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# The Light

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The Light is a peer-reviewed, thematic, and multidisciplinary journal of Father Saturnino Urios University, San Francisco Street, Butuan City. The journal accepts manuscripts in all fields such as Original Articles and Perspectives. Original Articles are manuscripts that report new findings contributing to a new knowledge base in the field. The Perspective section presents stimulating and reflective essays on a focused issue. The Editorial Board encourages submissions from beginning and established scholars in the Philippines and abroad.

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## EDITOR'S PREFACE

In response to the emerging Fifth industrial revolution where the industrial structure is transformed by the utilization of Artificial Intelligence, Big data, and Internet of Things, this edition of the Light Journal shares scholarly work contributions on the utilization and development of technological innovations.

The first article of John Ray Francisco et. al looked into the development of a game application that uses augmented reality and geolocation to promote tourism by encouraging visitors to visit local tourist spots.

The second article of Orlando Ritchie Natonton, Lorenzo Ezekiel Turla and Nephi Romano focused on the cyber security among selected educational institutions in Butuan City. Here, the authors shared common cyber security issues and gave recommendations for educational institutions to have sound cyber security protection and policies.

The third article of Jou Marlou Opella shared interesting insights on descriptive analytics and Naïve Bayes algorithm on mobile sales inventory and marketing while the fourth article of RJ May Ancha et. al. focused on the health monitoring system in Butuan City using the Decision Support System with Analytics.

Lastly, the article of Kenneth Clint Cataluna et. al. developed an interactive mobile web-based system designed in the Cebuano dialect to bridge gaps in the delivery of mother tongue- based multilingual education.

In this edition of The Light Journal, it is evident that Artificial Intelligence, Big data, and Internet of Things considerably contributed to the promotion of local knowledge, business and health despite the threats on cyber security that go along with them. Given its opportunities and setbacks, this edition of the Light Journal aims to spark discussions on the proper and effective way of utilizing these technological innovations.

**Shirlene Medori T. Alegre, PhD**
Editor in Chief

# Advance Mechanism for Endorsing City Tourism: An Augmented Reality Mobile Game Application with Geolocation Elements

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**Abstract**

The tourism industry in the city requires new and engaging ways that are also innovative in the local industry. This study aims to do that by developing a game application that uses Augmented Reality (AR) and Geolocation to boost tourism in the city and to spark interest among visitors that could encourage them to visit local tourist spots. The game is quest-based with augmented reality environments made with ARCore and geolocation made with Mapbox that encourages users to travel. The Technology Acceptance Model was implemented to determine the Behavioral Intention to Use for the system, with positive results. The application itself was developed with the Unity Engine using the Evolutionary Prototyping Development Model with feedback from project advisors and intended users as well as the company intended for deployment. Upon total completion, it will then be uploaded to the Google Play Store and will be available for download by Android users. Further, results show that most domestic tourists are willing to utilize the augmented reality mobile based application for endorsing city tourism.

**Keywords: Augmented Reality, Game, Geolocation, Tourism**

## 1. Introduction

The city of Butuan has had a rich history and culture (Hontiveros, 2004), with many tourist sites that denote historical and cultural importance such as the Balangay Shrine and Magellan's Anchorage (Cayron, 2017). There are also man-made landmarks that contribute to city tourism like the Delta Discovery Park and the Butuan National Museum. Agusan del Norte shares the same percentage as Surigao del Norte in terms of tourism contribution to the region which is 35% to economy (Abello-Camarin, 2017), and the greater bulk of the province's tourist arrivals can be attributed to Butuan City. The presence of the Bancasi Airport that service flights from Manila and Cebu are contributory to the arrivals. The city, which is also Caraga's regional center, sits strategically in the province. It has major gateways such as the previously mentioned Bancasi Airport, as well as Nasipit Port and Land Terminal that provides most of the tourists who come to the region (Abello-Camarin, 2017). It is in a central position travel-wise and points to other destinations in Caraga. This provides ample opportunity to attract tourists with a new way of multi-sensory interactive tourist engagement. With this research, users will be encouraged into visiting these locations featured in the application.

This research will promote tourism in the city of Butuan by featuring its various tourist spots and historical sites as hotspots or “points of interest” in a geo-location-based augmented reality game. The game would use augmented reality elements to improve user immersion, if it gives the user a quality and memorable experience using the technical quality of an augmented reality environment (Molnár & Szűts, 2019); (Shin, 2017), which could generate visiting interests (Berger, et al., 2007).

The app will focus around designating the tourist spots as points of interest upon which several game content interactions may occur. The players will be incentivized into traveling to these tourist spots by the game mechanics that connect the points of interest using a quest system and then providing players upon arrival with an augmented reality environment through which the game content will be presented.

With the growth of technology and various media platforms over the past decades, more and more ways to spread information to the masses emerged more than ever before. One of these ways is the modern trend in mobile applications. According to statistics from Sensor Tower and App Annie, as of 2018, 105 billion apps were downloaded from the Apple App Store and Google Play by 2.9 billion smartphone users, 33% of these apps being games (Iqbal, 2019). With billions of downloads, apps published in app store platforms like the Google Play Store and the Apple App Store have the potential to be an effective tool for tourism promotion. This is because of these platforms' wide reach, which covers key customer demographics (Islam, Islam, & Mazumder, 2010). A potentially better way to achieve this is through applications that are intended for gaming. There have been past studies (Malone, 1981); (Thomas & Macredie, 1994); (Xu, Buhalis, & Weber, 2017), the empirical evidence showed that video games capture attention and encourage retention through their game mechanics that appeal to a user's intrinsic curiosity and sense of fantasy and challenge.

Advancements in technology have given these mechanics more appeal to consumers, shown by the growing number of users showing interest in emerging technologies like Augmented Reality (AR). The innovative aspects of AR add a certain 'edge' to a game, which would make prospective players want to play it (Nilsen, Linton, & Looser, 2004). These features also add immersion by melding the virtual world in the device's screen with the reality of the player holding it, providing a new method of interaction with game content. In a gaming context, such an exploration of interaction is often motivation enough (Nilsen, Linton, & Looser, 2004).

## 2. Review of Related Literature

### 2.1. Promoting Tourism with Augmented Reality

According to (Weber, 2014), the location-based mobile Augmented Reality Games are an innovative way to attract tourists into challenges and interactive gameplay while they are exploring an urban

destination or cultural heritage site. AR games provide more engagement with the locations by gamifying an educational experience, making it more entertaining or "fun" using location-focused storytelling, with features and social interactions that feel personalized. The player's location and the game's context are important factors in creating rewarding location-based gameplay. The younger generation born into an abundance of digital media demands new forms of media applications for creating engaging experiences. With modern smartphones and tablets, there can now be a ubiquitous link between real and virtual environments (Mortara, et al., 2013) which enable mobile and location-based games to become pervasive and, and to be played in any situation of life. The learning aspect of an AR tourism application might be a reason for traveling as it broadens the horizon and enhances the understanding of cultures and history. It has also been a neglected area in tourism research (Falk, Ballantyne, Packer, & Benckendorff, 2012).

## 2.2. Existing AR Applications that Promote Tourism

An example of an augmented reality application promoting tourism would be Florence Travel Guide by Daniel Juarez Garcia, which utilizes augmented reality as well as geolocation to make traveling around the city of Florence, Italy more convenient and engaging. Another example is the Skin & Bones app by the Smithsonian Institution which makes visiting the Smithsonian's Natural History Museum in Washington, DC more immersive by bringing the skeletons to life in augmented reality. There have also been augmented reality games that boost tourism as a side-effect, most notably Pokemon GO (Zach & Tussyadiah, 2017). It combines augmented reality and geolocation to provide players with an exploration and location-focused game experience. Based on a series of regression analyses by (Zach & Tussyadiah, 2017), Pokemon GO increases travel and visitation to other geographic areas. Findings also contend that in terms of spending, increasing motivation to win battles and enjoyment are associated with increased probability to spend money on goods (at shops), on food and beverages (at food establishments such as restaurants), and travel. Visitors can also be guided to locations already within the destination, thus allowing control of the flow of a location's visitors. The combination

of these experiences will have provided educational information and created memorable experiences.

## 2.3. Games as Promotional Tools

Previous studies of (Falk, Ballantyne, Packer, & Benckendorff, 2012); (Garretson & Burton, 2005) (Garretson & Niedrich, 2004), suggest that the presentation of an advertisement largely determines how well consumers receive the message. According to (Glass, 2007), video games have many elements that make them ideal platforms for advertisements. For the study 'The Effectiveness of Product Placement in Video Games' (Glass, 2007), participants played a video game that featured branded products, then took an implicit associations test to determine whether they "had more positive attitudes toward the brands in the game than toward a set of equivalently rated brands". All three hypotheses were supported by the results. Finally, they took significantly longer to categorize the in-game brands as bad than they took to do the same for their out-of-game counterparts. The same results can be anticipated for promotions regarding tourism.

## 2.4. Augmented Reality Entertainment Value

An appealing feature of outdoor AR games is the user's movement in the game reflects physical movement (Thomas, Krul, Close, & Piekarski, 2003). This gameplay mechanic must be integrated properly and seamlessly in a game. An issue that might arise is the fact that people walk slower compared to a game character's more pronounced movement in most video games. Therefore, the games are required to be designed to be accommodating. Users of a geolocation game will want the physical game device and hardware to be lightweight so as not to overly tire the user and unobtrusive to allow a great range of movement, such as the movements required in a pretend battle. To maximize entertainment value, developers should address the issues that affect the usability and playability of augmented reality games. There has been some testing for a game called ARQuake (Thomas, Krul, Close, & Piekarski, 2003) that found several issues in constructing virtual worlds. Poorly optimized field of view (FOV) settings caused depth perception problems. AR is more immersive and responsive in a well-lit

environment. In the Augmented Virtuality and Augmented Reality modes, very dark and black colors (unless used for occlusion purposes) should be avoided.

### 2.5. Geolocation Gaming

Location-based mobile games utilize physical space as the game environment, enhancing players' experience of the physical world through 'the linking of information to places, and players to each other via location awareness', with 'the game (taking) place primarily in the physical space and on the cell phone screen, as players can see each other and/or virtual game elements on their mobile screen' (Silva & Hjorth, 2009). An example is Ingress by Niantic. Ingress does more than just motivate players to recognize significant sites in their immediate surroundings (Stark, 2016). However, In-game achievements and collaboration within the community result in modifications to player mobility, including where people go, how they behave while they are there – for instance, driving four or more laps of a route while 'farming' for equipment; how they move, including walking instead of driving or catching public transport; and encouraging participation in the curation and experience of cultural heritage (via portal submissions and mission design).

### 2.6. Simulations in Conceptualizing History

According to (Kapell & Elliott, 2013), simulations not only present users with challenges similar to those faced by historical actors in their appropriate context but also model the concepts necessary to assemble historical facts into historical representations. Concepts such as an autocratic government, mercantile economics, or war tactics are all exercises in the organization of systems. Concepts allow us to infer patterns observed from certain events. For example, without formally learning about siege warfare, a player may unwittingly develop an understanding of it by playing a game that features it. Complex relationships between concepts can be better understood through the unique subjectivity offered by simulations, as well as the inherent active participation in a simulated scenario. Rather than a “what-if simulation with a known case study as a referent”, nonspecific simulations “provoke

a wider range of interrogations, encouraging the more abstract, theoretical engagement of historical processes" (Uricchio, 2005).

## 3. Methodology

The game will then be developed using the Unity Editor and coded in c# using Visual Studio 2017, using the Evolutionary Prototyping Model. External assets to be used in the game will be imported and utilized in the development environment. Saved files will be stored using binary formatting serialization, and player preferences will be stored using Unity's PlayerPrefs utility. The project itself will be backed up to Unity Cloud Storage for collaborative development throughout the prototyping process.

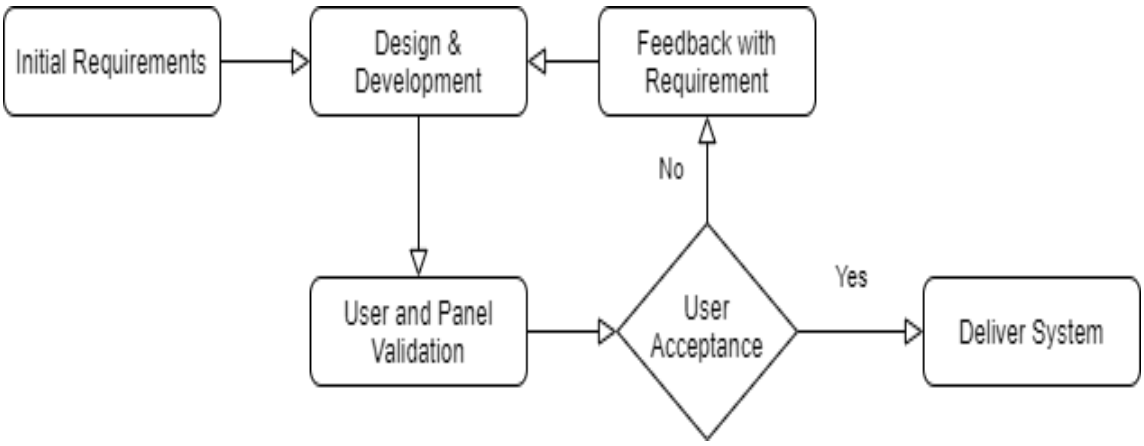


**Figure 1: Evolutionary Prototyping Model Diagram**

The initial phase of development focused on background research of the locations. The user interface (UI) and geolocation elements were then coded. Afterwards, the structure and game flow were formalized as the foundation for the AR module of the application was built. Quest content, dialog, the registering of coordinates, and design then followed before the final bouts of testing were conducted.

The Technology Acceptance Model (TAM) by (Davis, Bagozzi, & Warshaw, 1992) will be used to determine user acceptance of the technology about Perceived Usefulness, Perceived Ease of Use, and Behavioral Intention of Use. There will be 105 respondents.


(a)


(b)


(c)

**Figure 2: Screenshots of the application. (a) The title screen. (b) The map screen showing the player near a point of interest. (c) AR scenes, which can be seen when the player enters different points of interest.**

## 4. Results

This chapter presents the analyses and interpretation of the data gathered for the study. Specifically, the presentations were according to the specific scale that this study aims at revealing: the acceptability,

effectiveness, efficiency, and overall Ease of Use of the Augmented Reality Game Application. Behavioral Intention to use is the dependent variable. Performance Usefulness, Perceived Ease of Use, are independent variables. Age, Sex, and Experience using augmented reality applications are the moderating variables.

### 4.1. User Acceptance using Technology Acceptance Model (TAM)

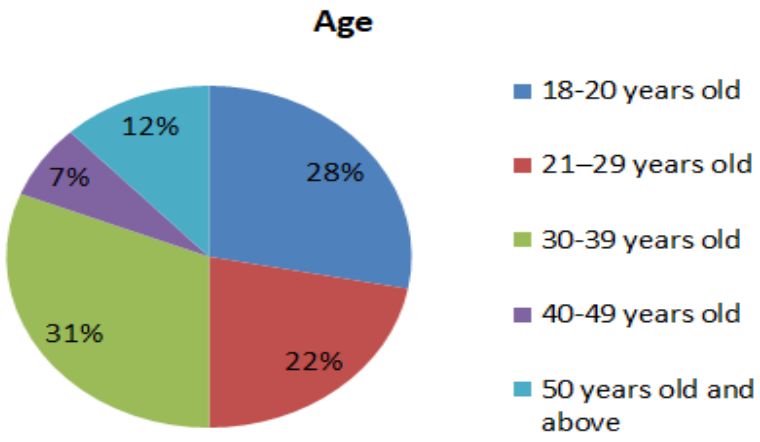


**Figure 3: Profiles of the Respondents According to Age**

Figure 3 indicates that the respondents of the study are mostly 30-39 years old which comprised 31%, followed by 18-20 years old which is 28%, next is the 21-29 years old, or 22%, and then the 50 years old and above or 12%, and the 40-49 years old, the 7% of the respondents. This also assumes that there is diverse representation included as data for the different age groups in the people of Butuan City.

