

CLIQUE: A Web-Based Queue Management System with Real-Time Queue Tracking and Notification of Units for Angeles University Foundation Office of the University Registrar

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Abstract

The CLIQUE is a web-based queue management system with real-time monitoring of queues and notification of units, which was developed to improve the queue system of the University Registrar at Angeles University Foundation. The system aims to deliver an enhanced web-based queue management system organized for maximum productivity and excellent service by reforming the traditional process in a way that utilizes technology. The method used in developing the system is Design Thinking, a framework designed to help designers solve various complicated problems and figure out solutions for clients. The development tools of the system are; HTML, CSS, Bootstrap, JavaScript, Model-View-Controller, ASP.NET, C#, and MySQL. As a result, the developed queue management system is more suitable for clients than the traditional queuing process due to the fact that the clients and staff can track and monitor queues. Also, the developed system has lessened clients' confusion upon entering the Office of the University Registrar, and the staff would work efficiently in assessing clients. Henceforth, the clients, staffs, and admins were able to manage the queuing process because of the developed queue management system.

Keywords

queue management, real-time monitoring, service delivery, web application, customer satisfaction

1. Introduction

Queues for service of one kind or another arise in many different fields of activity. According to Thomopoulos (2012), a queue is "a line of persons or vehicles waiting in order of their arrival." Queues are a fair and essential way of dealing with clients' flow when there are limited resources. However, adverse outcomes arise if a queue process is not established to deal with overcapacity. As a result, queuing can significantly affect how well an institution would be time and cost-efficient (Gabriel, 2011). Queuing has played an essential role in society; several institutions attempt to improve the queuing experience by providing clients with excellent service. According to Tsernov (2019), as the time spent in queues increases, the client's patience decreases. Approximately 25% of the clients would wait a maximum of two minutes, while 59% would wait no longer than four minutes, and 73% would abandon their service requests if they had to queue for over five minutes.

Queuing lines frequently suffer from longer delivery times, and mislabeled tickets can unnecessarily waste time. People always complain about the inconvenience of queuing. Sometimes, the reasons for the dissatisfaction are uncertain to the client (Tsernov, 2017). According to Obamiro (2003), several clients are annoyed and verbally express their frustration. Obamiro (2010) stated that queuing is a somewhat unpleasant experience for a client due to the remaining client's adverse effects. Furthermore, Yusuf et al. (2015) have determined that queuing creates the perception of inefficiency in the public's eyes. Hence, a client leaves unhappy when an institution fails to deliver excellent service.

CLIQUE is a web-based queue management system with real-time monitoring of queues. The researchers aim to develop this web-based queue management system that will be used by the staff and clients of the Angeles University Foundation Office of the University Registrar in Angeles City, Pampanga. With this system, the current queuing system will be enhanced, the queuing process will be much organized, and maximum productivity for excellent service will be achieved. The web-based queue management system's queuing process consists of three relevant steps. The first step is choosing the type of client (admissions, student or graduate, faculty, or others) and then being directed to the corresponding unit counters. However, this step may vary since it depends on whether the client is an admission, student or graduate, faculty, or others. The second step is service selection after selecting a unit counter. The last step is that the client has to fill up their name to be queued and addressed at particular unit counters.

1.1 Objectives

The general objective of the study is to enhance, design, and develop a web-based queue management system for the Angeles University Foundation Office of the University Registrar that will track the clients' queues in real-time and notify the staff working area when a client has queued. Furthermore, the study aims to boost the staff's productivity and lessen the confusion of the clients. Furthermore, the specific objectives of the study is:

- to develop a web-based queue management system;
- to develop a web-based system with real-time queue tracking;
- to develop a web-based system that enables the clients to be familiarized with the unit counters;
- to develop a web-based system that notifies both the receiving and staff working area

2. Literature Review

Queuing Theory

Queuing theory is usually considered an application of probability theory. The queuing approach is applied in different areas, including computing devices, computer systems, machine plants, and many related areas. The approach is based on a situation where a population of clients sees a facility to obtain service, and the number of clients they can serve at once is limited. In a waiting line, a new client would need to wait till the facility is accessible. This theory identifies three critical factors in the service center, including: (1) a service center location, (2) the number of clients, and (3) the line of waiting. The queuing theory attempts to answer questions such as the serving area, the average wait period in the waiting line, the allocation of clients, and the system's mean reaction time (Fomundam and Herrmann 2007).

