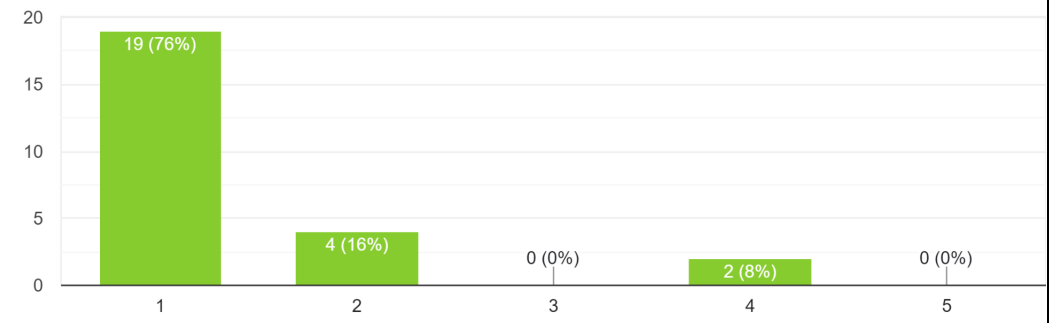
3. I thought the system was easy to use.

25 responses



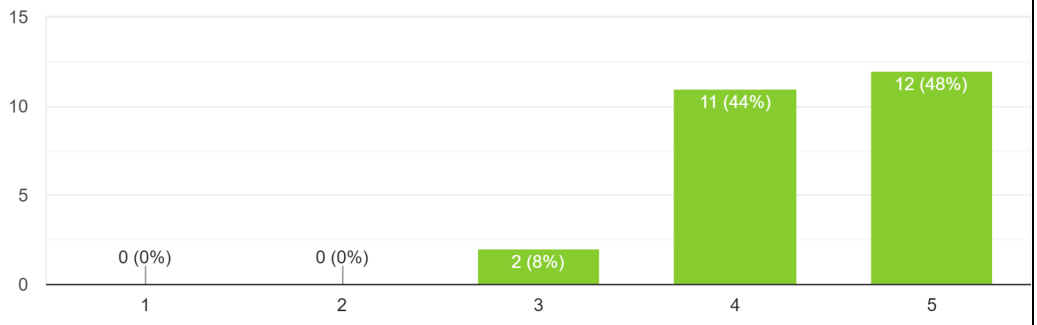
4. I think that I would need the support of a technical person to be able to use this system.

25 responses



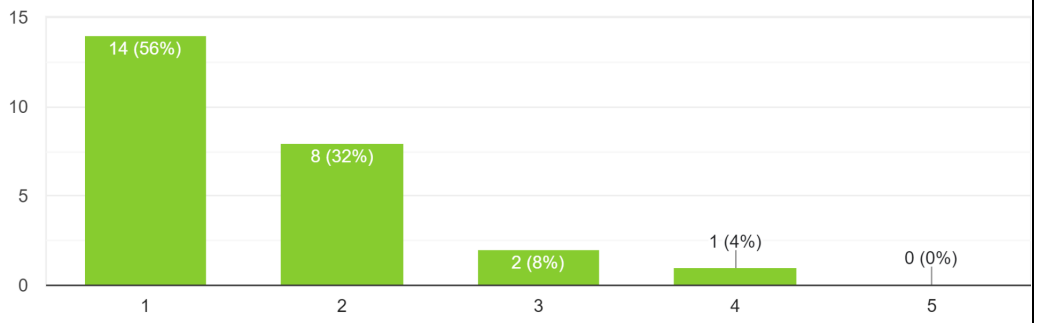
5. I found the various functions in this system well integrated.

25 responses



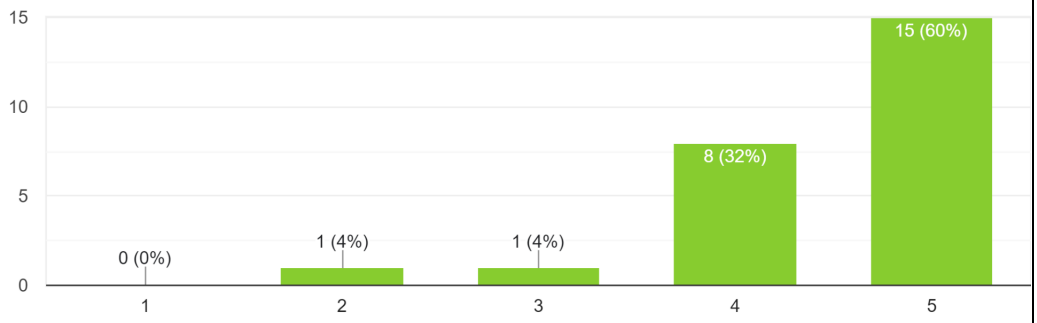
6. I thought there were too many inconsistencies in this system.