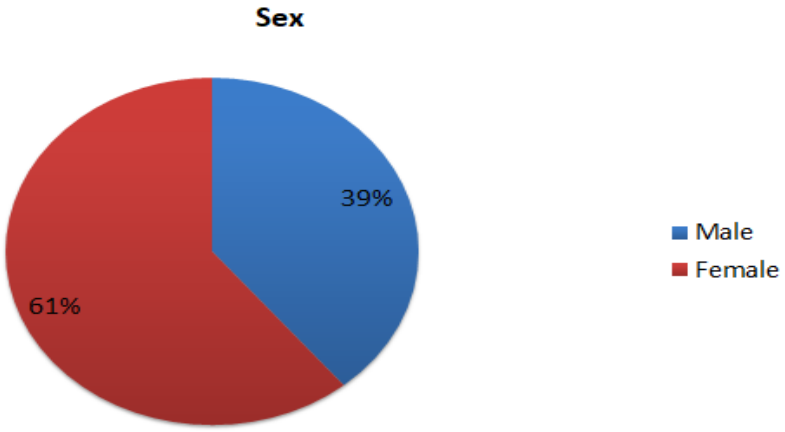


**Figure 4: Profiles of the Respondents According to Sex**

The chart in Figure 4 shows that there are 41 identified as males comprising 39% of the total samples, 64 individuals were recognized as females comprising 61%. In total there were 105 people in Butuan City who served as respondents for the TAM survey.

| Perceived Usefulness | Weighted Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| 1. Using the system would make … | 4.5 | 0.50 | Strongly Agree |
| 2. Using the system would help … | 4.47 | 0.56 | Agree |
| 3. Using the system would increase … | 4.37 | 0.49 | Agree |
| 4. Using the system would improve … | 4.06 | 0.49 | Agree |
| 5. I would find the system useful in … | 4.09 | 0.42 | Agree |
| **Average weighted mean** | **4.30** | **0.49** | **Agree** |

**Table 1: TAM Perceived Usefulness**

In the statistical analysis of the TAM survey, the results for the Perceived Usefulness indicated that respondents strongly agreed that the system would make them more interested in Butuan City and agreed that the system would help them learn more about the city, would increase their interest in visiting its tourist spots, would improve their experience when visiting these tourist spots, and would be useful in improving tourism in Butuan City. These findings agree with those of (Weber, 2014) which stated that location-based mobile Augmented Reality Games can be a way to attract tourists into exploring an urban destination or cultural heritage site. Thus, the researchers have the basis for the creation of this system as it helps the promotion of tourism in Butuan City.

| Perceived Ease of Use | Weighted Mean | SD | Interpretation |
|---|---|---|---|
| Learning to operate the system would be easy for me | 4.30 | 0.52 | Agree |
| I would find it easy to get the system to do what I want it to do | 3.49 | 0.68 | Unsure |
| It would be easy for me to become skillful in the use of the system | 4.02 | 0.46 | Agree |
| I would find the system easy to use | 3.30 | 0.58 | Unsure |
| **Average weighted mean** | **3.70** | **0.56** | **Agree** |

**Table 2: TAM Perceived Ease of Use**

The results for the Perceived Ease of Use revealed that respondents agreed that operating the application would be easy for them and that it would be easy for them to become skillful in the use of it. But they are not sure if they will find it easy to do what they want to do and find it easy to use. Thus, researchers must provide guidelines in using the system (Andersen, et al., 2012) and information for the people about the places included in the system for them to be able to access the said places as well as the mechanics on how to use the application.

| Behavioral Intention to Use | Weighted Mean | SD | Interpretation |
|---|---|---|---|
| 1. I presently intend to use the system when travelling to tourist spots in Butuan City | 4.45 | 0.55 | Agree |
| 2. I presently intend to use the system as a way to learn more about Butuan City | 4.54 | 0.55 | Strongly Agree |
| **Average weighted mean** | **4.50** | **0.55** | **Agree** |

**Table 3: TAM Behavioral Intention to Use**

The results for the Behavioral Intention to Use makes it known that respondents agreed and have the intent to use the system when traveling to tourist spots in Butuan City and intend to use the system as a way to learn more about the city. Respondents showed interest, which is supported by (Camilleri, 2019) stating that AR can play a vital role in generating curiosity and interest on travel destinations.

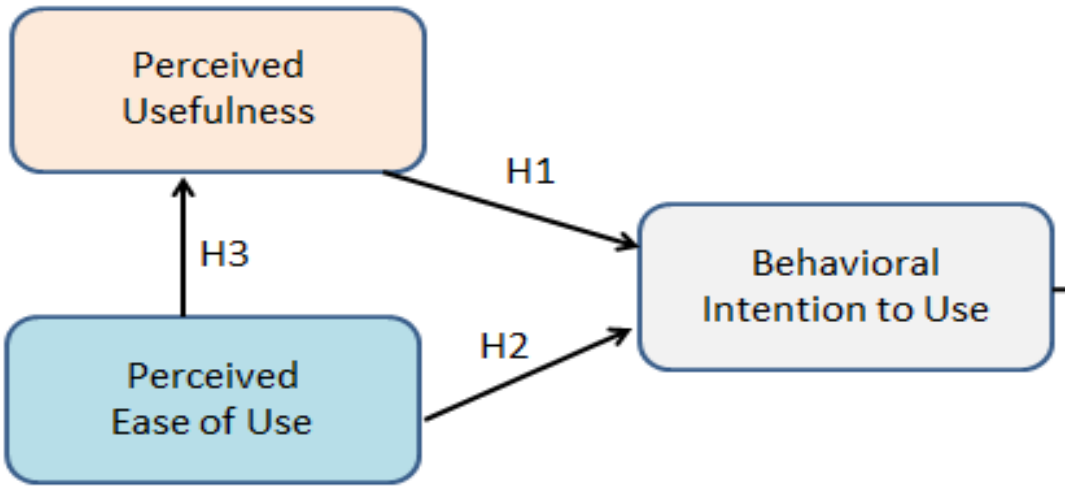


**Figure 4: Conceptual Research Model used in the study**

This study was tested using the following hypotheses:

H1: Perceived usefulness (PU) will have a significant effect on behavioral intention to use (BIU).

H2: Perceived ease of use (PEU) will have a significant effect on behavioral intention to use (BIU)

H3: Perceived ease of use (PEU) will have a significant effect on perceived usefulness (PU).

| Hypothesis | R | $R^2$ | P-value | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|---|
| H1 | 0.405 | 0.164 | 0.000 | Reject | Supported |
| H2 | 0.324 | 0.105 | 0.000 | Reject | Supported |
| H3 | 0.408 | 0.166 | 0.000 | Reject | Supported |

**Table 4: Summary Results of Hypotheses Test**

Table 4 indicates that the Perceived Usefulness (PU) has an R-Square of 0.164, which shows a capability of explanation of 16.41% in relation to the proportion of the variance in the dependent variable Behavioral Intention to Use (BIU) that is explained by PU. The P-value of PU is 0.000, and this shows significance.

It also indicates that the Perceived Ease of Use has an R-Square of 0.105, which shows a capability of explanation of 10.54% in relation to the proportion of the variance in the dependent variable PU that is explained by PEU. It is less than the capability of explanation of PU of the BIU. The P-value of PEU is 0.000, and this shows significance.

On the other hand, it indicates that the Perceived Ease of Use has an R-Square of 0.166, which shows a capability of explanation of 16.65% in relation to the proportion of the variance in the dependent variable BIU that is explained by PEU. It is slightly more than the capability of

explanation of PU of the BIU. The P-value of PEU is 0.000, this also shows significance.

Lastly, the findings showed that the augmented reality application has a significant effect on tourism. However, additional features of the said application must be added to further improve the performance, and likelihood of acceptance from the users.

## 5. Conclusion and Future Work

Therefore, based on the statistical analyses of the Technology Acceptance Model (TAM), the researchers conclude that there is a basis to develop this system, as it would help improve tourism in the City of Butuan. Respondents reported that it would make them more interested in Butuan City and agreed that the system would help them learn more about the city's history. It would also improve their experience when visiting tourist spots in the city. However, surveys also indicated that respondents found the response time of the information display to be slightly late, and that there needs to be a short tutorial text when using the application for the first time. In addition, Perceived Ease of Use (PEU) had less significant effect on Perceived Usefulness (PU) when compared to the significance of PEU and PU on user's Behavioral Intention (BIU) to use the application. BIU also had a significant effect on user experience in actual system use. Overall, respondents indicated that they have the intent to use the system when traveling to tourist spots in Butuan City and they also intend to use the system to learn more about the Butuan. Their experience in using the system shows a significant relationship among the Intention to Use the System, Perceived Ease of Use of the System and their Perceived Usefulness of it.

For future papers, research, and projects regarding this topic, it should be mentioned that the GPS accuracy could still be improved, and more tourist spots could be added. An AR view of the locations and their distance from the user could also be added. In addition, the structure of the application has been developed in a way that it could also be used for other cities and locales for their own tourist spots. Image recognition

of tourist spots could also be implemented, that could identify a building or scenery using reference images. One could also implement online functionality, such as a leaderboard, multiplayer aspects, factions, item trading, and synchronous multiplayer gameplay. More 3D models customized for each location could also be added, such as a 3D recreation of the Balangay Boat or a possible 3D recreation of the Banza church ruins at its prime. A social media aspect could also be integrated into the gameplay. A customizable player avatar is another recommended feature, which could be customized using items unlocked in-game.

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# Cyber Security Awareness Among Selected Educational Institutions in Butuan City Philippines

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**Abstract**

Internet use is becoming a daily routine for most Filipino educators and students. However, the Philippines ranked low in cultural aspect due to unintentional downloading of malwares through emails or search engines. This case study focuses on identifying and determining the level of awareness in cybersecurity of selected schools in Butuan City Philippines. This research utilizes the descriptive research model and describes the level of awareness in cybersecurity among selected and limited personnel from both government and private educational institutions in terms of experience of being breached or hacked, level of perception in security of the organization, presence of policies and procedures, presence of a unit responsible for cybersecurity awareness and monitoring, and awareness of information security attacks.

A survey questionnaire using Google Forms was used to determine the answers. The results showed that forty one percent (41%) of the responses from the private institutions have experienced virus attacks while 33% of the responses from the public educational institutions have experienced such. Fifty four percent (54%) say that their system is secure to a certain extent. While in the public experience, fifty percent (50%) mentioned that they perceived that their system is not secure.

46% of the respondents from the private institutions say that they have a dedicated department or division responsible for network security

while fifty percent (50%) of the public institutions say that they have no department dedicated for network security.

40% responses from the private educational institutions state that cyber incident response plans have been prepared by their organization. While 13% chose none of the selection or are not aware of the policies and procedures.

Fifty three percent (53%) of the responses from the private educational institution selected those presentations and discussion at conferences has raised their awareness of information security attacks while fifty percent (50%) from the public sector responded that both became aware through the conferences as well as legal and /or regulatory requirements.

There is a need for further study among educational institutions to foster preparedness especially in terms of a cyber threat or attack using other factors such as use behavior in such situations. Since almost forty one percent (41%) of the respondents have perceived that they have experienced virus infections which are probably through files downloaded which have embedded malware even though they are at PDF, DOC, and other non-detectable file extensions. The researchers recommend exploring other methods and instruments to evaluate other factors.

**Keywords**: Cyber security, cyber security perception, cyber knowledge, cyber awareness, cyber education, youth

## 1. Introduction

Internet use is becoming a daily routine for most Filipino educators and students, from social media news and email updates to school websites. The internet or the "Cloud" is important to the teachers and learners in coping with education updates and new trends. Some websites such as Google Plus, Facebook, Snapchat, LinkedIn, Twitter, Instagram, Google Gmail, Yahoo Mail, Dropbox, Google Drive, and Google sites are some of the current internet technologies used by most educational institutions in the Philippines.

Despite the massive use of the internet or cyberspace, little has been researched and investigated about the level of awareness of users in cybersecurity. Although the distinction between information and cybersecurity sometimes overlaps, the two are mostly discussed synonymously. Information security or data security focuses on confidentiality, integrity, and availability of data which is found in servers, laptops, and devices not necessarily connected to the internet. Cybersecurity, on the other hand, is protecting data in electronic form which basically is located online or in cyberspace. In some cases, authorities and school officials could only respond when a particular school's website has been maliciously hacked causing damages to certain crucial files. Most attacks such as defaced websites cause financial losses, from opportunity cost of having their website non-functional for several hours or days as well as damage to reputation of the school's ability to protect its information online. According to Kaspersky Real Time Cybermap, the top five (5) most attacked and infected countries are: Russia, Germany, Vietnam, India, and the USA, while the Philippines ranked 23rd among the most attacked countries. In the survey results in the Global Cybersecurity Index or GCI, the Philippines ranked 39th among 193 countries as of January 15, 2018. This was due to the high ratings from the legal aspect in implementing the Data Privacy Act (RA 10173), Anti-Wiretapping Law (RA 4200), the e-Commerce Law (RA 8792) and the latest Cybercrime Law (RA 10175). However,

according to study, the Philippines was low in rank in cultural aspect since most Filipinos inadvertently downloaded malwares through emails and the internet search engines. Many cases still present high rates of Filipinos responding to scam emails with attached malware in the forms of PDF or android installer file APK. Several cybercrime cases have been reported in terms of hacking, malware, cyber bullying, phishing, online scams, ransomware, and identity theft worldwide (Kaspersky, 2018).

In response to these cases, the Cyber Security Awareness campaign or CSA were researched by some countries to determine the level of citizen preparedness of a cyber threat or cyberattack. In South Africa, results of a study among students in a particular private institution revealed that twenty-four-point one percent (24.1%) have no knowledge about general secure behavior such as downloading and sharing pirated content. Eleven-point four percent (11.4%) are aware of password management, twenty seven percent (27%) are informed about cyberbullying, five percent (5%) do not know about phishing and online scams, forty-three-point one percent (43.1%) do not know about malware and or ransomware, and twenty one percent (21.7%) are responses relating to identity theft. In the United Kingdom, studies about cybersecurity awareness have been responded to since 2016. The Philippines has also responded by implementing RA 10175 (Cybercrime Law of 2012). The Philippine National Police (PNP) as well as the Department of Information and Communications Technology (DICT) has been active in their campaign to push schools to offer cybersecurity related subjects. However, despite the campaign in cybersecurity, there is a need to be updated on the level of awareness of the Filipino people in terms of being safe online most especially in the academic or educational sector. As such there is a need to evaluate the awareness of people from each region of the country. This case study focuses on identifying and determining the level of awareness in cybersecurity from selected schools in Butuan City, Philippines.

## 2. Related Literature

Cybersecurity awareness (CSA) is a key defense in the protection of people and systems. One of the studies for selected students has shown that instances of “cognitive dissonance" make the students (who were the subjects of their study) potentially vulnerable to cyber-attacks. Their methods involved giving a questionnaire which tested students in terms of four variables: cybersecurity knowledge, self-perception of cybersecurity skills, actual cybersecurity skills and behavior, and cybersecurity attitudes. The results suggest that there is a need for targeted CSA campaigns that could address the specific weaknesses of populations of users (Chandarman & Niekerk, 2017).

The graph below illustrates their findings:

**Figure 3: Students' knowledge of six cybersecurity matters**
(N = 1188, 1197, 1193, 1191, 1182, 1196)

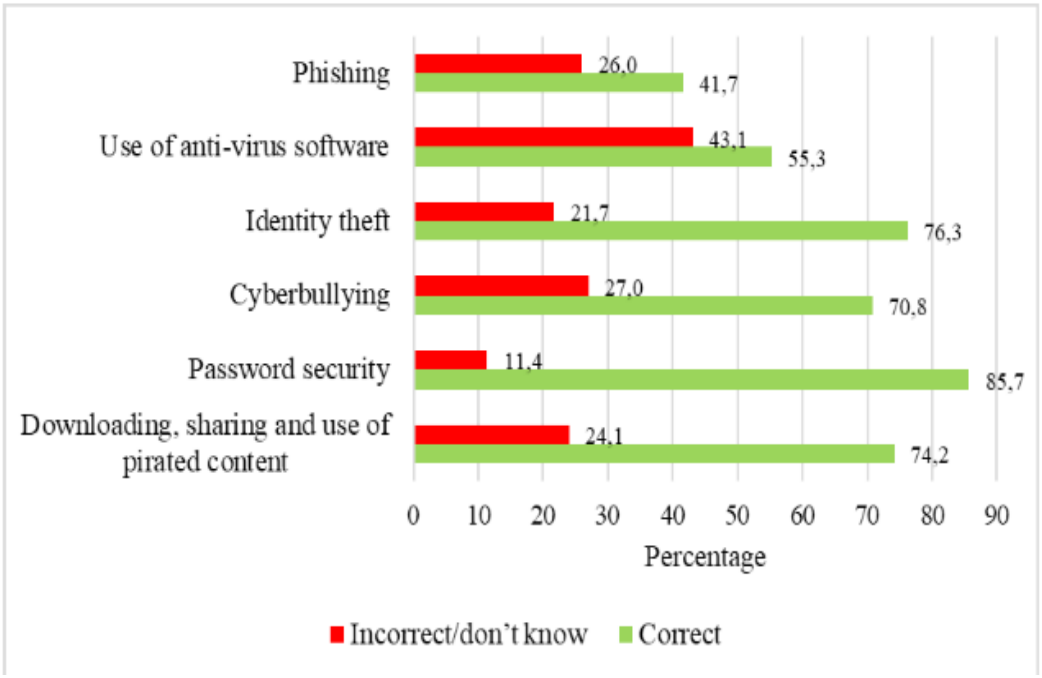


**Figure 1: R. Chandarman's - Students' knowledge of six cybersecurity matters**

In a study conducted by (Hadlington, 2017), he explored the relationship between risky cybersecurity behaviors, attitudes towards cybersecurity in a business environment, internet addiction, and impulsivity. The results demonstrated that internet addiction was a significant predictor for risky cybersecurity behaviors. On the other hand, a positive attitude towards cybersecurity in business was negatively related to risky cybersecurity behaviors. Interestingly, the measure of impulsivity also revealed that both attentional and motor impulsivity were significant positive predictors of risky cybersecurity behaviors, with non-planning being a significant negative predictor. The results present a further step in understanding the individual differences that may govern good cybersecurity practices. It strongly emphasizes the need for more effective training by focusing directly on the awareness mechanisms (Hadlington, 2017).

