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Computer-Based Instruction in Teaching Secondary Biology

[1]Romel C. Mutya, [2]Cristina B. Ramas

Abstract

This study investigates the effectiveness of Computer-Based Instruction (CBI) in teaching Biology to 7th graders of a secondary night school in Cebu City, Philippines. A pretest and posttest quasi-experimental design with a control group was utilized to two groups of students, of which one was exposed to CBI and the other to the conventional lecture method (CLM). An Instructional Materials Motivation Survey (IMMS) was used to assess its motivational characteristics. Data gathered were analyzed using descriptive statistics, frequency count and percentage, mean and standard deviation, t-test. Findings revealed that both groups had Fairly Satisfactory performance in the pretest, which implies that the students had low knowledge on the topic. The study also found that both groups had significantly increased their performances from the pretests to the posttests, implying the essence of CLM and CBI use. Ultimately, the study revealed that the use of CBI is more effective than CLM, as seen in the enhanced students' performance, signifying the effectiveness of the instruction using a computer in teaching Biology concepts. The students commended the CBI for being a user-friendly, autonomous, self-paced, and self-regulating instructional design that helped them enhance their performance in the least learned competencies. A contextualized CBI in Biology was crafted to serve as a guide for teachers and enable the students to pave the way for the mastery of the different competencies in Biology.

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1. Introduction

The Philippines' current state of science education lags other countries worldwide based on the international standardized tests (Cabansag, 2014) and declining educational standards during the first decade of the 21st century (Macha et al., 2018). It ranked 76th out of 137 countries in math and science education in the Global Competitiveness Report (Schwab, 2017-2018) and 249 in science on Trends in International Mathematics and Science Study (TIMSS) (International Association for the Evaluation of Educational Achievement, 2019). In addition, in the report of Project Monitoring and Evaluation to meet Education Targets (MEET): An Undertaking for Constant Change Towards Progress (2017) of the Department of Education in Cebu City Division, the findings stated that District Central Schools and Night High Schools were the most significant contributors to Learners at Risk of Dropping out (LARDO) and Learners at Risk of Failing (LARF). The main factors of Filipino students' poor science performance are a lack of support for scientific culture, as seen by shortcomings in the school curriculum, ineffective teaching-learning process, a lack of teacher training (Magnanimous Science, 2014), and insufficient instructional materials (Torio, 2015).

The student's interest in science is a critical component of academic achievement and an essential element of motivation (Kahu & Nelson, 2018). It has been seen as a vital part of science and biology education (Renninger et al., 2015). Despite this goal, evidence suggests that biology education faces a unique challenge in building students' interest in biology content (Rowland et al., 2019), and the method of teaching is one of the factors contributing to the low interest in science and expressing the need to come up with alternative teaching strategy that could motivate students' interest and enhance their achievement (Ajaja, 2013). One of the strategies that can be addressed these challenges is computer-based instruction (CBI). CBI is a teaching material arranged systematically and designed with a programming language or software that uses strategic learning methods with materials, exercises, questions, and quizzes. Learning media that is packaged in a computer program aims to help understand the material to facilitate the teaching and learning process (Limbong et al., 2018)

Students must be faced directly with the real problems during the learning process at school, especially in science learning, which is always related to the surrounding natural environment. Natural sciences are concerned with deliberately acquiring information about the

natural environment, rather than accumulating knowledge in the form of concepts, facts, or principles and observing the subject of research (Tawar, 2016). An innovative teaching strategy is essential to improve the students' academic performance (Oyelekan et al., 2018). Understanding the Ecological Interaction at the secondary night school is vital since it is a piece of scientific knowledge that has been tested for the truth through the scientific method, with the characteristics of objective, methodical, systematic, universal, and tentative (Tuwuh, 2015). By using CBI, it plays a pivotal role in improving students' higher-order skills in the context of problem-based learning for Science, Technology, Engineering and Mathematics (STEM) education (Kim et al., 2018). The computer-based science and technology laboratory is becoming increasingly important in the educational curriculum due to the rapid pace of technological breakthroughs (Serin, 2011).