Traditional Queue

Tsernov (2017) said that approximately 20% of the surveyed customers feel annoyed by the waiting process. The pain in a customer's heel can cause muscle strain and inflammation, and most times, customers do not have to wait. Customers will not have their patience tested if they are not waiting in line. This logic is simple to understand because traditional queuing practices often lead to inefficient results. MIT's Richard H. Larson postulated the inefficiency many years ago. There are attempts to cut through lines and create social friction. Queuing lines frequently experience longer delivery times due to a lack of service, and invalid or mislabeled tickets can unnecessarily waste time. People always complain about the inconvenience of waiting in line. Sometimes, the reasons for the dissatisfaction are uncertain to the customer. Without any knowledge of the circumstances, they only know that they have been wronged. In addition to excellent queue management, each customer gets individualized service

Queue Management System

Queue management includes a business practice formed to withstand it adequately, identify necessities, and not reinvent it. Once the organization disregards its queue management, difficulties will occur, particularly those handling a vast customer volume. One such drawback is Wal-Mart employees' downfall because of customers' stamping in November 2008. This news article pioneered the idea of queue management to worldwide attention. The solutions to systematically serving customers and avoiding overcrowding in a limited amount can be achieved through different mechanisms and assets. Line management psychology is a field of psychology older than three decades and focuses on improving waiting lines (Ibrahim 2021).

Queuing Services Disciplines

Service disciplines can be defined as a policy that determines the formation of a queue or queues and the method by which the client is chosen for service among those waiting for service (Egbunu et al. 2020).

FIFO (First-In, First-Out): A client who arrives and sees that the facility is busy will go to the queue's end. The concept of first-in, first-out (FIFO) queuing is simple. The first client to reach the service center is the first client to be served (Egbunu et al. 2020). Note that FIFO queuing is also referred to as queuing for first-come, first-served (FCFS) (Medhi et al. 2018).

LIFO (Last-In, First-Out): A client who turns up and perceives the facility continues to the queue head busily. If no further clients come, the client will be attended to; the last clients will be first-served (Teknomo 2014).

Improper Management

According to Uddin et al. (2016) "Inappropriate management such as queuing will create issues or stress among customers, leading to reduced job satisfaction of the employees."

A queue management system has been created to assist service providers in monitoring customers productively. The goal of this framework is to separate the customer line based on their order. Unlike the usual First-In-First-Out (FIFO) approach, the recommended queuing system will perform tests using algorithms every 15 minutes and compare the wait and average wait times. The current queuing system is compared to the old queuing system, and failures are identified.

Ticketing System

It is already a norm to stand in line at a fast-food restaurant or small store because they are most likely busy. Providing a ticketing booth allows the client to sit and rest instead of standing in line, which will boost client satisfaction and comfort (Sharma et al. 2013).

Notification System

It is inevitable to not wait in line and finish the required transactions in any bank. There are proposed solutions to solve this issue which are to be elaborated further. On the other hand, the effects would reduce customer queues, increase sales, profitability, and improve productivity and operational efficiencies. The overall purpose of any Queue Management System is to provide quality service to customers. Traditionally, Queue Management Systems have a ticket number prepared beforehand for customers and eventually announce the following ticket number when a teller is available.

In consequence, customers may lessen the allotted time they have waited to address their concerns. However, it does not mean each customer will have a specific time assigned to them while being addressed. Thus, customers still have to wait for a few minutes for their turn. Due to this, a newly developed Queue Management System has been implemented with SMS notification. The Queue Management System with SMS notification has a small interface, user-friendly on smartphones for a Queue Management System that includes an SMS notification for mobile users (Ramasamy and Chua 2012).