Stories of cyber-attacks are becoming a routine in which cyber attackers show new levels of intention by sophisticated attacks on networks. Unfortunately, cybercriminals have figured out profitable business models and they take advantage of online anonymity. Since most cyber incidents are human enabled, this shift requires expanding research to underexplored areas such as behavioral aspects of cybersecurity. In an effort to provide a review of relevant theories and principles, research has been conducted by (Maalem Lahcen, Caulkins, Mohapatra, & Kumar, 2020) to give insights about the matter. As a result, they proposed an interdisciplinary framework that combines behavioral cybersecurity, human factors, and modeling and simulation. Though they concluded that organizations should be involved in research to make sure that the model works the way they are intended (Rahman, Khalid, Sairi, Zizi,, & Khalid, 2020).

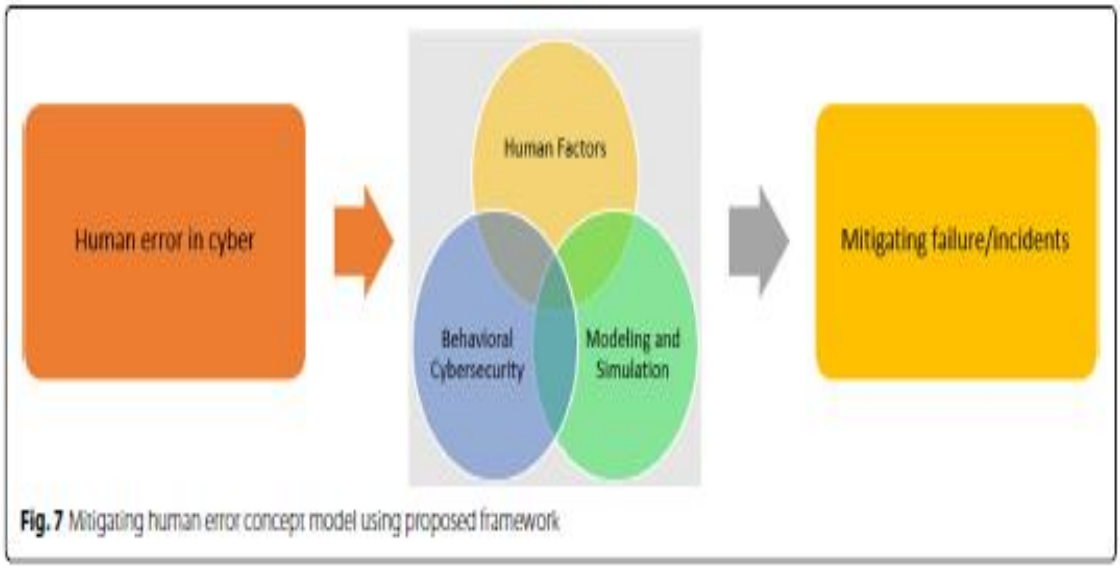


**Figure 2: Lachcen's Mitigating human error concept model.**

To tertiary institutions, a study was conducted by (Fatokun, Hamid, Norman, & Fatokun, 2019), which investigated if age, gender, and educational level has an impact on the cybersecurity behavior and beliefs of tertiary institution students, and to find out to what extent this difference exists. In their research, a cross-sectional survey was conducted among 340 students and Structural Equation Modelling was employed for evaluating impacts. Results show that students' cybersecurity behaviors varied based on Age for factors such as: Perceived Severity, Peer Behavior, Familiarity with Cyber Threats, Response Efficacy and Perceived Vulnerability. Gender effects also existed in Security Self Efficacy, Computer Skills, Cybersecurity Behaviors, Perceived Severity, and little effects in Prior Experiences with Computer Security Practices. Educational level differences existed in Cues to Action and Familiarity with Cyber-Threats. In summary and as a conclusion, all the three factors of age, gender, and educational level have some vital impacts on the components of cybersecurity perceptions and behaviors of students in the tertiary institution. Their findings instigate the need for specific/focused cybersecurity

training and interventions for students in the tertiary institutions (Fatokun, Hamid, Norman, & Fatokun, 2019).

In a published study of Monica Whitty, her team tried to focus particularly on the risky practice of sharing passwords. Despite the number of public advice campaigns, they hypothesize why individuals still engage in risky password practices. As they have predicted, it has been inferred that individuals who scored high on a lack of perseverance on their experiment test were more likely to share their own passwords. They also found out that age was a significant predictor of sharing passwords, as older people were more likely to share passwords (Whitty, Doodson, Creese, & Hodges, 2015).

Almost everybody has heard of cybersecurity. However, the urgency and behavior of persons do not reflect a high level of awareness. The inability to frame concepts of cybersecurity properly will result in a failure to develop appropriate policies. In a paper of (de Bruijn & Janssen, 2017), the study discussed the challenges in framing policy on cybersecurity. The limited visibility, socio-technological complexity, ambiguous impact, and the contested nature of fighting cybersecurity complicates policymaking. In their proposal, they presented evidence-based framing strategies which can help increase societal and political awareness of cybersecurity and put the issues in perspective. They argued that it is important to take the evidence as a starting point of framing the advocacy, and to avoid utopian and dystopian frames, as these typical strategies might be counterproductive (de Bruijn & Janssen, 2017).

In the Middle East, a study was conducted by (Al-Janabi & Al-Shourbaji, 2016) to understand the level of awareness of information security, the associated risks, and overall impact on the institutions. They conducted surveys to gather data and analyze the information security awareness particularly among academic staff, researchers, undergraduate students, and employees within educational environments. The results reveal

that the participants do not have the requisite knowledge and understanding of the importance of information security principles and their practical application in their day-to-day work. It was implied in the study that the situation can be corrected through comprehensive awareness and training programs (Al-Janabi & Al-Shourbaji, 2016).

Even though the internet has been advantageous to humankind, there are dangers that emerged related to the use of it. Cases like cyber-bullying, online fraud, racial abuse, pornography, and gambling had increased tremendously due to the lack of awareness and self-mechanism among internet users to protect themselves from being victims to these acts. One of the vital measures to be taken is to cultivate knowledge and awareness among internet users from an early age, i.e., young children. In a paper written by (Rahman, Khalid, Sairi, Zizi,, & Khalid, 2020), few strategies were discussed as to how cyber security education can be implemented in schools. The study tried to explore why it is so critical that modern learners are educated about the risks associated with being active in cyberspace. As a conclusion, factors such as the teacher's level of knowledge, funding, and resources are identified as the top challenges to cybersecurity in education. The general media which includes television and radio are also implied to play important roles in educating children through cybersecurity campaigns (Rahman, Khalid, Sairi, Zizi,, & Khalid, 2020).

In much recent research produced by (Wiley, McCormac, & Calic, 2020), the research attempted to explore the relationship between Information Security Awareness (ISA), organizational culture, and security culture. The results showed that while organizational culture and security culture were correlated with ISA, security culture played an important mediating relationship between organizational culture and ISA. This suggests that organizations should focus on security culture rather than organizational culture to improve ISA (Wiley, McCormac, & Calic, 2020).

In today's information-communication environment, awareness of and preparedness for digital threats is of utmost importance for organizational systems. It is not possible to fully guard against or eliminate all digital threats but with an educated awareness, management of the risks along with appropriate policies, and processes in place, organizational systems are competent to become digital resilient. In this regard, (Galinec & Luić, 2020)from Crotia proposed a model-based approach and methodology to create a model scheme, thus they created the novel Cyber Resilience Model within digital resilience.


**Figure 3: Galinec and Luic's Engagement Cyber Resilience Model**

Digital resilience modelling approach takes account of the components of digital threats within digital security and engagement. Further investigations are directed towards finding and enabling efficient and effective processes for agile cyber

resilience of the security information system able to cope with unforeseeable and unpredictable events in the inner and outer environment of the system (Galinec & Luić, 2020).

## 2.1. The Scenario

In the Global perspective, cybersecurity is a must. According to Kaspersky Real Time Cybermap, the top 5 most attacked and infected countries were: Russia, Germany, Vietnam, India, and the USA while the Philippines ranked 23rd as the most attacked country. Kaspersky's Cyberthreat Real-Time Map utilizes threats and attacks as detected from their installed software around the globe. It monitors eight areas per second namely: On Access Scan (OAS), On Demand Scan (ODS), Mail Anti-Virus (MAV), Web Anti-Virus (WAV), Intrusion Detection Scan (IDS), Vulnerability Scan (VUL), Kaspersky Anti-Spam (KAS), and Botnet Activity Detection (BAD). As of August 27, 2018, at 9:41 AM, the Philippines was ranked 24th as the most attacked country. The information in relevance to the eight areas as of the said date was: OAS (5,897 detections per second), ODS (8,578), MAV (40), WAV (8413), IDS(660), VUL (191), KAS(3118), and BAD (0). In relation to Top Infected mail using MAV in last week (August 19 to 25, 2018) the following were discovered and ranked:

1. (14.9%) Exploit. Win32. VE-2017-11882.gen.
2. (12.03%) Trojan.Win32.Crypt.gen.
3. (10.88%) Backdoor.Win32. Androm.qftz;
4. (4.98%) Dangerous Object.Multi-Generic; and
5. (4.97%) Worm.Win32.WBVB.vam. CVE-2017-11882 ranked last week and last month as No. 1 exploit detected by Kaspersky.

CVE-2017-11882 is a vulnerability that exists in Microsoft Office software. A successful attacker could take control of the affected system and then install programs; view, change, or delete

data; or create new accounts with full user rights. Such an attack could impact a great loss for educational institutions affected with such vulnerability.

In the survey results in the Global Cybersecurity Index or GCI, the Philippines ranked 39th among 193 countries as of January 15, 2018. This was due to the high ratings from the legal aspect in implementing the Data Privacy Act (RA 10173), Anti-Wiretapping Law (RA 4200), the e-Commerce Law (RA 8792), and the latest Cybercrime Law (RA 10175). However, the Philippines ranked low in cultural aspect due to reasons where most Filipinos unintentionally download malwares through emails or through search engines. Many cases still present high rates of Filipinos responding to scam emails with attached malware in the forms of PDF as well as android installer file APK. Some still enter their username and passwords in websites enabled for phishing as well as clicking links without suspecting if such link is malicious or not. Many cybercrime cases have been reported in terms of hacking, malware, cyber bullying, phishing, online scams, ransomware, and identity theft worldwide.

## 2.2. Global and National Cyber Security Awareness (CSA) Campaigns

In response to these cases, the Cyber Security Awareness campaign or CSA has been conducted as research by some countries to determine the level of preparedness of its citizens in case of a cyber threat or cyberattack. One of the efforts that is central to the conception of this study is the survey conducted by the Deloitte company, an Anglo-American multinational professional services network, through their Caspian region sector. Such endeavors gave insight into the information security maturity of organizations, with a focus on cyber security, and by far, one of the largest information surveys in Central Asia. The survey identified the five most relevant conclusions on the current state of information security programs in Central Asia, which were as follows: 1. Majority of companies have not been exposed to

cybersecurity incidents. 2. Information security policies, procedures and responsibilities are mostly in place and defined. 3. Insufficient controls to ensure third parties, (i.e., vendors / partners), comply with appropriate security standards. 4. Awareness of business (senior) management and end-user around cybersecurity risks is insufficient. 5. Though basic security measures are in place; more advanced solutions are uncommon. In South Africa, results of a study in the level of awareness among students in a particular private institution revealed that twenty four point one percent (24.1%) of the respondents do not have knowledge about general secure behavior such as downloading and sharing of pirated contents, eleven point one percent (11.4%) are aware of password management, twenty seven percent (27%) are informed about cyberbullying, fifty six percent (56%) do not know about phishing and online scams, forty three point one percent (43.1%) do not know about malware and or ransomware, and twenty one point seven percent (21.7%) are responses relating to Identity theft. In the United Kingdom, studies about cybersecurity awareness have been responded since 2016.

The Philippines has also responded to the cyber threats as well as attacks by implementing the Cybercrime Law of 2012 or the RA 10175. Government agencies such as the DILG-PNP as well as the Department of Information and Communications Technology (DICT) has been active in their campaign to push schools to offer cybersecurity related subjects (sunstar.com, 2017).

However, despite the campaign there is still a need to be updated on the level of awareness of the Filipino people in terms of being safe online most especially in the academic or Educational Sector.

## 3. Methodology

The case study utilized the descriptive research model. Describing the level of awareness in cybersecurity among selected and limited personnel from both government and private educational institutions in terms of (1). Experience of being breached or hacked, (2) Level perception in security of the organization, (3) Presence of policies and procedures, (4) Presence of a unit responsible for cybersecurity awareness and (5) Monitoring, and awareness of information security attacks. These factors are derived from the questions conceptualized in the 2014 study conducted by Deloitte in Central Asia. A survey questionnaire using Google Forms was used to determine the answers.

## 4. Results and Discussions

The case study focused on identifying and determining the level of awareness in cyber security from selected schools in the province of Agusan del Norte, Philippines, in terms of experience of being breached or hacked, level perception in security of the organization, presence of policies and procedures, presence of a unit responsible for cybersecurity awareness and monitoring, and awareness of information security attacks.

### 4.1. Profile of Respondents

a. Educational Institution Employed

i. Private Educational Institution(s) = 82.2%

ii. Government Educational Institution(s) = 11.8 %

A total of fifteen (15) respondents answered the questionnaire online. Thirteen (13) or eighty-seven percent (87%) of the respondents come from the private educational institutions

while two (2) or thirteen percent (13%) of the respondents came from government educational institutions.

**1. In terms of Experience of being breached or hacked.**

| | **Private Educational Institutions (n=13)** | **Public Educational Institutions (n=2)** |
|---|---|---|
| a. Not Exposed | 4 | 1 |
| b. Virus | 7 | 1 |
| c. Hacker | 2 | |
| d. Malware | 2 | 1 |
| e. Stolen Assets | 0 | |
| f. Information not available | 1 | |
| g. Weaknesses highlighted during testing | 1 | |
| **Total** | **17** | **3** |

**Table 1: Have you suffered a breach or hack in the past twelve (12) months? (Multiple answers considered)**

From Table 1, 7 or 41% of the responses from the respondents from the private institutions have experienced virus attacks while 33% of the responses from the public educational institutions have experienced such.

**2. Level of perception in security of the organization**

| **Selection** | **Private** | **Public** |
|---|---|---|
| a. Sufficient secure | 4 | 1 |
| b. Secure to a certain extent | 7 | 0 |
| c. Info not available | 2 | 0 |
| d. Highly secure | 0 | 0 |
| e. Not secure | 0 | 1 |
| **Total** | **13** | **2** |

**Table 2: How secure do you think your organization's network is?**

Responses from the private educational institutions reveal that seven (7) personnel or fifty four percent (54%) say that their system is secure to a certain extent. This means that fifty-four percent perceived that their system could protect them only to a certain extent. There are possibilities that the system would and could not be secure. While in the public educational institutions' experience, fifty percent (50%) mentioned that they perceived that their system is not secure.

**3. Presence of policies and procedures**

| Selection | Private | Public |
|---|---|---|
| a. Cyber incident response plans | 6 | |
| b. Information security roadmap | 1 | |
| c. Business continuity plans | 2 | |
| d. Not developed but due to be developed | 1 | |
| e. Information security governance structure | 1 | |
| f. Information security strategy | 2 | |
| g. None of the Above | 2 | |
| **Total** | **15** | |

**Table 3: Which of the following (policies / procedures) has your organization documented and approved? (Multiple answers possible)?**

40% responses from the private educational institutions state that cyber incident response plans have been prepared by their organization. While 13% or 2 responses chose none of the selection or are not aware of the policies & procedures.

**4. Presence of a unit responsible for cybersecurity awareness**

| Selection | Private | Public |
|---|---|---|
| a. Yes, dedicated department / division | 6 | 0 |
| b. Yes, but as part of another department (IT or Internal Control Department) | 5 | 1 |
| c. No | 1 | 1 |
| No answer (Blank) | 1 | 0 |
| **Total** | **13** | **2** |

**Table 4: Does your organization have a (dedicated) department responsible for Network Security?**

46% of the respondents from the private institutions say that they have a dedicated department or division responsible for Network Security while fifty percent (50%) of the public institutions say that they have no department dedicated for network security.