This study investigates the effectiveness of CBI in teaching Ecological Interactions to Grade 7 students in a secondary night school in Cebu City, Philippines. Specifically, it determined the pretest and posttest performances of those exposed in CBI and those exposed to CLM, determined whether there was a significant improvement in the performance of the students after the implementation of CBI and CLM, determined whether there was a significant difference between the mean gains of the two groups of students, and determined the level of student's Instructional Materials Motivation on CBI in terms of attention, relevance, confidence, and satisfaction.

2. Literature review

Science teachers were facing problems presenting concepts so that the student's knowledge and interest would increase. The issue of students' performance in biology has led to several proposals for enhancement. Unfortunately, those proposals revolve around unfitting teaching strategies and insufficient real-world exposure as the leading cause of students' poor performance in biology. Many students had difficulty in understanding the topics in biology (Castro & Morales, 2017; Mead et al., 2017). As computer technology evolves, the use of computers in education has become inevitable. Using technology in education provided students with a more conducive learning environment. Thus, it creates a conducive environment for the students (Bhushan et al., 2021; Hew & Kadir, 2016) and corrective feedback (Ai, 2017). Technological devices began to be used in instruction in education to develop audio-visual materials such as animation and simulation as a representation of factual scenarios and processes, which resulted in the development of

computer-based instruction techniques (Cavkaytar et al., 2017; Fuady & Mutalib, 2018; Wazeema, & Kareema, 2017)

Computer instructional program can be implemented in conjunction with traditional teaching methods to enhance the overall educational experience (Fotaris et al., 2016; Pappas, 2014). This provides a supplementary tool for instructional support in the classroom (Bulman & Fairlie, 2016; Shute & Rahimi, 2017). Using computer-based assessments, the students are assessed with the given performance standard within the learning sequence in each learning task determined by the learners' performance (Hoogland, & Tout, 2018; Muraina et al., 2011; Nguyen et al., 2017). The critical function of science education is to teach students science concepts in a meaningful way and enable them to learn how to use them in their daily lives. Anchored instruction promoted learning by making the context more significant, providing multiple ways of education, and making maximum use of experience and existing knowledge (Guzman, 2000; Srisawasdi, N., & Panjaburee, 2019). Students can proceed at their own pace, following a path through the curriculum as suited to their interests and talent (Achuonye, 2011).

The CBI being effective in the delivery of instruction as literature revealed may benefit the students' performance in biology, particularly the least learned competencies in Ecological Interactions. However, this notwithstanding, a comparison would be made in this study between the students' performance using CBI and CLM.

2.1. Theoretical framework

The present study is anchored on Lowe and Holton's Theory of Computer-Based Instruction for Adults (2005) that provides a framework for research to explain or predict effective learning by adults using a desktop computer. It plays an essential role for self-directedness and computer self-efficacy of adults in designing CBI for adults. It is intended to be interwoven with the units of self-directedness, computer self-efficacy, learning goal level, instructional design, and external support. The learning goal level affects instructional design strategy and the instructional control component of CBI design. External help and instructional support are needed to provide a positive CBI experience, and the theory draws together the isolated variables researchers consider essential in the adult learning process and aligns them to provide effective CBI.