25 responses



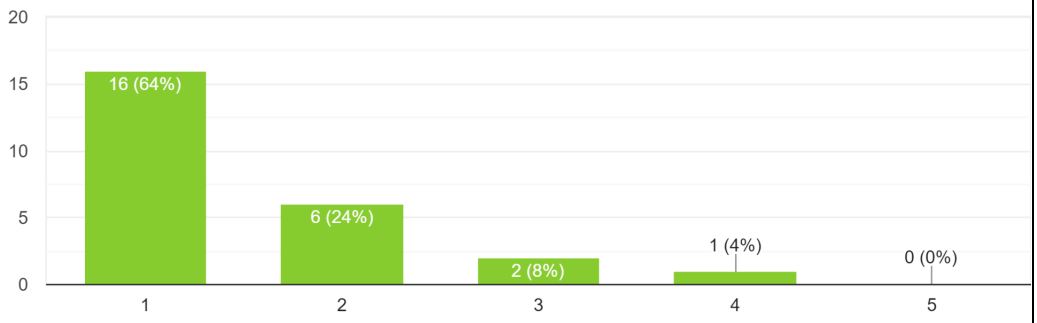
7. I would imagine most people would learn to use this system very quickly.

25 responses



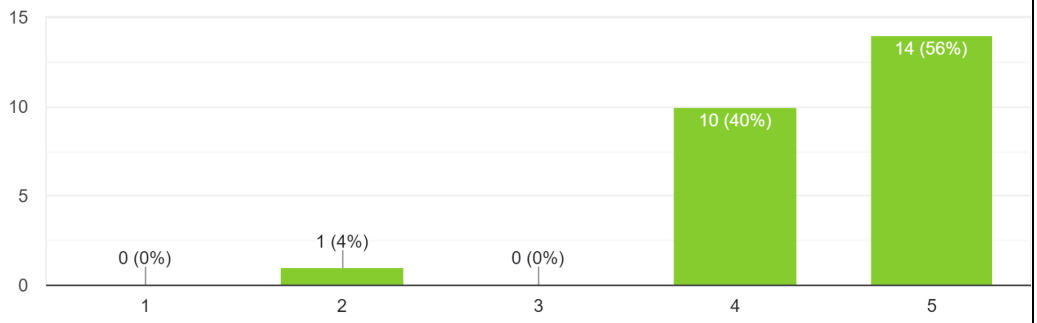
8. I found the system very cumbersome to use.

25 responses



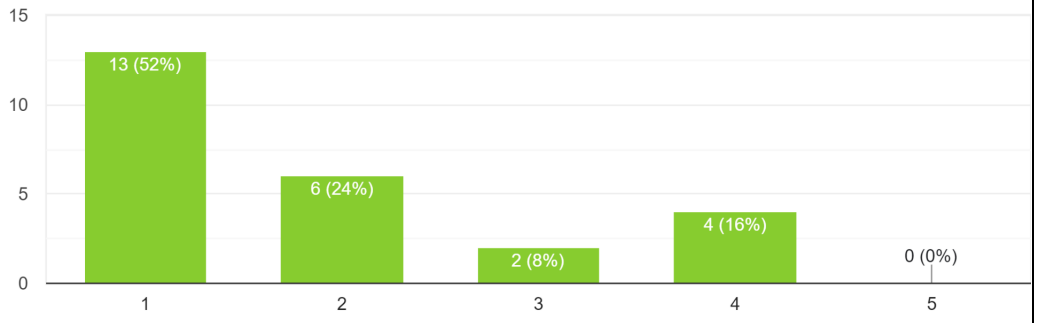
9. I felt very confident using the system.

25 responses



10. I needed to learn a lot of things before I could get going with this system.

25 responses



APPENDIX G

De La Salle Lipa
College of Information Technology and
Engineering Information Technology Department

GRAMMARIAN'S CERTIFICATE

This is to certify that the undersigned has reviewed and went through all the pages of the Capstone Project entitled "**An AI Chatbot System for Tech Support in the MyDCampus Website of De La Salle Lipa using Expert System and Natural Language Processing Techniques"** by **Zeth Raphael Arguelles, Patrick Pangilinan, Sanjay Sajnani,** and **Aaron Charles Vergara.**

Signed this 6th day of February in the year of our Lord, 2023 at De La Salle Lipa, 1962 JP Laurel Ave, Lipa City, Batangas.

Signed:

ALMA G. DIMAANO
Master Teacher
I Grammarian

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