**5. Monitoring, and awareness of information security attacks**

| Selection | Private | Public |
|---|---|---|
| a. Presentations and discussions at conferences | 10 | 1 |
| b. Publications in magazines, on websites and mailing lists | 5 | 0 |
| c. Legal and/or regulatory requirements | 4 | 1 |
| d. The infrastructure of our organization was under attack | 0 | 0 |
| e. Clients of our organization were attacked | 0 | 0 |
| **Total** | **19** | **2** |

**Table 5: What has raised your awareness of information on security attacks? (Multiple answers possible)**

Ten (10) or fifty three percent (53%) of the responses from the private educational institution selected that presentations and discussions at conferences have raised their awareness of information security attacks while fifty percent (50%) from the

public sector responded that both became aware through the conferences as well as legal and /or regulatory requirements.

## 5. Summary, Conclusion, and Recommendations

| | Private (n=13) | Public (n=2) |
|---|---|---|
| Experience of being breached or hacked | 41% | 33% |
| Level perception in security of the organization | 54% | 50% |
| Presence of policies and procedures | 40% | 13% |
| Presence of a unit responsible for cybersecurity awareness | 46% | 50% |
| Monitoring, and awareness of information security attacks | 53% | 50% |

**Table 6: Summary of Results**

The case study focused on identifying and determining the level of awareness from selected schools in the province of Agusan del Norte, Philippines, in cyber security in terms of experience of being breached or hacked, level perception in security of the organization, presence of policies and procedures, presence of a unit responsible for cybersecurity awareness and monitoring, and awareness of information security attacks. Forty one percent (41%) of the responses from the respondents from the private institutions have experienced virus attacks while 33% of the responses from the public educational institutions have also experienced such. Fifty-four percent (54%) say that their system is secure to a certain extent. While in the public experience, fifty percent (50%) mentioned that they perceived that their system is not secure. 40% of the responses from the incident response plans have been prepared by their organization. 13% responses from the respondents say that procedures were done by their institution. 46% of the respondents from the private institutions say that they have a dedicated department or division responsible for network security while fifty percent (50%) of the public institutions say that

they have no department dedicated for network security. Fifty-three percent (53%) from the private educational institution responded that presentations and discussions at conferences have raised their awareness of information security attacks while fifty percent (50%) from the public sector responded that both became aware through the conferences as well as legal and /or regulatory requirements.

The need to be updated on the level of awareness of the Filipino people in terms of being safe online most especially in the academic or educational sector is a must. Since almost forty one percent (41%) of the respondents have perceived that they have experienced virus infections which are probably through files downloaded which have embedded malware even though they are at PDF, DOC, and other non-detectable file extensions.

There is a need for further study among educational institutions to foster preparedness especially in terms of a cyber threat or attack using other factors such as use behavior in such situations.

Lastly, in future studies, the researchers recommend exploring other methods and instruments to evaluate other factors.

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# Descriptive Analytics and Naïve Bayes Algorithm on Mobile Implementation for Sales and Inventory Marketing

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**Abstract**

The Descriptive Analytics and Naïve Bayes Algorithm on Mobile Implementation of Sales and Inventory Marketing is tool that solved the burden of J9ntel Computer Marketing personnel in handling their daily transactions. Updated sales and inventory of products in all branches that can be viewed on desktop computers and mobile phone. An evaluation instrument derived from ISO 9126 was utilized in testing the system and obtained the mean rating of 4.10 with an adjectival rating of Very Good. The testing result indicates that the system passed the software quality evaluation and possesses the quality of a good software. It has been demonstrated that the system can manage product sales and inventory, including the identification of the most-to-least selling products as part of the implementation of business analytics and forecasting. However, the system needs more features that will support decision making.

**Keywords**: **Descriptive Analytics, Forecasting, Mobile Implementation, Sales and Inventory, Naïve Bayes**

## 1. Introduction

Prediction is a statement about what will happen in the future as defined by (Cambridge, n.d.) dictionary. In the field of business and marketing this prediction has placed an important role for the success of the business establishment. In sales and inventory, forecasting is a big help to keep the business sales on its peak. With the aid of the newest available technology in the market forecasting was made easily. Forecasting was made simple with the help of the most recent available technology on the market. Many things come to its instant through the aid of these technology advancements and innovations. Nonetheless, it is a continuing process of improvement as human intelligence keeps on moving forward to sustain its wants and needs.

Massive urbanization in any part of the world has brought a perpendicular growth to demands of products and services. To sustain these demands as stated in the study of Mohan that suitable technology policies might mobilize urbanization (Mohan, 1988). Business firms whose primary purpose is not only to gain more profit but to satisfy customers' needs must provide competitive Point of Sale and Sale and Inventory System as well.

Inventory management in a supply chain is a challenging problem (Plinere, 2015). Finding quantity of inventories to fulfill customers need and to avoid overstocking is the major purpose of inventory management. Sustaining enough level of inventory might result in a better financial performance (Shin, Ennis, & Spurlin, 2015). Since the overstocking may result in increases in cost while understocking may result in loss of sales. The inventory management should not also take much capital to invest despite from its necessity since the return of investment might be longer.

Sales and inventory system is a very important tool to make file updated and easy to locate because it is accurate and orderly organize (Abacahin & etal, 2012) . Report for various personnel in the warehouse become easy since data were available electronically and very accessible anytime needed. In such manner, the better productivity of the employee that the company had benefited.

Despite the advancement of technology and inventory management system had mentioned above, J9ntel Computer Marketing is still using manual process in doing all their sales transactions and product inventory. The company is using paper and pencil in providing customers receipt and using spreadsheets for their stocks inventory. Monitoring of stocks available and stocks on a critical level is not readily available with just one click of the fingertip in computer keyboards. This issue had repercussion more complicated problem such as overstocking that affects product cost and under stocking that resulted in a loss of company sales.

It cannot be denied that there are lot of existing automated sales and inventory management on the market nowadays. It becomes very common to most establishments who are engaged in sales and marketing. However, creating such with additional features like analytics and business intelligence might be a very helpful. Analytics and its related fields have grown tremendously and now there are wide varieties of industry participants that use analytics. They range from industries that provide data infrastructure, data warehousing solutions, middleware, data aggregation, and analytics software developers to analytics user organizations and academics. There are three types of analytics: descriptive, predictive, reporting, and prescriptive. In this system descriptive analytics were used to the collected data from the database to provide trends of sales and product inventory. This type of analytics focused on the business intelligence and has been significant technology around visualization.

Implementation of Analytics and Naïve Bayes Algorithm on Mobile Sales and Inventory System aims to provide a competitive inventory of stocks and management of sales transaction. It also includes timely reports needed for documentation and future references to orders and daily sales target. Monitoring of the most to least selling products was also included in the system by integrating Naïve Bayes algorithm in forecasting and other business analytics.

## 2. Related Literature

The rapid growth of population has emerged huge demands for products and services. These rising demands have enabled technology a necessity for human life. Papers and pencils which is usually used to document daily transaction such as sales, inventory and reports were converted into an electronic file. Long queuing to service counter on grocery stores is no longer a problem since Point of Sale were developed that is more efficient than manually writing receipt using pencil and papers. The electronic copy of inventory that can be easily retrieved has replaced the previous pencil and logbooks.

In manufacturing firm inventory is the second largest assets (Raphella, Gomathi, & Chitra, 2014), ABC analysis of inventory is a method to categorize the valuable items into three categories: A- item with highest consumption value, B- items with medium consumption value, and C- items with the least consumption value. Maintaining sufficient stocks resulted to smooth sales operations and efficient customer service. In such manner, the system for J9ntel Marketing can monitor the top to the least selling products so that overstocking and under-stocking be avoided.

Olap.com defined Business Intelligence (BI) as technologies, applications, and practices to collect, integrate, analyze, and presents business information to the prescribed client. Supporting to create a better decision making is the main objective of Business Intelligence. Basically, the term Business Intelligence systems are data-driven Decision Support Systems (DSS). It is sometimes interchangeably used with consulting books, report, and querying tools. For most of the executive information systems, it contains historical, current, and forecast views of the future business operations and enhancement. In such manner, the developed system can forecast sales and even graphically displays the most to the least selling products.

The accurateness of sales forecasting can be enhanced by predictive analytics as mentioned in an article Predictive Monthly: Sales Forecasting—How Algorithms Are Putting an End To Guessing (Leroux, 2015). This predictive analytics is a tool used by salespersons to identify

on how and when to approach customers based on an algorithm that controls variable that influences customer's decision to buy. Forecasting in many aspects especially the economy is a risky and sometimes humbling task (Litterman, 1986). Using the current and previous data to generate possible future events is one problem in forecasting. However, there are a lot of statistical procedures developed and had successfully forecasted a variety of context. The Naive Bayesian classifier is based on Bayes' theorem with independence assumptions between predictors. The absence of iterative parameter estimation that makes it suitable for a huge dataset and the model is easy to build. The sophisticated classification methods used and its surprising performance in forecasting made it widely used by the industries. Bayesian theorem provides a way of calculating the posterior probability, *P(c|x), from P(c), P(x), and P(x|c)*. (Litterman, 1986); (Sayad, 2017) Naïve Bayesian theorem assumes that the values of each predictor are independent of each other.

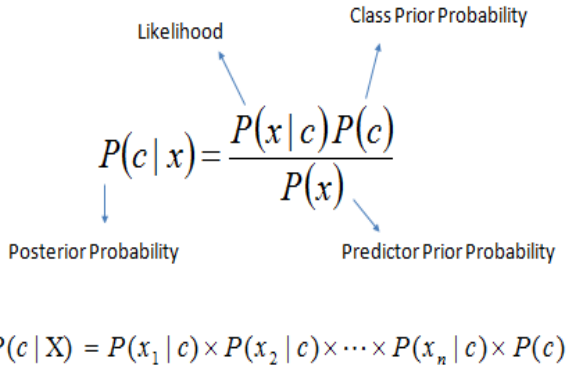


**Figure 1: Conditional Independence**

where:

- P(c|x) is the posterior probability of class (target) given predictor (attribute).
- P(c) is the prior probability of class.
- P(x|c) is the likelihood which is the probability of predictor given class.
- P(x) is the prior probability of predictor.

Figure 1 shows the formula used in Naïve Bayes algorithm in forecasting. The posterior probability can be calculated by first, constructing a frequency table for each attribute against the target. Then, transforming the frequency tables to likelihood tables and finally use the Naive Bayesian equation to calculate the posterior probability for each class. The class with the highest posterior probability is the outcome of prediction.

Evaluation is an essential procedure done prior to the implementation of any developed software. With this regard, the researcher makes use of an evaluation instrument adapted from ISO 9126 that composed of six quality characteristics. Functionality which is defined as the essential purpose of the study. Reliability characteristic defines the capability of the system to maintain its service provision under defined conditions for defined periods of time. Usability refers to the ease of use for a given function. Efficiency is focused on the resource being used when providing the required functionality. Maintainability is the ability of the system to identify and fix a fault within a software component. Portability refers to how well the software can adapt to changes in its environment or with its requirements. The evaluation instrument used five-point Likert Scale in which the highest rating is 5 and 1 is the lowest (Vagias, 2006). The total of 100 respondents evaluated the system using 14 indicators and rated numerically using a scoring system in Table 1. The respondents were chosen using purposive random sampling (Kemper, Stringfield, & Teddlie, 2003). This is a combination of two methods purposive and random sampling. Purposive sampling is a method choosing respondents based on the characteristics of a population and the objective of the study (Palys, 2008); (Crossman, 2017). Random sampling is a technique of choosing a sample in which the respondents of an accessible population have an equal opportunity to be chosen (Teddlie & Yu, 2007).

| Numerical Rating | Descriptive Rating |
|---|---|
| 5 | Excellent |
| 4 | Very Good |
| 3 | Good |
| 2 | Fair |
| 1 | Poor |

**Table 1: Five Point Likert Scale**

The Central Limit Theorem (CLT) was one of the bases in getting the sample size. According to Investopedia Central Limit Theorem is a statistical theory that states for given a sufficiently large sample size from a population with a finite level of variance, the mean of all samples from the same population will be approximately equal to the mean of the population. Most sources state that for most application N=30 is sufficient as sample size [6]. The minimum sample size is 100 to obtain a meaningful result and the maximum of 10% of the total population for as long as it will not exceed to 1000 [10].

The result of the software evaluation from the respondents was counted and the mean was computed using the formula:

**Mean = Σwx/Σw**

where:

Σ is the sum of,

w is the weights, and

x is the value[11].

The result of the computation was interpreted based on the distribution as shown in Table 2. This matrix will be used to identify the score and the corresponding adjectival rating.

| Weighted Mean | Adjectival Rating |
|---|---|
| 4.21 - 5.00 | Excellent |
| 3.41 - 4.20 | Very Good |
| 2.61 - 3.40 | Good |
| 1.81 - 2.60 | Fair |
| 1.00 - 1.80 | Poor |

**Table 2: Mean Interpretation Table**

## 3. Methodology

Peter DeGrace originated the Sashimi model as a modified version of waterfall model (Matkovic & Tumbas, 2010). It consists of six overlapping phases: requirements, design and architecture, developing and coding, quality assurance and software testing, implementation, and maintenance and support as shown Figure 2. An overlapping phase allows on-time identification of errors while development is still in progress. In addition, the model treats the documentation as a unified document that results to a significant reduction in documentation volume.

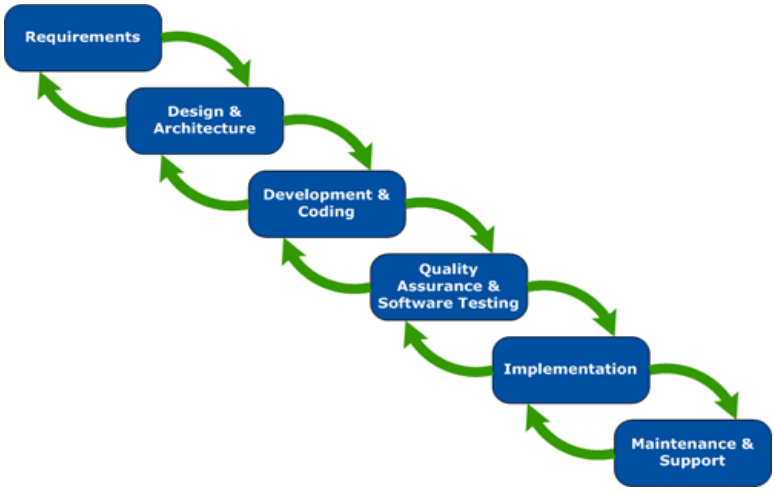


**Figure 2: Sashimi Waterfall (DeGrace, 2010)**

This model was used and served as a guide for the researcher to set deadlines of deliverables and outputs. Timelines for every phase was also studied and scheduled so that breach of contract to the client must be avoided.

**Requirements**. The researcher gathered data through interview of the branch head and employees of J9ntel Computer Marketing to know how they do their daily manual transactions.

**Design & Architecture**. The feature of the system was created on this phase. Different modules were designed to satisfy the requirements of the client as shown in figure 4.

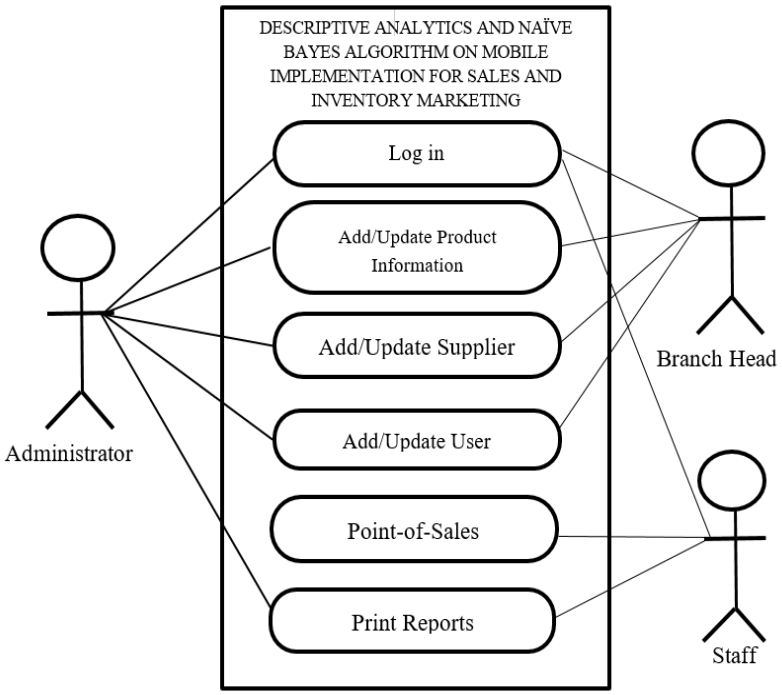


**Figure 3: Use Case Diagram of the System**

Figure 3 shows the different types of users that will interact with the systems together with its major functions. The stickman indicates the user and a box which indicates boundaries between user and the system. The major functions of every user can be identified by a straight line connecting to the user which is symbolized by a stickman.

**Development and Coding**. The designed served as a basis for the project development. Every unit of code was tested and debugged immediately to comply the requirements of the system.