Figure 1

Theory of Computer-Based Instruction for Adults
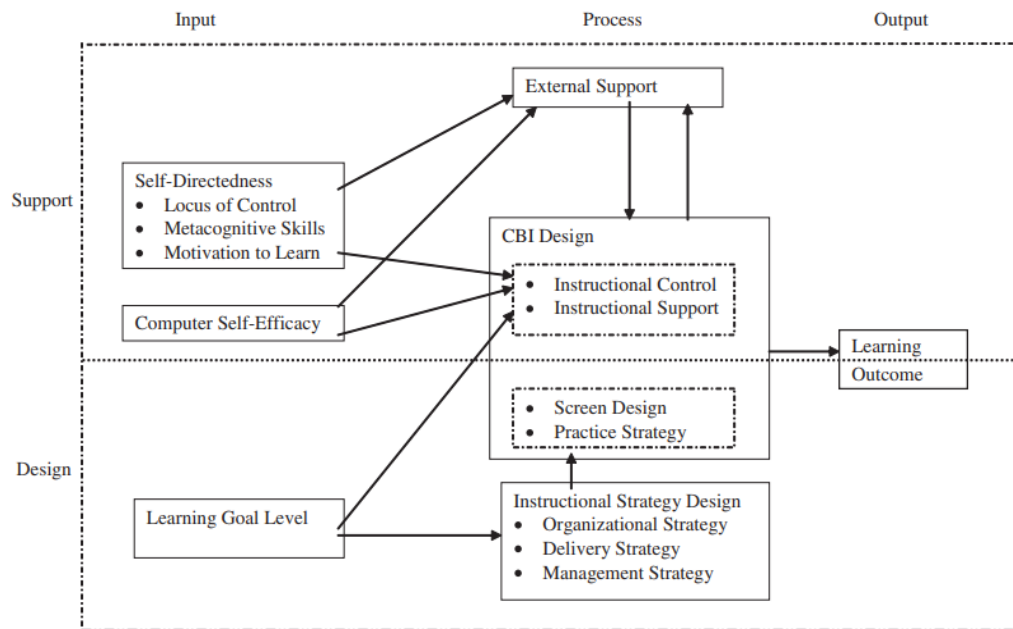
Source: Lowe & Holton (2005)

3. Methodology

3.1 Research Design, Environment and Respondents

The study employed two pedagogies: CLM for the control group and CBI for the experimental group. CLM infused teacher-directed lecture format. Lectures constituted classroom discussion and problem-solving. The study utilized the quasi-comparative research design in which pretest and posttest with control group design were employed to determine the effectiveness of CBI in teaching ecological interactions concepts in night high school students. Two groups of 30 randomly selected 7th-grade students from a public secondary night school in Cebu City, Philippines, participated in the study. These participants were selected through fish-bowl method randomization. Figure 2 shows the demographic profile of the respondents in terms of age and sex.

A total of 60 students from two groups participated in the study. For both group, most of the participants were males, CLM (57%) and CBI (53%), and their ages ranges from 12 to 15 years old with a mean of 13.70 for CLM and 13.60 for CBI.

Figure 2

Respondents' Demographics according to age range and proportion of male and female
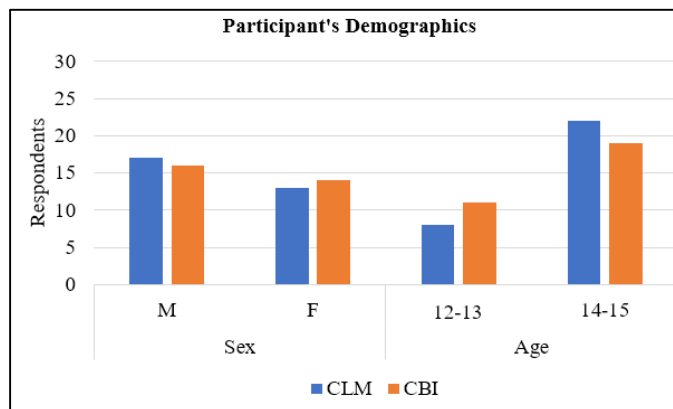
3.2 Research Pedagogies and Research Instruments

The study utilized the conventional lecture method (CLM) for one group of students and the Computer-Based Instruction (CBI) for the other group. CLM used lectures constituted of classroom discussion. In CBI, students accessed web pages with detailed lecture notes supplemented with graphics, animations, and hyperlinks. The teacher first identified the target of instruction and operationalized it to be observable and measurable. Then, baseline data were collected appropriately for the targeted skill. Next, technology support personnel were identified in the school/program building. The teacher did the check of computer availability schedules in the computer laboratory and developed a plan for the learner's use of available computers. The ratio of students to the computer was 1:1. Appropriate software, graphics, animations, and hyperlinks were identified and selected. Orientation and filling out of demographics by the respondents were done. As the students navigated the computer, the teacher provided minimal support and intervention.