Real-Time Queue Tracking

According to Ghazal et al. (2016) more people are delayed because of waiting in lines when the world's population expands. They found that client satisfaction relies on how long the wait is. Davis and Heineke (1994) investigated how several factors affected client satisfaction. These include the wait time, comfort level during wait times, and whether clients are preoccupied while waiting. Consequently, it is essential to develop an effective queue system that anticipates how long a consumer will have to wait based on the type of service rendered.

Institutions and other organizations have implemented queue management systems with time estimation algorithms. Unfortunately, people who draw several tickets as a precaution against missing their turn abuse them. The device considers the additional ticket customers and overestimates the running time, discouraging future customers. To avoid this, service providers hire a watch person to ensure that each client only receives one ticket. Clients often disregard the advice to depart and return at the appointed time because they fear losing a turn. Furthermore, handling waiting times could even assist service providers in allocating resources and enhancing care quality.

Mobile Environment

Technology has progressed with tempo, helping to bring ease to our daily activities. Despite the fact that mobile devices have become a necessity in our daily lives, we continue to face the issue of long lines. This issue can be solved

by implementing a mobile-based queueing system that optimizes processes. Mobile Cloud Computing is a combination of cloud computing, mobile computing, and wireless networks that gives mobile users and service providers more resources (Yadav et al. 2016). According to Yadav et al. (2016), “cloud computing viewed as a substitutional for traditional or outdated mainframe client-server model because the resources are widespread, expandable, strongly and virtualized”. We propose to implement this system in a cloud-based mobile application to reduce the mobile device's resource usage in this implementation (Kanesaraj et al. 2015).

Automation

An automated queue management system aids service providers in efficiently managing customers. The system can make customer flow management easier, which is beneficial to service provider managers. A queuing system that can analyze the queue status and take decision which customer to be served first. The average waiting time and different queuing algorithm approaches used in banks to serve customers.

3. Methods

The Design Thinking Framework was designed to help designers solve various complicated problems and figure out solutions for clients. Furthermore, the Design Thinking Framework is a type of method that is community-based, a learning organization, open to multiple solutions, pays attention to details, thinks outside the box, focuses on practical solutions, uses imagination, and helps in brainstorming to achieve the desired outcomes which benefit the users.

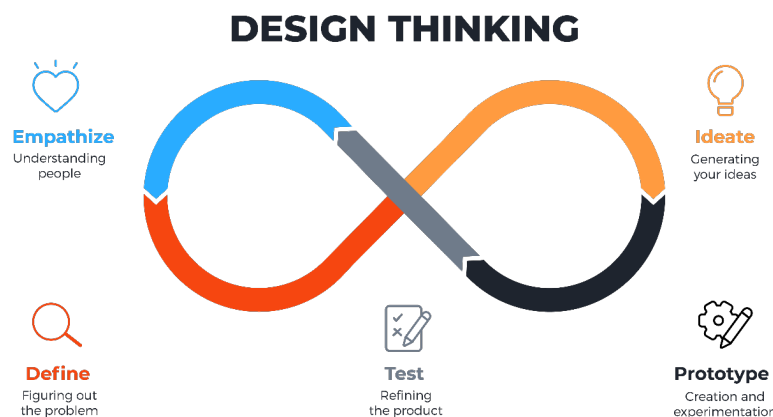


Figure 1. Design Thinking Framework

- **Empathize** - The researchers conducted an interview with the client to gather important information. Henceforth, the information and issues gathered were utilized to develop the proposed system.
- **Define** - The interviewed results and the survey determined the proposed system. The researchers coordinated with the University Registrar and participants for suggestions and improvements to the proposed system.
- **Ideate** - After thorough investigation and interviews with the research participants, the researchers developed a web-based Queue Management System as a proposed solution to the problems encountered pertinent to queues.
- **Prototype** - The system's overall design is similar to a Kiosk device in which clients could choose their desired unit assignments with the corresponding colors and numbers. Accordingly, the device also has access to print a slip as the queue number for clients.
- **Test** - The researchers and clients tested the final product system, which is the Queue Management System. Afterwards, the system was implemented.