**Quality Assurance and Software Testing**. Before implementation of every developed software, a series of testing should be administered. This is to ensure that the software complies all the requirements and follows the standard of a good quality software.

*Unit testing* is done to verify the internal logic of code if it satisfies the known functions of the website.

*System testing* the second state of a testing process where the user was allowed to navigate the software and test the system functionality, reliability, usability, efficiency, maintainability, and portability.

*Acceptance* the third and last stage of a testing process where the client was allowed to navigate the system and test if it satisfies the specified requirements as approved in the memorandum of agreement.

**Implementation**. In this phase, the software was deployed to the client and a user's manual was also provided for the users to further understand the program work through.

**Maintenance and Support.** After the software is deployed to the client, the development team have agreed that a six-month maintenance will be provided pertaining to problems encounter but not limited to the scope stated in the memorandum of agreement.

The study made use of PHP as the main language for development, MySQL for the database, JavaScript as a scripting language, and different plugin available on the internet for design and most functions.

The Descriptive Analytics and Nave Bayes Algorithm for Mobile Implementation of Sales and Inventory Marketing is a four-module system that includes User Account Modules, Sales and Inventory, Setting Modules, and Report Modules.

The user account modules are a module where the administrator can add or edit user accounts. Viewing of orders, generating order slip, viewing of the volume of orders graphically, and forecasting of delivery volume can be found in the order and delivery module. The third module, setting modules is where the administrator can add news and events, add products, and edit prices, product descriptions, add and edit supplier information, add, and edit branch, and content management of the website. Lastly, the report modules consist of sales report and inventory reports on a daily, weekly monthly, and annually.

## 4. Results and Discussion

The system is composed of four different modules and can be viewed using desktop and mobile phones. It consists of three different landing pages. The home page that allows three different types of users to log in: administrator, branch head and staff (Fig. 4). The administrator can view inventory, sales, suppliers of products in all branches and can add branches, branch head has almost the same access level of the administrator except it only view only records from the assigned branch. The distinct function of a branch head is adding new products, category, and brand name. Sending request for products to the administrator also done by branch head only (Fig. 5 and Fig. 6).

Figure 4 is the home page. This is where the user can log in by supplying the valid username and password. It prompts error message if the user did not provide the username and password correctly however if it is correct the system itself can identify the type of user.

Figure 5 shows the home page for branch head. The dashboard shows the total monthly sales of every product and the most selling products of the branch in a graphical form. As an application of business intelligence, the system can identify products in critical stock and out of stock and it can be shown in the product tab.


**Figure 4: Home Page**

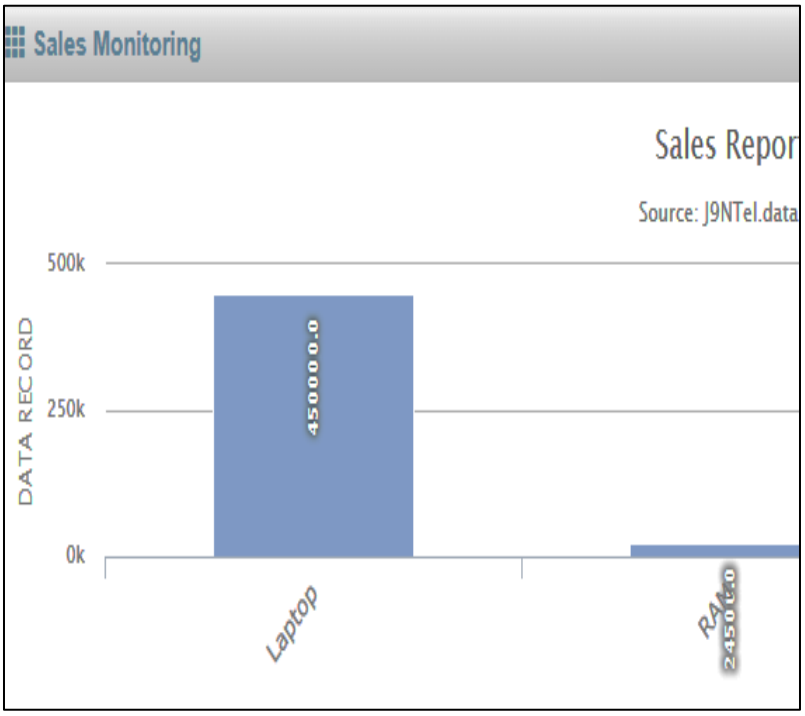


**Figure 5: Home Page for Branch Head**

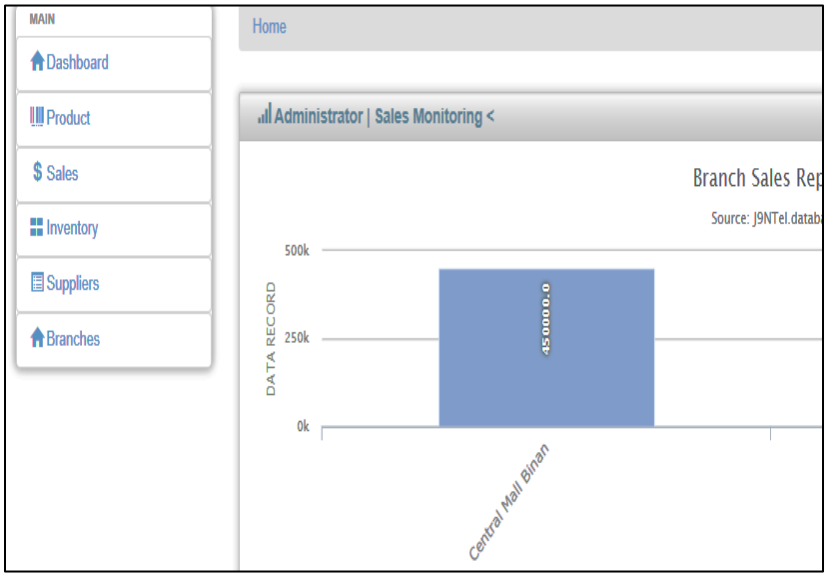


**Figure 6: Home Page for Administrator**

Figure 6 shows the home page of the administrator. The total sales for every branch and the top selling products for all branches were also shown.

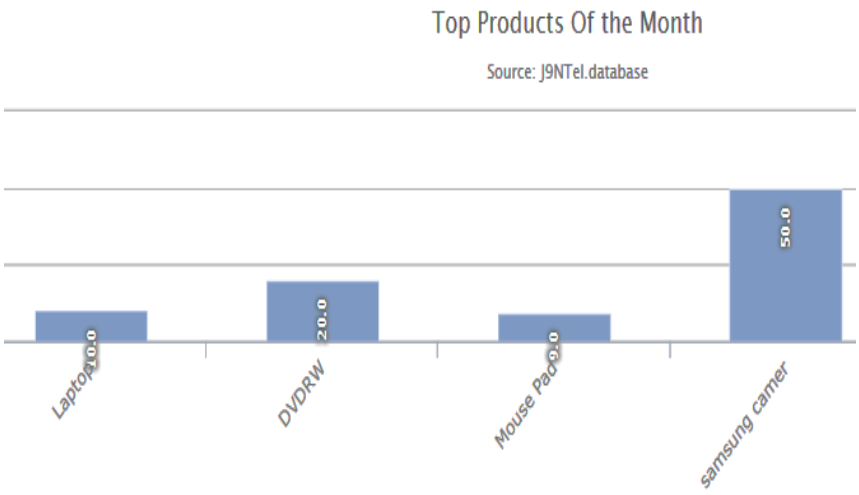


**Figure 7: Most to Least Selling Products**

Figure 7 is the application of business intelligence, and it can be found both the administrator and the branch head dashboard. Most to least selling products are graphically displayed for the management to easily find out some measures to improve sales on least selling products and somewhat be the basis for the number of orders to the supplier. Monitoring historical data of a product to predict future sales is very essential to a business (Rotenberg & K, n.d.). Such monitoring can help managers set a more realistic expectations on what to order and which product should be given enough stock every sales cycle.


**Figure 8: Forecast of Sales of Products**

Figure 8 shows the forecast of a product to be sold the following month. Since sales forecasting is very essential to a company especially when it comes to sales and marketing business (Rotenberg & K, n.d.). It can help visualize the targets more realistic. In addition, this will allow managers foresee how relative is the sales to the goals and may somehow set common goals among the members of the team. The basis is the previous month record. The percentage of the chances to be ordered are also indicated. This figure is an application of the Bayesian algorithm in forecasting.

In order determine if the system complied both the requirements of the client and the requirement of a good quality website a project evaluation was conducted. Using the questionnaire derived from ISO 9126 a total of 40 respondents which consist of thirty different customers and ten employees of J9ntel Computer Marketing. They were advised to navigate the system functionalities to determine if it satisfies their needs. The overall results as shown in table 3.

| Criteria | Mean | Adjectival Rating |
|---|---|---|
| Functionality | 4.28 | Excellent |
| Reliability | 3.96 | Very Good |
| Usability | 3.95 | Very Good |
| Efficiency | 4.05 | Very Good |
| Maintainability | 4.12 | Very Good |
| Portability | 4.26 | Excellent |
| **Mean** | **4.10** | **Very Good** |

**Table 3: Overall results of the evaluation**

Functionality criterion highest among all criteria which indicate that the system is working and have complied all the required functionalities of a good quality software. However, usability criterion got the lowest among all criteria which still indicates that the system is user-friendly and easy to navigate.

## 5. Conclusions

In the view of the summary of findings, and incognizant with the general objective of the developed system the following conclusions were derived: the system was able to monitor inventory, manage sales transactions, identify the most to least selling products, generate printable reports and official receipt, forecast monthly sales in a graphical form, and successfully passed the evaluation using the instrument adopted from ISO 9126 to be Very Good with the mean 4.10.

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# Decision Support System with Analytic: Real-Time Health Monitoring System in Butuan City

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**Abstract**

The different types of Local Government Units (LGU) in Butuan City like rural health units, local units, and barangay health centers used the traditional data gathering method in storing data to monitor young ages 0 to 72 months which posed risks in data loss and data vulnerability. Thus, the researchers developed a system utilizing advanced tools that can help to improve the current way of gathering data on young ages health status. The researchers used Decision Support System (DSS) with analytics in health monitoring of young ages 0 to 72 months. The web system itself was developed with the CodeIgniter which utilizes Model View Control Framework. In addition, the researchers applied Agile Method of Development for rapid development to achieve the goal within the desired timeframe. As a result, the system with analytics provides decision support technologies for the health care provider aimed at enabling knowledge workers such as physicians, nurses, and health officials, health policymakers, and pharmacists, to gain insight and make better and faster health decisions. Further, the Technology Acceptance Model (TAM) was employed to examine the behavioral intention of the target end users to use for the system. Moreover, the finding of study shows that the beneficiary of the systems positively adopted the system since it is very useful in monitoring and in the decision-making process. Amongst the constructs used in the TAM,

Security, Technological Complexity and Perceived Ease to Use were not statistically supported. However, the practical relevance of the finding could be considered by the management in order to improve the consistency of work in the barangay health centers in Butuan city.

**Keywords: Decision Support System, Data Analytics, Health Monitoring Systems**

## 1. Introduction

Young age health interventions are treatments, technologies, and key family practices that prevent or treat childhood illness and reduce deaths in children under five years of age (Lithuania, 2019). When interviews were conducted, 70% among the barangays health workers stated that child interventions is what the city of Butuan needs and its manual recording of information leads to delayed reports to the City Health Office. This prompted researchers to find ways in improving the consistency of output in barangay health centers in Butuan City.

Healthcare analytics have been identified as a solution to such a problem. These applications can be considered a "collection of decision support technologies for the health care provider aimed at enabling knowledge workers such as physicians, nurses, and health officials, health policy makers, and pharmacists to gain insight and make better and faster health decisions" (Raghupathi, & Raghupathi, 2013)

## 2. Related Literature

In recent years, the health sector has been rapidly integrating technology in the monitoring, diagnosis, and treatment of patients remotely and on site (Tupel et al.,2017). Thus achieving to improve the quality of life of patients and greater traceability of information from them. Most studies reviewed point to a child health monitoring which is responsible for the first development and implementation of the child health monitoring intended for analysis of preventive child health check-up and morbidity data (Lithuania, 2019).It is a very important way to develop a comprehensive solution where no matter what kind of diseases, type of check, or different units to be handled, this can become a possible solution for sequential monitoring of these patients (Batumi, 2019).

Other systems have found special features which make use of their development. In the case of the monitoring system using sensor technology, which is provided to a school organization to monitor the

child's physical condition (Heartbeat and Body temperature), it can be determined using sensors (Tupel et al.,2017).

Within these systems, it can also be found that the development of some of these is dedicated to patient care through telemedicine. Through interactive media and development of alternative technologies, it could contribute to improved consultation and clinical monitoring as well as anything related to health care from home, proposing a terminal for the integration of medical services from home using external sensors for measuring vital signs (Chen et al., 2018).

The health monitoring system includes a lot of data about the patients. There are patient safety issues that arise mainly from medical errors and result in increased patient deaths and financial and legal consequences for the providers and because of that, data warehouses merge disparate data to create health dashboards, clinical data repositories, and individual patient views (Ahmed, 2016). Health entities are moving toward predictive analytics, building on the capabilities of descriptive analytics to forecast future events using various models and what-if analyses (Bouayad, 2017). According to Jaisal (2018), data analytic is the art of exploring the facts and figures from the data with specific answers to specific questions. It draws conclusions from the information that is available so as to enable the employer of analytics to arrive at the right decisions. Moreover, Mehta, & Pandit, (2018) give emphasis that in the case of Big Data analytics, it has strengths in areas such as pattern recognition, information retrieval, parsing and production of natural language, translation from one representation to another, several kinds of reasoning, planning and problem solving (Shahzad et al. 2017)

## 3 Research Methodology

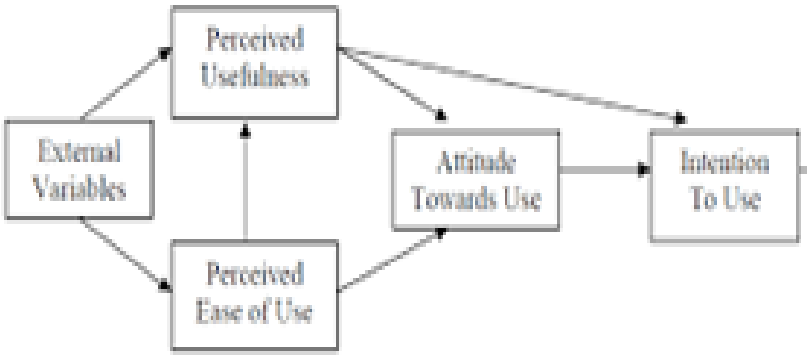


**Figure 1: Technology Acceptance Model (TAM)**

The system will then be developed using the Sublime Text 3 and coded in CodeIgniter using Visual Studio Code version 1.39, using the Agile model in SDLC. The system will be uploaded online using GoDaddy web hosting. The Technology Acceptance Model (TAM) by Davis et al.(1989) was used to determine user acceptance of the technology with regards to Perceived Usefulness, Perceived Ease of Use, and Behavioral Intention of Use. There will be 60 respondents.

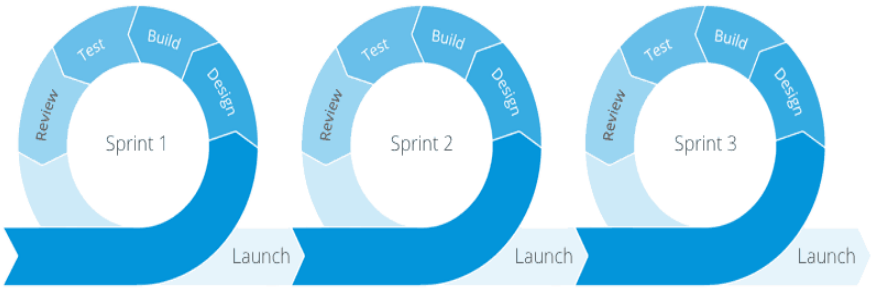


**Figure 2: Agile Model Diagram**

The researchers used the agile model of Systems Development Life Cycle which contains the six important stages that flow from one to the next and are essential to the developers. The initial phases where researchers are involved with creating a set of plans, scouting of an available company, accumulating all necessary information, conducting interviews, and setting appointments for further information. In the next phase, researchers will develop a web-based system that can monitor the child's health status in real-time and can store and retrieve data in one database of all health facilities that render services in child health. In the design phase, it is significant to analyze how the system works and visualize the flow and processes of the system by the use of the Flowchart and Data Flow Diagram. After completion, the System Usability Scale (SUS) was implemented to test the system with fifty (50) respondents.

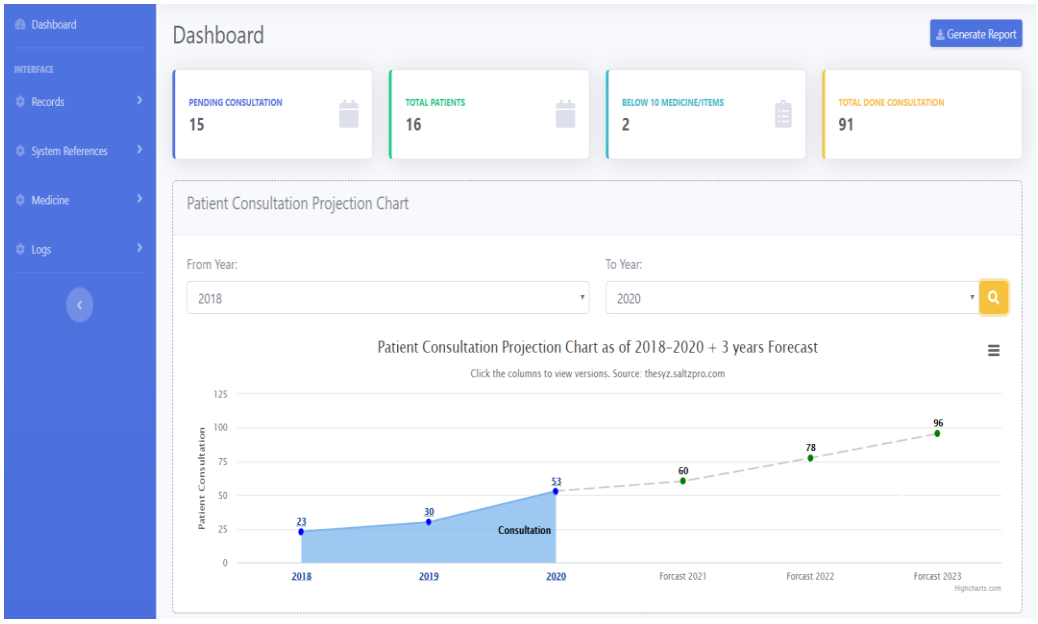


**Figure 3: Admin user Dashboard**

The admin user has all the privileges in the system, can create a user, and can control the amount of medicine alloted to the barangay health centers.

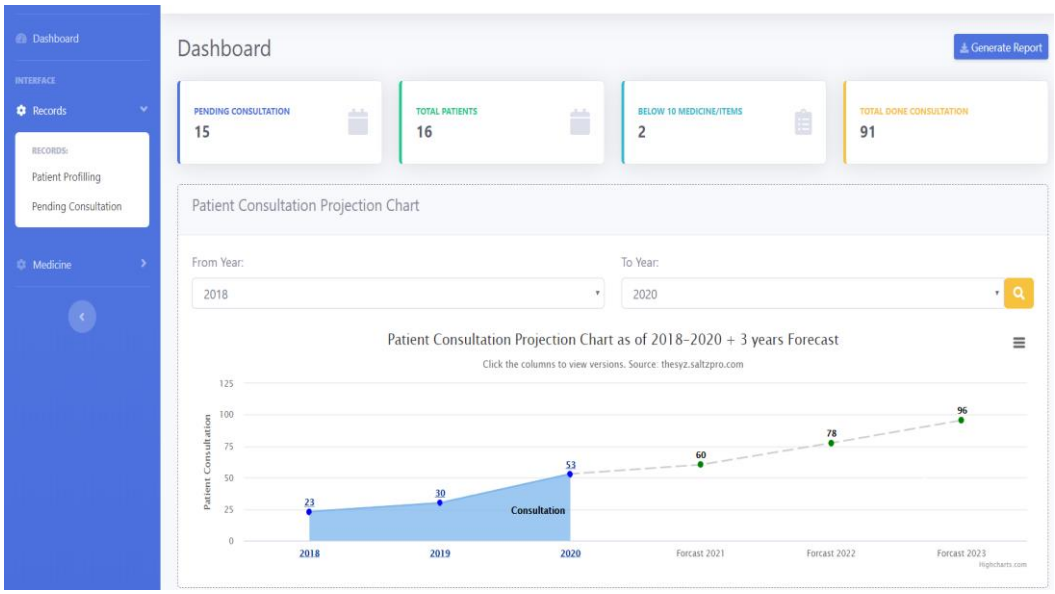


**Figure 4: End user Dashboard**

The end user can only add and edit patient's health records and consult and they can also see all the graphs

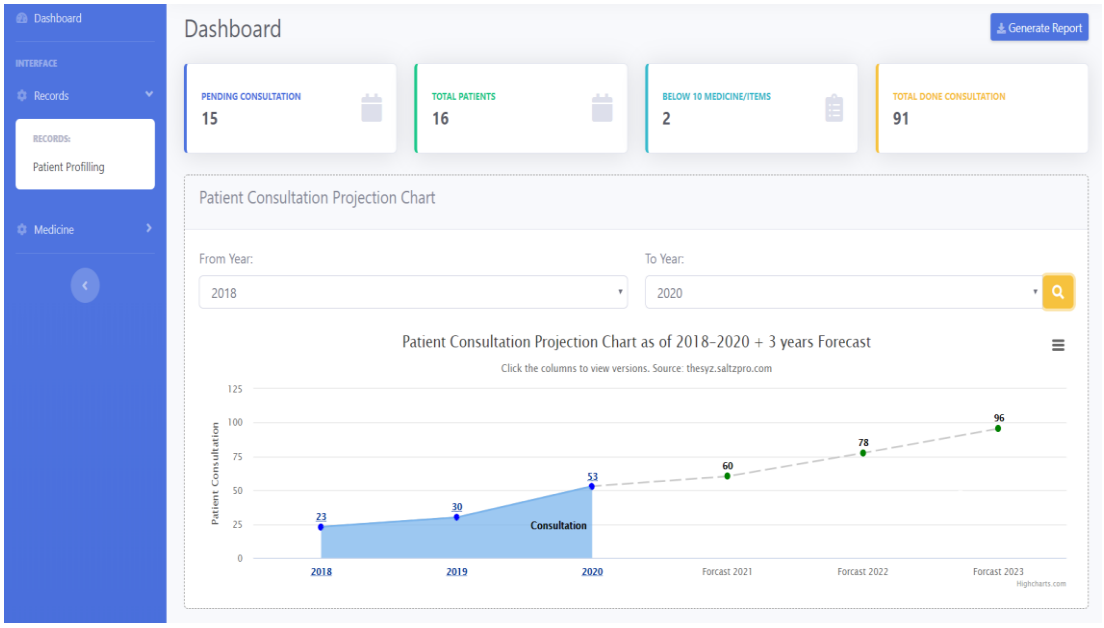


**Figure 5: Encoder Dashboard**

The barangay health workers/Encoder user can only add and edit patient's health records.

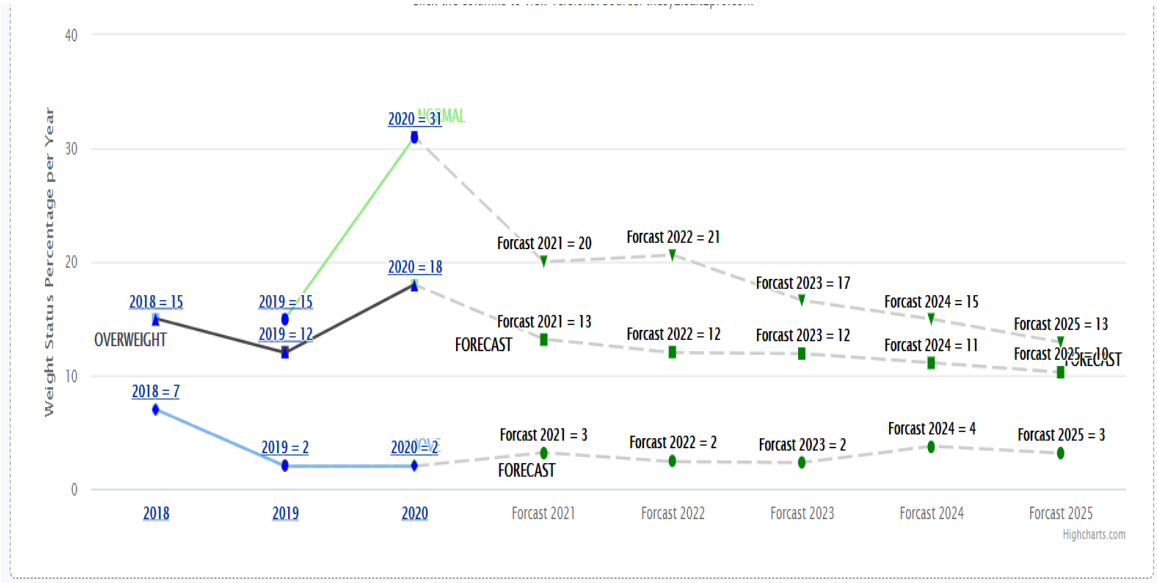


**Figure 6: Projection graphing**

Figure 3, Figure 4, Figure 5, and Figure 6 are the Screenshots of the System

## 4. Results and Discussions

This chapter presents the analyses and interpretations of the data gathered for the study. The system was successfully developed and a pilot system was deployed to selected health care centers within Butuan City. The researchers also collected data to examine the likelihood that the target users will use the system. Using the TAM framework, the Behavioral Intention was used as the dependent variable. Performances Usefulness, Perceived Ease of Use, Attitudes Towards System use, Facilitating Conditions, Self-Efficacy, Technological Complexity, S-Security, Risk, Reliability, Portability are considered as the independent variables. The respondent's Age, Job Designation, Gender, Employment Categories, Educational Level, Years of Work Experience, Experience Using an Automated system, Internet Access at the worksite, Internet Access at home are utilized as the moderating variables.

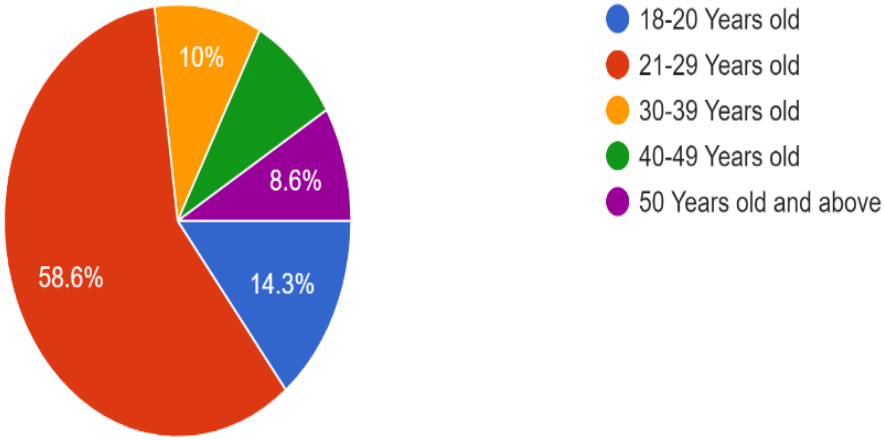


**Figure 7 : Profile of the Respondents According to Age**

Figure 7 indicates that the respondents of the study are mostly 21-29 years' old that comprised 58%, followed by 18-20 years' old which is 14.3%, next is the 30-39 years old comprising 10%, the 50 years old and above representing 8.6%, and the 40-49 years old with 8.5% of the respondents. This also assumes that there is a diverse representation included as data for the different age groups in the people of Butuan City.

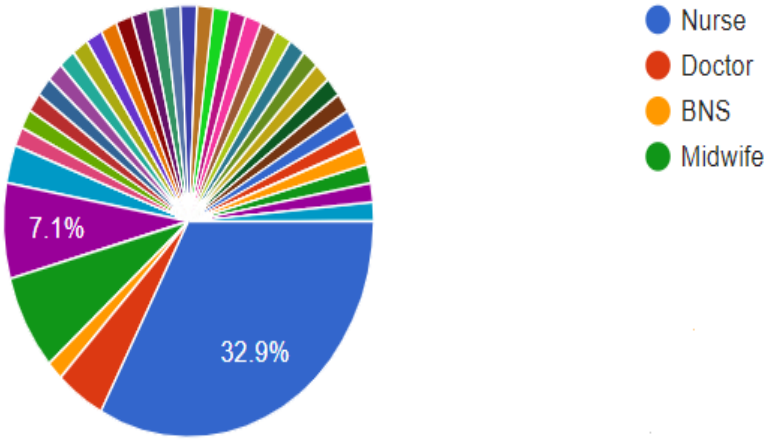


**Figure 8: Profile of the Respondents According to Job Description**

Figure 8 indicates that the respondents of the study are mostly nurses, twenty of them, which comprised 32.9%, followed by 5 BNS which is the 14.3%, next is Midwife 7.1%, then the doctors at 4.3% and the rest are other respondents.

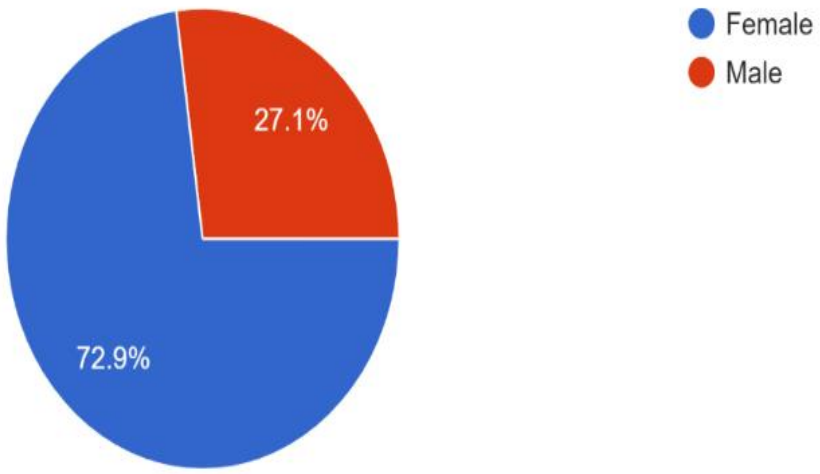


**Figure 9: Profile of the Respondents According to Gender**

The chart in Figure 9 shows that there are 19 identified as males comprising 27.1% of the total samples while 51 individuals were recognized as females comprising 72.9%. In total, there were 70 people in Butuan City who served as respondents for the TAM survey.

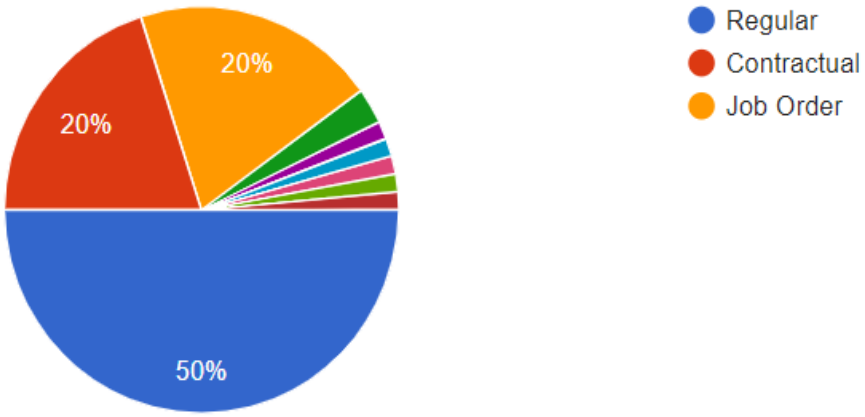


**Figure 10: Profile of the Respondents According to Employment Categories**

Figure 10 indicates that the respondents of the study are mostly regular which comprised the 58%, followed by contractual which is the 20% and job order which is 20%, and then the Others which consists 10% of the respondents. This will assume that most respondents are regular employees.

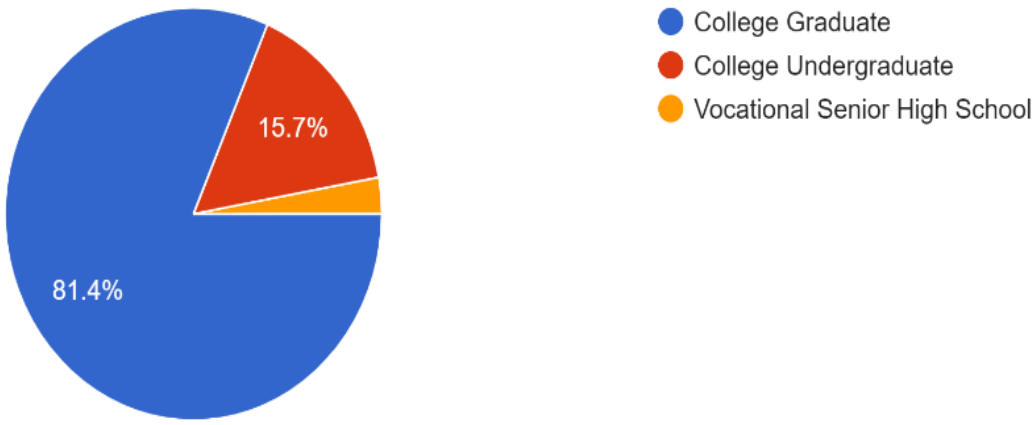


**Figure 11: Profile of the Respondents According to Educational Level**

Figure 11 indicates that the respondents of the study are mostly 21-29 years' old which comprises 58%, followed by 18-20 years old which is 14.3%. Next is the 30-39 years' old which comprises 10%, next is the 50 years old and above which is 8.6% and then the 40-49 years old consists 8.5% of the respondent. This also assumes that there are diverse representations included as data for the different age groups in the people of Butuan City.