Based on the interview, the University Registrar shared her experiences with the current system they were using and gave suggestions for improving the system. The University Registrar claimed that the current system was time-consuming and disorganized. The University Registrar also mentioned that new students, graduates, and representatives are unfamiliar with the unit counters. Furthermore, whenever a new client appears, the staff in charge of the receiving area creates a commotion because that specific staff needs to broadcast the clients who recently queued in, which disrupts work to the staff in charge. In addition to the problems that they encounter, the clients are unable to track their queue. Hence, the researchers proposed a system that comprehensively reforms the traditional method into

an automated system, much organized, hassle-free, and convenient. All clients should understand and familiarize themselves with the proposed system to be developed by the researchers for the Office of the University Registrar at Angeles University Foundation.

The researchers conducted a survey on April 14, 2021, to the clients of the Office of the University Registrar to determine the problems that they encounter regarding the current system. The survey consisted of seven (7) multiple-choice questions measured on a 4-point Likert scale and two (2) essay-type questions. Additionally, a client was defined as “an individual that uses the services of the institution.” The specified clients in this study are students or graduates, school faculty, admissions, and others.” Participants were given time to fill in the survey using their AUF email address through Google Document, and fifty-seven (57) clients responded.

The most common problems that the respondents encountered were long waiting times, inadequate service, and the lack of monitoring or tracking their queue status. The respondents also gave suggestions for improving the current queuing system of the Office of the University Registrar. The most common suggestions were implementing real-time monitoring of queues and an automated queuing system instead of the traditional procedure. In conclusion, the current system of the Office of the University Registrar should be improved because the service is not adequate based on the survey results.

The researchers used the Likert Scale (table 1) System to collect the ratings assessed by each of the respondents.

WHERE: WM = Weighted Mean
 w = Number of each category
 f = Number of respondents in each category
 N = Total number of responses

FORMULA: $WM = \frac{\sum wf}{N}$

Table 1. Likert Scale Weighted Mean

Rate	Verbal Interpretation	Score Range
4	Strongly Agree	3.51 – 4.00
3	Agree	2.51 - 3.50
2	Disagree	1.51 - 2.50
1	Strongly Disagree	1.0 – 1.50

4. Data Collection

The study was conducted at the Angeles University Foundation Office of the University Registrar in Angeles City, Pampanga. The proposed project targets both the clients and the staff of the Angeles University Foundation Office of the University Registrar to provide them with a Queue Management System where the staff can manage the queues and the clients can track real-time queues.

The researchers gathered the data through the following methods:

- **Interview** - An interview was applied to precisely identify the features of the system. Consequently, the researchers were able to gather more information that would support the study’s purpose. To be specific, the collected data served as a guide in the development of the system.
- **Internet Research** - The researchers gathered most of the data and information on the Internet to strengthen the system’s overall basis. The websites chosen had to be reliable and valid sources. For instance, websites from organizations, institutions, trustworthy authors or publishers and reviews of related literature and studies. Moreover, these sources helped support the study and the researchers in developing the system.
- **Library** - The researchers collected ideas from previous projects to develop the system to get the basis for the project.
- **Survey** - The researchers conducted a survey for the clients. It was used to know the efficiency, reliability, effectiveness, and functionality of the current system.

The researchers conducted an interview with the University Registrar and shared her experiences with the current system they were using and gave suggestions for improving the system. The University Registrar claimed that the current system was time-consuming and disorganized. The University Registrar also mentioned that new students, graduates, and representatives are unfamiliar with the unit counters. Furthermore, whenever a new client appears, the staff in charge of the receiving area creates a commotion because that specific staff needs to broadcast the clients who recently queued in, which disrupts work to the staff in charge. In addition to the problems that they encounter, the clients are unable to track their queue. Henceforth, the researchers proposed a system that comprehensively reforms the traditional method into an automated system, much organized, hassle-free, and convenient. All clients should understand and familiarize themselves with the proposed system to be developed by the researchers for the Office of the University Registrar at Angeles University Foundation.