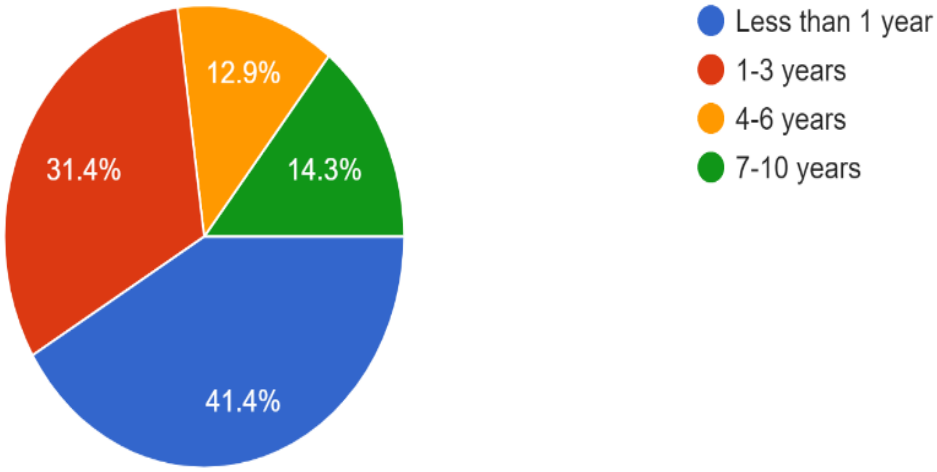


**Figure 12: Profile of the Respondents According to Years of Experience**

Figure 12 indicated that the respondents of the study are mostly less than year 1 year which comprised 41.4%, next is 1-3 years which is 31.4%, while 7-10 years comprises 14.3% and 4-6 years is 12.9%. This assumes that most respondents are working less than 1 year.

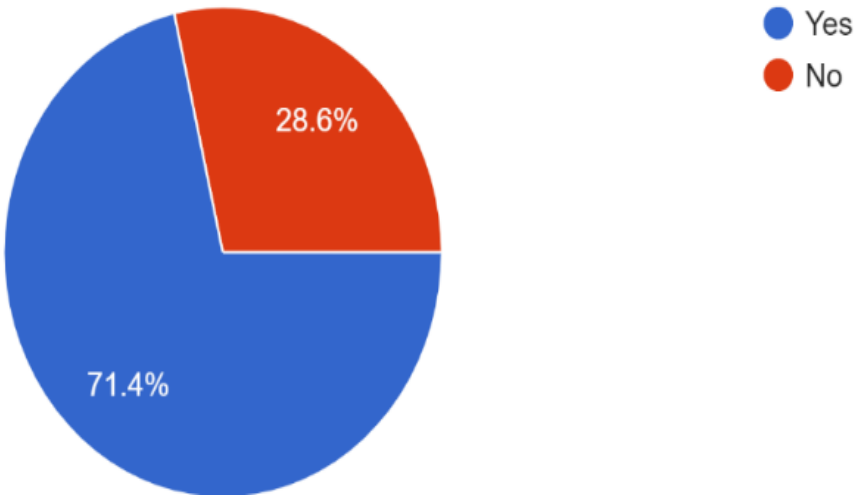


**Figure 13: Profile of the Respondents According to Experience Using an Automated System.**

Figure 13 shows that there are 20 responses for No comprising 28.6% of the total samples, 50 responses for Yes comprising 71.4% comprising 72.9%. This also assumes that 71.4% of the respondents already encounter an automated system.

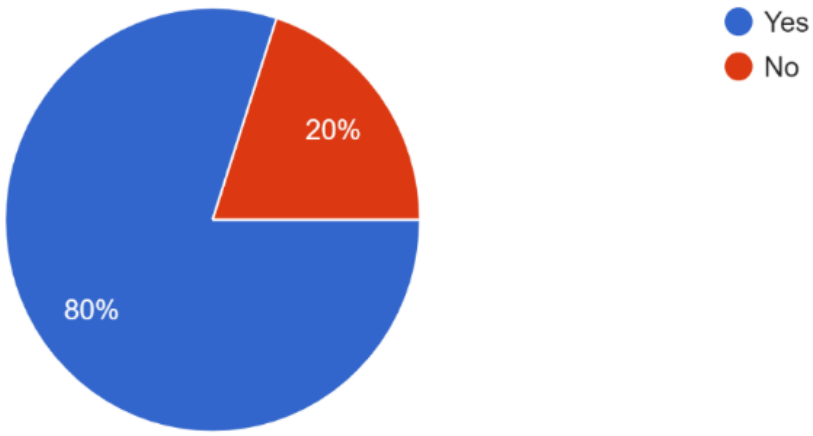


**Figure 14: Profile of the Respondents According to Internet Access at Worksite**

Figure 14 shows that there are 14 responses for No comprising 20% of the total samples, 56 responses for Yes comprising 80% . This also assumes that 80% of the respondents have internet access at the worksite.

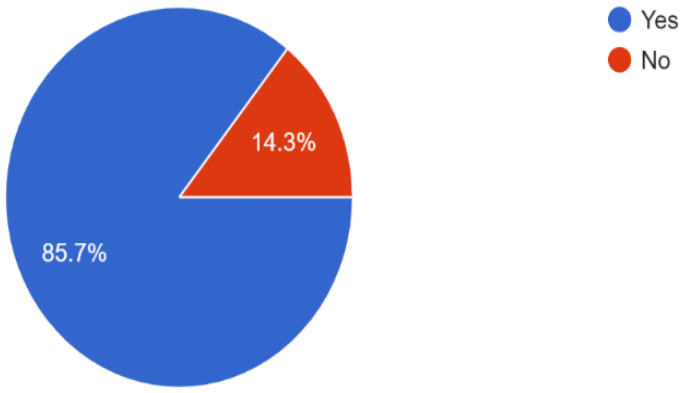


**Figure 15: Profile of the Respondents According to Internet Access at Home**

Figure 15 shows that 85.7 % respondents answered yes and 14.3% answered No. This also assumes that 85.7% of the respondents have internet access at home.

**This study was guided by the following null hypotheses tested at the 0.05 level of significance**.

H1: There is no significant relationship between the different features of an automated system and the behavioral intentions of end-users.

H2: There is no significant relationship between the different features of an automated system and the attitude of end-users.

H3: There is no moderating effect on the list of the demographic profile of the respondent to the model that studies the relationship of different features of automated systems and the behavioral intentions of end-users.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .811[a] | .658 | .596 | .3902 |

a. Predictors: (Constant), Portability, Risk, Peruseful, Falcon, TechComp, Selfeffic, Security, Perease, Reliability

Model for Features and Attitude

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .780[a] | .608 | .536 | .4010 |

a. Predictors: (Constant), Portability, Risk, Peruseful, Falcon, TechComp, Selfeffic, Security, Perease, Reliability

Model for Features and Behavioral Intention

**Table 1: MRA -Attitude and Behavioral Intention as Predicted Variables**

Table 1 shows the multiple regression analysis (MRA) that was utilized to determine the importance of varied features of the real time health monitoring system to the attitude towards system use and behavioral intentions of end users. As shown in the model summary table above. For attitude, the R squared showed that 65.8 % of the variance can be explained by the model while for the behavioral intention, R squared showed that 60.8 % of the variance can be explained by the model. The models provide insights to the features of the automated system that are relevant to the users. The models also showed that there is enough evidence to prove the association between varied features of the real time health monitoring system to the attitude and behavioral intentions of end users, thus rejecting the two null hypotheses.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Perceived usefulness | 0.352 | 0.002 | Reject | Significant |

**Table 2: Result on Hypothesis Test of Perceived Usefulness**

Table 2 indicating perceived usefulness is statistically significant, and the highest predictor of intention to use with a p value of .002; As a result, the null hypothesis is rejected and thus supporting the previous empirical study of technology acceptance.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Perceived ease of use | 0.304 | 0.019 | Reject | Significant |

**Table 3: Result on Hypothesis Test of Perceived Ease of Use**

Table 3 Perceived Ease of Use is significant and has a p-value of 0.019. It indicates strong evidence to prove the relationship with behavioral intention. This means that most of the users agreed that the system is very helpful to improve their performance and it requires minimal skill to use it.

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.794 | .436 | | 4.118 | .000 |
| | attitudeto | .563 | .103 | .587 | 5.480 | .000 |

a. Dependent Variable: Behavinten

**Table 4: Result on Hypothesis Test of Attitude**

Table 4 Attitudes Towards System Use is significant and has a p-value of 0.000. It indicates strong evidence to prove the relationship with behavioral intention of users of the automated system. This means the users deem it valuable to use the system.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Facilitating Condition | 0.517 | 0.00 | Reject | Significant |

**Table 5: Result on Hypothesis Test of Facilitating Condition**

Table 5 Facilitating Condition is significant and has a p-value of 0.000. It indicates strong evidence to prove the relationship with behavioral intention. This means that the users perceive that the organization's IT infrastructure is available for their daily use.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Self Efficacy | 0.253 | 0.074 | Accept | Not Significant |

**Table 6: Result on Hypothesis Test of Self-Efficacy**

Table 5 Self-Efficacy is not significant and has a p-value of 0.074. It indicates that there is not enough evidence that proves a relationship with behavioral intention. This means that a possible reason for this could be that the user feels that they cannot complete tasks earlier if someone cannot show them how to do it with a Real-Time Health Monitoring System.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Technological Complexity | -0.138 | 0.274 | Accept | Not Significant |

**Table 7: Result on Hypothesis Test of Technological Complexity**

Table 7 Technological Complexity is not statistically significant and has a p-value of 0.274. It indicates not enough evidence to show the relationship with behavioral intention. This means that a possible reason for this could be that the user thinks it will take too much in terms of familiarizing if they find the system complicated.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Security | -0.110 | 0.453 | Accept | Not Significant |

**Table 8: Result on Hypothesis Test of Security**

Table 8 Security is not statistically significant and has a p-value of 0.453, indicating that there is not enough evidence to prove the association with behavioral intention. This means that a possible reason for this could be that the user thinks that the system cannot provide a security password if they find it is easily attacked by a hacker.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Risk | 0.054 | 0.474 | Accept | Not Significant |

**Table 9: Result on Hypothesis Test of Risk**

Table 9 Risk is not statistically significant and has a p-value of 0.474 it indicates not enough evidence to show the relationship with behavioral intention. This means that a possible reason for this could be that the user may find any risk in using a Real-Time Health Monitoring system if they find that the system is not secured.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Reliability | 0.253 | 0.162 | Accept | Not Significant |

**Table 10: Result on Hypothesis test of Reliability**

Table 10 Reliability is not statistically significant and has a p- value of 0.162 it indicates not enough evidence to show the relationship with behavioral intention. This means that a possible reason for this is that adopting a Real-Time Health Monitoring System is not reliable in protecting data privacy, recovery against shutdown if the system is not reliable to use.

| Real-Time Health Monitoring System | Behavioral Intention | | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|---|
| | Rho value | P- value | | |
| Portability | 0.416 | 0.007 | Reject | Significant |

**Table 11: Result on Hypothesis of Portability**

Table 11 Portability is statistically significant and has a p-value of 0.007 it indicates strong evidence to prove the relationship with behavioral intention. This means that the user finds it convenient to use the Real-Time Health Monitoring system since the system is user friendly.

| Moderating Variable | P-Value | 5% Level of Significance H0 is | Conclusion |
|---|---|---|---|
| Age | 0.073 | Accept | Not Significant |
| Job Description | 0.400 | Accept | Not Significant |
| Gender | 0.198 | Accept | Not Significant |
| Employment Categories | 0.329 | Accept | Not Significant |
| Educational Level | 0.170 | Accept | Not Significant |
| Work Experience | 0.117 | Accept | Not Significant |
| Experience in an automated system | 0.817 | Accept | Not Significant |
| Internet access at a worksite | 0.072 | Accept | Not Significant |
| Internet access at home | 0.889 | Accept | Not Significant |

**Table 12: Statistical treatment of moderating variable**

Table 12 The P-value of Age is 0.073, and P-Value is less than $\alpha = 0.05$ the age of respondents does not have any moderating effect in the model. Also, at P-value of Job Description is 0.400, the job description

does not have any moderating effect in the model. At P-value of 0.198, the Gender does not have any moderating effect in the model. At P-value of 0.329, the employment categories do not have any moderating effect in the model. At P-value of 0.170, the Education Level does not have any moderating effect in the model. At P-value of 0.117, the Experience in using Automated system does not have any moderating effect in the model. At P-value of 0.072, the Internet access at home does not have any moderating effect in the model and at P-value of 0.889, the Internet access at work does not have any moderating effect in the model. This shows significance and indicates less evidence for the null hypothesis.

The moderating variables do not influence the relationship between the Independent variables to the Dependent variable. This means that age, job description, gender, Employment categories, educational level, work experience, experience in automated system, Internet access at a worksite and internet access at home were consistently not significant in the model and therefore was not a predictor for Portability, Risk, perceived usefulness, facilitating condition, Technological Complexity, attitude towards system use, Security, Self-efficacy, Perceived ease to use, Reliability

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .781[a] | .610 | .548 | .3957 |

a. Predictors: (Constant), Portability, Risk, Peruseful, Falcon, TechComp, attitudeto, Security, Perease

**Table 13: Summary Result of Technology Acceptance Model Survey for Decision Support System with Analytics: Real-Time Health Monitoring System in Butuan City**

Table 13 indicates that the PEU, PU, ATU, FC, SE, TC, S, RI, RE, and P has an overall R-Square of .610, which shows a capability of explanation of almost 61% in relation to the proportion of the variance in the dependent variable BI that is explained by PEU, PU, ATU, FC, SE, TC, S, RI, RE, and P. The higher the $R^2$ value, the better the model fits to predict the behavior of data.

The results revealed that Portability, Risk, perceived usefulness, perceived ease of use, facilitating condition, Attitude Towards system use, Self-efficacy, and Reliability have positive influence on Real-Time Health Monitoring System adoption and continued use by the nurse, midwife, and other employees in health facilities in Butuan city. The Security, Technological Complexity, reliability, and risk were not statistically significant but must be considered by management to improve the consistency of work in the barangay health center in Butuan city. Health workers were positive that they will adopt an automated system soon.

## 5. Conclusion

The system improved the present way of gathering data on child health status and the system was very useful in the decision-making process due to its analytical capability. By using DSS: Child health monitoring system, it will help in various things such as time to time update of data using the web procedures, provide a piece of standard data information in all health facilities in CARAGA Region on inputs and outputs on data, and analyze report generation, and to collect, process, store, and present information in child health monitoring through a web-based application. In addition, Portability(P), Risk(R), Performances usefulness (PU), Facilitating condition (FC), Attitude Towards system use (ATU), Self-efficacy (SE), and Reliability (RE) have a positive influence on Real-Time Health Monitoring System adoption and continued use by the nurse, midwife, and other employees in health facilities in Butuan city. The Security(S) and Technological Complexity (TC) were not statistically significant but must be considered by the management to improve the

consistency of work in the barangay health centers in Butuan city. Health workers were positive that they will adopt an automated system soon.

## 6. Recommendations

The research which includes system development and data analytics paved the way for new opportunities to augment the life of community. The researchers recommend further improvements and promote the automated system in health care facilities in Butuan city. Also, this project recommends further work to the patient that will be notified through SMS (Short Messaging Service) before the day of their schedule. Double authentication for users could also be implemented on the system to secure when they log in to the system.

The findings of the study provide new information to the body of knowledge and will serve as reference material, and a guide for future researchers who wish to conduct the same experimental study or any study related to Analytics and Monitoring systems.

## ACKNOWLEDGEMENT

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# First -Language -First Education: An Interactive Web-based Mobile MTBL-MLE Learning System for Grades One to Three Learners

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**Abstract**

Technology is undoubtedly an integral aspect of contemporary education. Digital technology is also reconfiguring how information and knowledge are created, accessed, and used. However, some challenges must be addressed, especially in the implementation of the mother-tongue based multilingual education (MTB-MLE) in the new curriculum mandated by the Department of Education (DepEd).

This study develops an interactive mobile web-based system specifically designed for the Cebuano dialect to bridge the gaps in the delivery of the mother-tongue based multilingual education.

The system provides interactive activities based on mother-tongue language and focus on picture recognition vocabulary and grammar activities. The system is developed using iterative agile methods to attain rapid development. The system also makes use of the Code Igniter framework, which is open-source software for rapid web development and the creation of dynamic websites. Also, the system can be used with smart mobile platform devices, which make it easier to carry around and use.