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5. Results and Discussion

The goal of this project was to develop an automated web-based queue management system that allows clients to monitor real-time queues displayed on the monitor or television screen. In order to develop the system, HTML, CSS, Bootstrap, JavaScript, Model-View-Controller, ASP.NET, C#, and MySQL were used, and a touch-screen monitor based on a kiosk system was also used for queuing. The clients can also monitor their real-time queue online through any browser-supported device. The developed system will help the clients to queue efficiently with no confusion once they enter the University Registrar. Furthermore, staff can manage and track the clients’ queue, which then results in organized logs. In addition, the queue management system allows staff to be notified, track clients’ real-time queues, and increase productivity.

The research objectives were to reform the traditional process in a way that utilizes technology to minimize time and cost-efficient. Adverse outcomes arise if a queue process is not established to deal with overcapacity. The developed system will eliminate the inconvenience process of queuing.

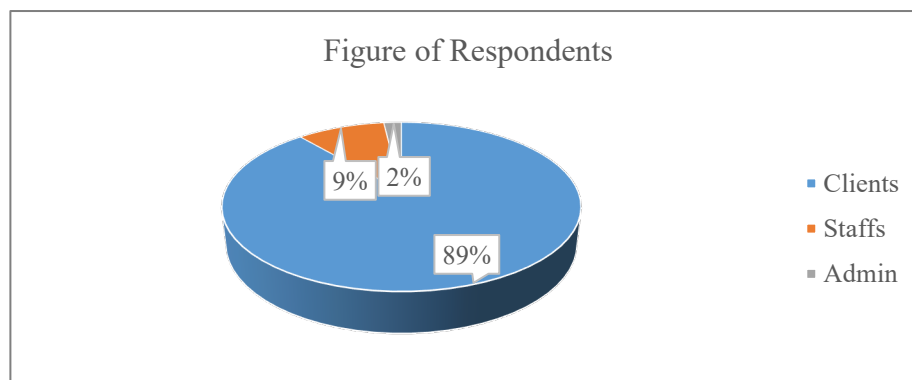


Figure 2. Figure of Respondents

The researchers conducted and distributed survey forms to the clients, staffs, and admin of the Office of the University Registrar to determine their personal experience while using the system. Thus, forty-seven (47) clients, three (3) staffs, and one (1) admin responded to the survey, a total of fifty-one (51) respondents (figure 2).

The survey consisted of ten (10) multiple-choice questions for the clients and staffs, while fifteen (15) multiple-choice questions for the admin, measured on a 4-point Likert scale. The respondents were given time to fill in the survey form after using the system.

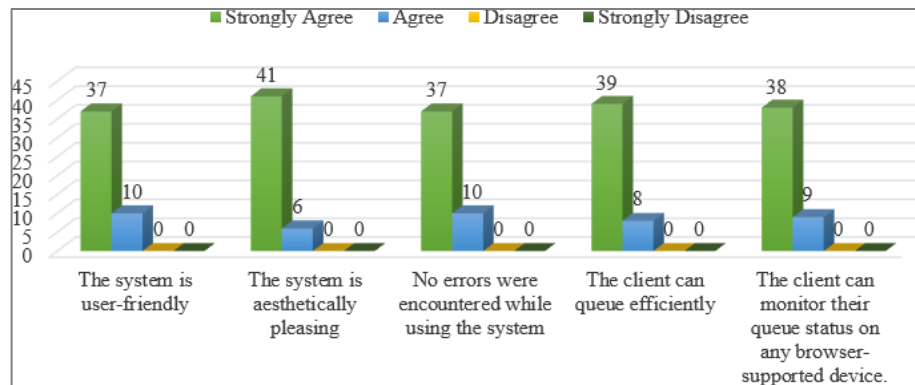


Figure 3. Client Question 1-5 Result

Figure 3 shows the percentage of the client evaluation for questions 1 to 5. All criterias received Strongly Agree.

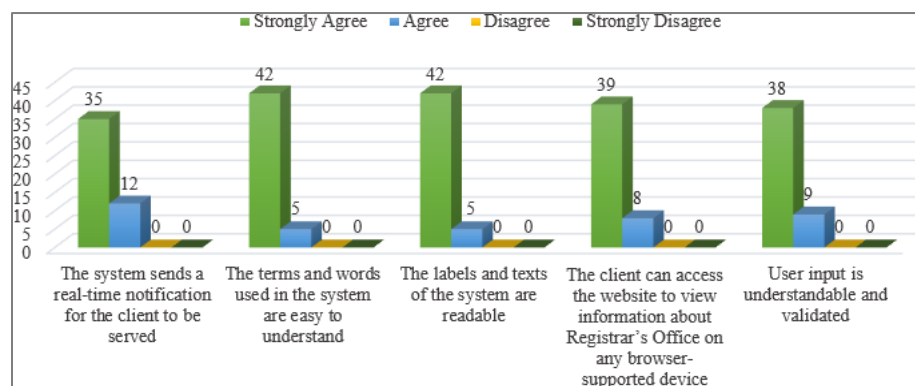


Figure 4. Client Question 6-10 Result

Figure 4 shows the percentage of the client evaluation for questions 6 to 10. All criterias received Strongly Agree.

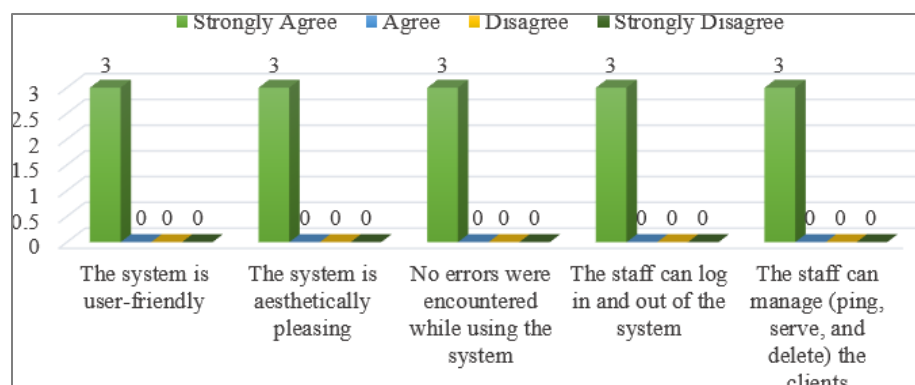


Figure 5. Staff Question 1-5 Result

Figure 5 shows the percentage of the staff evaluation for questions 1 to 5. All criterias received Strongly Agree.

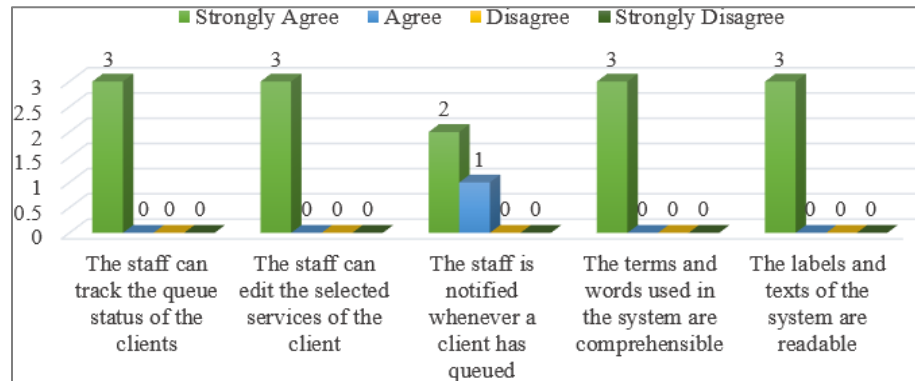


Figure 6. Staff Question 6-10 Result

Figure 6 shows the percentage of the staff evaluation for questions 6 to 10. The third criteria received agree while the first, second, fourth, and fifth criteria received Strongly Agree.