The study also used the system usability scale to validate the usability of the system. Results show an average score which depicts that the overall system is fair in terms of ease of use. This means that the teachers have the intention

to use the system in teaching the MTB-MLE curriculum. Results also show that the teachers find the system useful as shown in the good scores of the indicators for user friendliness and usefulness of the system in educational purposes. However, they stressed the need for assistance in terms of technical skills because of the technological complexity in the system use. This study recommends the conduct of activities and programs that would address computer literacy, comprehensive training of end-users, and the use of modules with artificial intelligence.

**Keywords: First Language-First Education, Mobile we-based, Agile Development, MTBL-MLE Learning System**

## 1. Introduction

In the implementation of the K to 12 Program, additional features have been added to further improve it from the previous education system. The Mother Tongue-Based Multilingual Education is one of these features. It mandates teachers to teach the students using their first language as medium.

Currently in Butuan City, the first language the kids of this generation are familiar with is Sinugbuanong Binisaya. Teachers in the city teach Sinugbuanong Binisaya as the medium for non- English and Filipino subjects. While the Mother Tongue-Based Multilingual Education (MTB-MLE) has been part of the elementary curriculum for a while, there are still existing problems pertaining to its implementation.

According to Beaudouin- Lafon (1997), an interactive system is a computer application that considers, during its execution, the information communicated by the user or users of the system, and which produces, during its execution, a perceptible representation of its internal state. The difficulties in delivering and understanding the topic is more challenging (Roberto, Gabinete, & Rañola, 2016). This study is the bridge to the existing problem of online interactive learning using the MTB-MLE feature.

This study aims to develop a system where the students will learn different activities wherein their teacher will choose the activities that their students will do. The activities of the said system shall be based on the current curriculum guide of the MTB-MLE program. There shall be activities focusing on picture recognition, vocabulary, and grammar. There shall be stars that will represent the scores of the students. It was in view of these foregoing premises that this study was conceptualized and executed. These include poor picture-word recognition of the students, their reading ability, and a strong foundation in the mother tongue. This study was conceptualized by the researchers to help Grades 1 to 3 pupils in public schools, specifically in the Department of Education, Butuan City Division. This will greatly help the Grades 1-3 pupils and teachers.

## 2. Related Literature

UNESCO has encouraged mother tongue instruction in early childhood and primary education since 1953 (UNESCO, 1953). Many children speak a home language that differs from the language of instruction in education programs. Research confirms that children learn best in their mother tongue as a prelude to and complement of bilingual and multilingual education. Whether children successfully retain their mother tongue while acquiring additional languages depends on several interacting factors. Studies show that six to eight years of education in a language are necessary to develop the level of literacy and verbal proficiency required for academic achievement in secondary school (Ball, 2010).

There is a growing trend around the world to support mother tongue instruction in the early years of a child's education. In Southeast Asia, this is apparent in a rising number of educational programs that utilize this approach. However, the Philippines is the only country in Southeast Asia to have instituted a national policy requiring mother tongue-based multilingual education (MTB-MLE) in the primary school years. While studies have long supported the use of mother tongue as the language of instruction, they have primarily been conducted in community rather than national setting. Existing research that reviews literatures about MTB-MLE stated that MTB bilingual education programs have benefits to the language skills, overall academic achievement, and self-confidence and cultural price of children (Ball, 2010).

Agile methodologies have been continually sought by software programmers in their rapid application development. According to the study of (Maruping, Venkatesh, & Agarwal, 2009), using agile methodology is most effective for responding to requirements change. The study of (Kumar & Bhatia, 2012) also identified the benefits of choosing agile in the software development process. Their study stated that it dramatically improves the planning phase, detects the faults earlier and improves code development due to continuous testing feedback. The Agile method was also adopted by studies that are focused on improving teaching and learning processes (Dewi & Muniandy, 2014). Furthermore, the agile method has been used by

existing software (Kaleel & Harishankar, 2013); (Rottier & Rodrigues, 2008) in their development process.

The System Usability Scale (SUS) is a simple usability scale developed by (Brooke, 1996) that allows users to quickly assess the usability of a system. According to (Tullis & Stetson, 2004) , the SUS is a useful, empirical quantitative tool for supplementing direct assessments about the use of a software. The SUS was also used by existing learning systems (Arnab, et al., 2015); (Schmidt, Beck, Glaser, & Schmidt, 2017); (Bansal, Nagpal, Ravindran, & Sorathia, 2017)& (Alnuaim, Caleb-Solly, & Perry, 2014) which allowed them to measure not just the usability of their system, but also the user satisfaction in using the services of their system.

## 3. Methodology

This study used the Agile development method for rapid development as shown in Figure 1. "Agile development is more difficult for larger teams," but they cite occasional successful larger agile projects with up to 250 people. Larry Constantine finds agile methods highly attractive for small projects, but he concludes that "The tightly coordinated teamwork needed for these methods to succeed (Maruping, Venkatesh, & Agarwal, 2009). Agile processes like extreme programming (XP),1-3 Scrum,4 Crystal,5 and adaptive software development aim to increase a software organization's responsiveness while decreasing development overhead (Kumar & Bhatia, 2012).

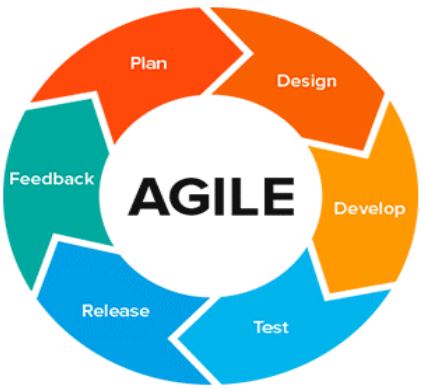


**Figure 1: Agile Method**

Further, the system will be evaluated by System Usability Scale using the 5-point Likert scale. The standard SUS consists of ten items (odd-numbered items worded positively; even-numbered items worded negatively). The test question used in SUS are the following:

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 that the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that 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.

### 3.1. Results

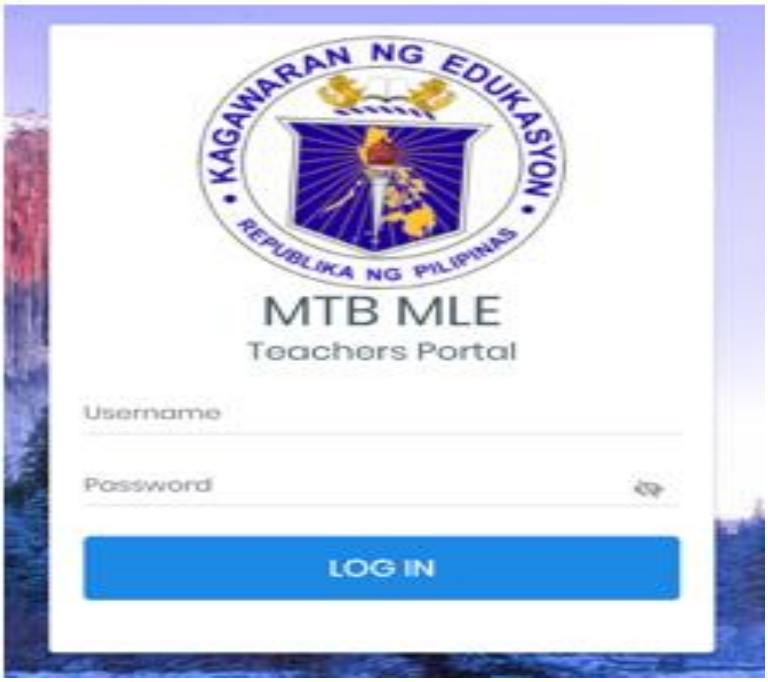


**Figure 2. Teachers' Portal**

Figure 2 shows the Teachers' Portal. This module allows the teacher to insert their credentials to enter the teacher main page.

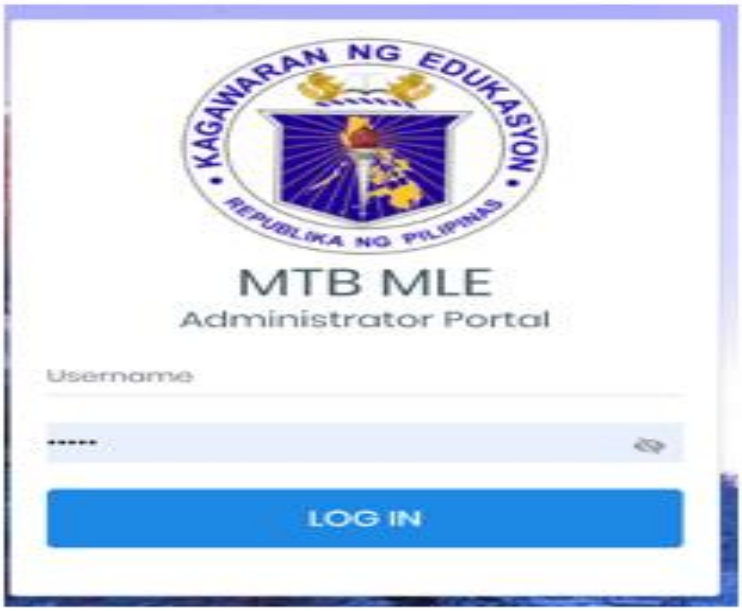


**Figure 3 Admin Portal**

Figure 3 shows the Admin Portal where the admin can login to access the admin dashboard.

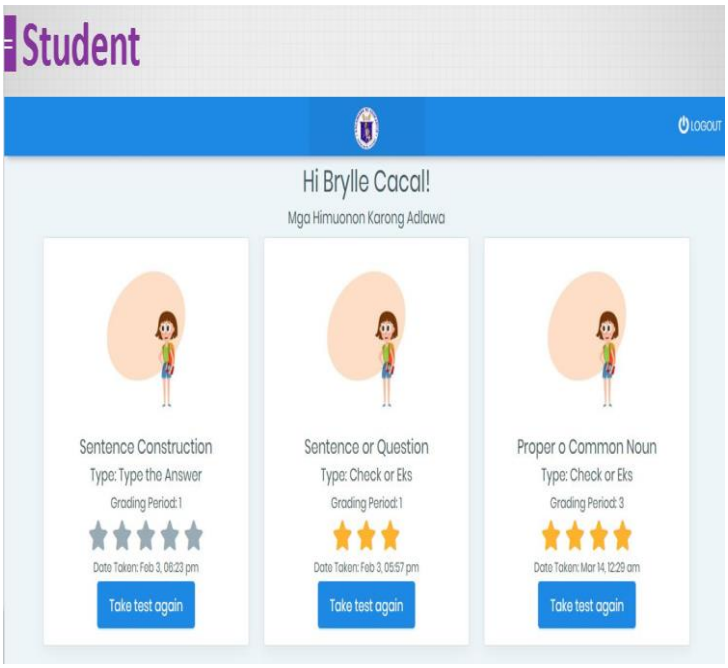


**Figure 4. Student Portal**

In Figure 4, there are activities shown in which the students can take. Other data such as the name of the activity, type of activity, stars which represents the score of the student, and date taken are also shown per activity.


**Figure 5. Student Portal**

Figure 5 shows where the students will log-in.

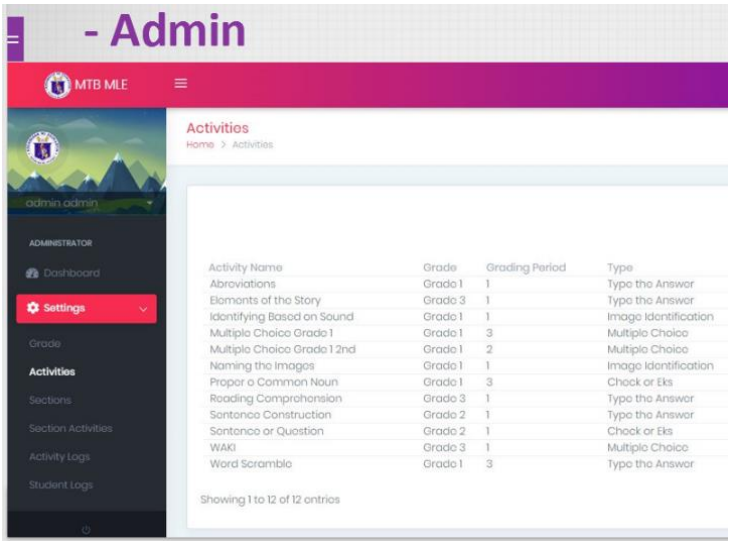


**Figure 6. Admin Page**

In Figure 6, it shows the Student Page. This page shows questions, the choices, and the correct answer of the question. The admin can add additional questions as well as edit or delete the existing ones.

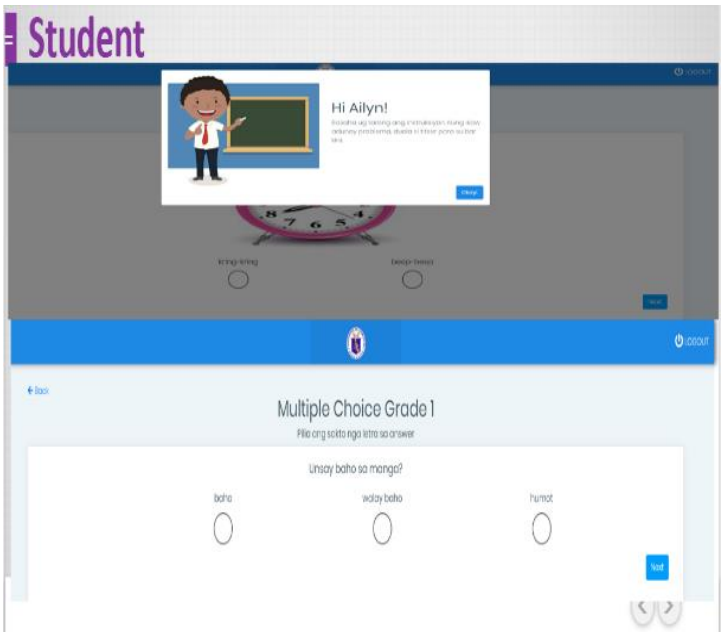


**Figure 7. Student Page**

In Figure 7, it shows the students under the supervision of the teacher assigned to them and their respective section.

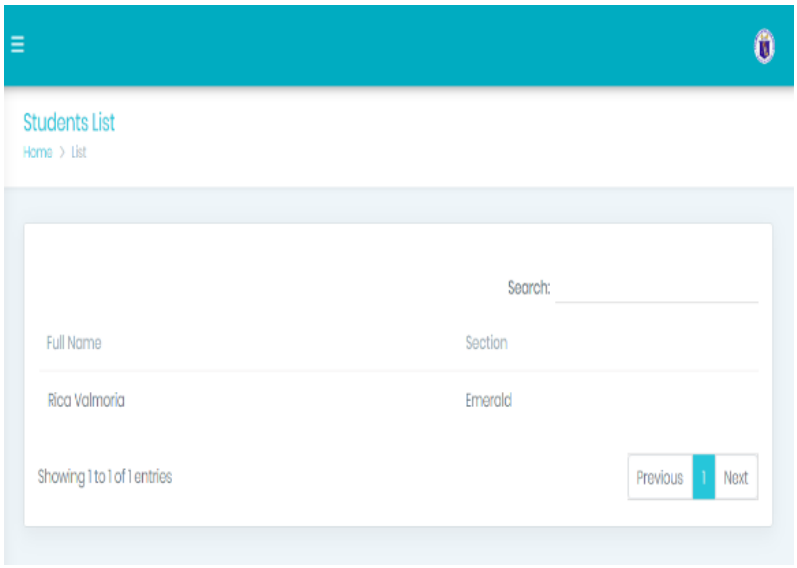


**Figure 8. Teacher Panel**

In the teacher panel, teachers can view or search the student information.

## 4 RESULTS AND FINDINGS

| SUS Score | Adjective Rating |
|---|---|
| 92 | Best imaginable |
| 85 | Excellent |
| 72 | Good |
| 52 | OK/Fair |
| 38 | Poor |
| 25 | Worst imaginable |

**Table 1: System Usability Scale (SUS) Interpretation Table**

The system was evaluated using the System Usability Scale and participated in by fifty (50) Grades 1 to 3 public school teachers. Data analysis resulted with an SUS score of 51.9, which, according to the Adjective Rating Scale of (Bangor, A., et. al., 2009), that the overall system was Fair. This means that the system was acceptable in achieving its purpose.

## 5. Summary, Conclusion, and Recommendations

Teachers have the intention to use the system in teaching the MTB-MLE curriculum. In addition, the system plays a vital role in the learning process of every student in the public schools. Further, the system enhances the productivity of the pupils and teachers. Results also showed that the teachers find the system useful. Moreover, the good scores of the indicators for user friendliness and usefulness of the system highlights the educational purposes of the system. However, technical assistance is necessary to familiarize the functions of each module due to the complexity of the system.

This study contributes to the body of knowledge, thus recommending the conduct of activities and programs that would address computer literacy and comprehensive training of the pupils and teachers. Also, additional modules for data analytics are necessary for decision making support. Lastly, in view of future studies, the researchers recommend exploring other methods and instruments to evaluate other factors.

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