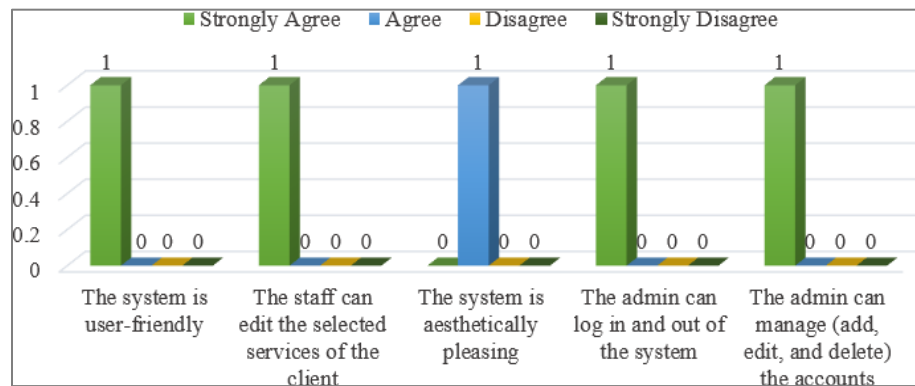


Figure 7. Admin Question 1-5 Result

Figure 7 shows the percentage of the admin evaluation for questions 1 to 5. The third criteria received agree while the first, second, fourth, and fifth criteria received Strongly Agree.

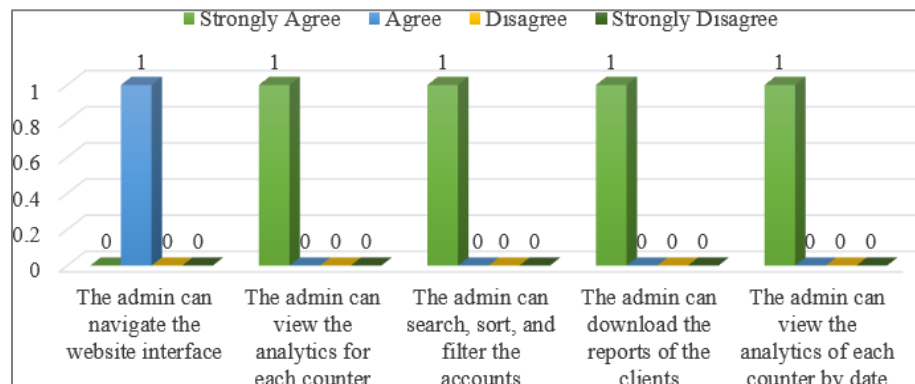


Figure 8. Admin Question 6-10 Result

Figure 8 shows the percentage of the admin evaluation for questions 6 to 10. The first criteria received agree while the second, third, fourth, and fifth criteria received Strongly Agree.

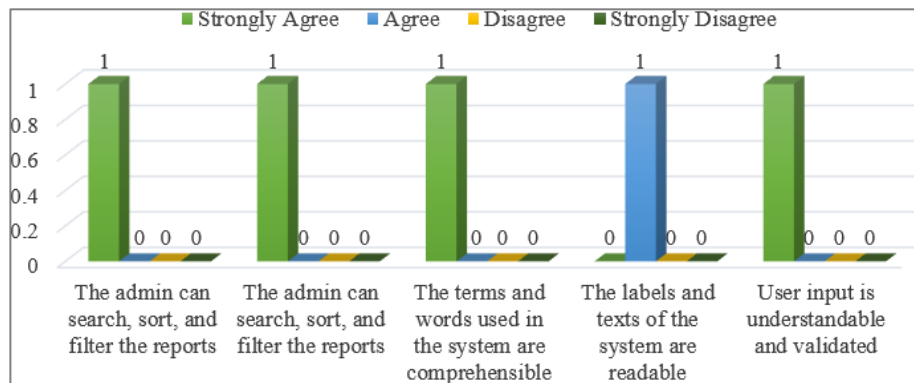


Figure 9. Admin Question 11-15 Result

Figure 9 shows the percentage of the admin evaluation for questions 6 to 10. The fourth criteria received agree while the second, third, fourth, and fifth criteria received Strongly Agree.

6. Conclusion

The web-based queue management system implemented for the Angeles University Foundation Office of the University Registrar was enhanced and optimized. In conclusion, the developed queue management system is more suitable for clients than the traditional queuing process due to the fact that the clients and staff can track and monitor queues. Also, the developed system has lessened clients' confusion upon entering the Office of the University Registrar, and the staff would work efficiently in assessing clients. Henceforth, the clients, staffs, and admins were able to manage the queuing process because of the developed queue management system.

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Biography

Marc Lester Z. Mallari as a technology enthusiast, has dreamed of becoming a front-end engineer since he was eighteen (18) years old. His love for technology started at a young age, and he developed an early interest in building UI/UX design. Due to this, he decided to take up a course that is related to technology. Marc is currently pursuing his passion and is now a candidate for graduation with a Bachelor of Science in Information Technology at Angeles University Foundation, Angeles City, Philippines. Furthermore, Marc is a motivated, personable, collaborative team player, dependable, flexible, fast learner, punctual, sociable, resourceful, and hardworking. He can prioritize and complete tasks within the time constraints established, effectively communicate with all levels of the organization and execute objectives. Eager to know more about technology, he wishes to solve problems creatively and effectively by enhancing his educational and professional skills. Marc believes that when you are authentic to yourself, you become the influence that leads others through observing yourself.

Joshua S. Guintu twenty-two years ago came into this world which is before the era of 20th century and the last era of the 90s. That year was the year of the rabbit; he was the eldest of the siblings, two sisters came after him. His mother and father later sent him to the Collegio De San Lorenzo De Pampanga. Joshua's parents decided to send him there at an early age to learn properly in a private school. Joshua never left or changed his school and stayed in the same school from nursery until graduating from senior high school. Aside from being a plus-size man, Joshua was also good at mathematics, and he was awarded Computer Geek when he was in high school. From a young age, Joshua had an interest in technology, especially on computers, because of games. This led Joshua to explore more on what a computer can do and led him to the path where he takes Bachelor of Science in Information Technology at Angeles University Foundation, and he is currently a candidate for graduates. Joshua is a young man with a big dream of being successful one day, one of his dreams is developing software or application. Joshua plans to work on some companies first and earn to start his business and build his own company to achieve his dream. Joshua is a timid and lazy guy but will do his work efficiently that is still on time. Although he does what he wants, he makes sure that things are done properly.

Yoben C. Magalong is a candidate for graduation this 2022 on Bachelor of Science in Information Technology at Angeles University Foundation, Angeles City, Philippines. He grew up in Mabalacat City and graduated from Don Bosco Academy Pampanga with a loyalty award in 2018. He is a dedicated person who is willing to do what is needed to be done and a motivated person with strong communication skills. He is also seeking to improve more on his skills

and abilities to achieve higher goals in life. He is a computer enthusiast who has a dream of developing his own game or application.

Daisy S. Yap finished her degree in Bachelor of Science in Computer Science at Angeles University Foundation year 1999. She earned her master's in information technology in 2009 at AUF. She completed 15 academic units of Doctor of Information Technology also at Angeles University Foundation. She took a Professional Education Course at Systems Plus College Foundation and earned her Licensure for Professional Teacher in 2017. Currently taking Doctor of Philosophy in Education major in Educational Management also at AUF and finished 27 units. Aside from teaching, she is currently the Assistant Dean of CCS. With her love and passion for teaching, she is now in her 22nd year of service at AUF.