A researcher-made pretest and posttest questionnaire was structured based on Bloom's Taxonomy framework and went through validity by the panel of experts and reliability test of Cronbach's alpha value of 0.84. An Instructional Materials Motivation Survey (IMMS) survey instrument adapted from Keller (2016) was utilized to assess the motivational characteristics of instructional material using the Attention, Relevance, Confidence, and Satisfaction (ARCS) model of motivation, and rated in five-point Likert scale ranging from "*not evident*" to "*highly evident*."

3.3 Data Gathering Procedures and Data Analysis

A permit from the Schools Division Superintendent and the school principal was secured before the conduct of the study. Upon approval, the pretest tool was administered to the two groups. After pretesting, the two groups of Grade 7 students underwent the experimentation phase. The first group was exposed to CLM, while the other was exposed to CBI. After two weeks of experimentation, the two groups were given the posttest. The CBI group was given the IMMS survey to assess the motivational characteristics of the instructional material.

To analyze the data obtained from the assessment tool, a t-test for single and small samples were employed. To determine whether there is a significant difference between the pretest and posttest performances, a t-test for correlated samples was used. Lastly, to know the difference between the mean gains of the two groups, a t-test for two independent samples was utilized. All tests were used at a level of significance, $\alpha=0.05$. Figure 3 shows the data collection process.

Figure 3

Data Collection Procedure
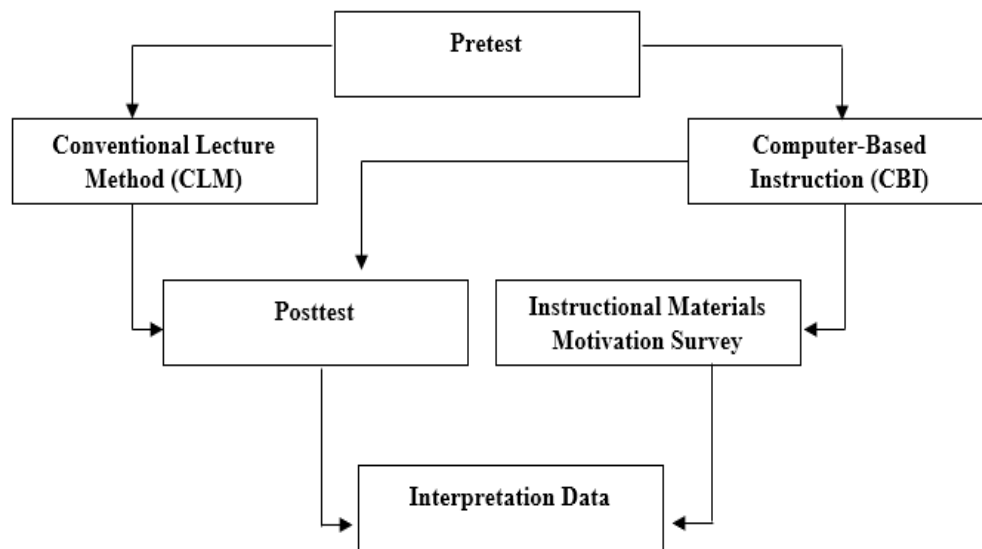
3.4 Ethical Consideration

Research permission was sought from the Schools Division Superintendent and school principal before the conduct of the study. An informed consent was given to the respondents with the considerations as to freedom to participate in the study. All names remained anonymous while data obtained from the study were kept private and confidential.

4   Findings and Discussion

4.1 Performance Level of the Students in Biology in Pretest and Posttest

The performance level in Ecological Interactions from both CLM and CBI groups is significantly lower than the standard set by the Department of Education (Table 1). This low performance implies that the students had low knowledge of the topics as shown in the pretest, understandably because the lesson on Ecological Interactions was not yet introduced.

In the posttest, the CLM group had Satisfactory performance while the CBI group had very satisfactory performance. This performance was supported by De Witte et al. (2015) that higher exposure to the utilization of computers in learning leads to higher test outcomes and given the participation to computer-assisted learning program doing more exercises leads to higher test results and working this toll seems therefore effective.

Table 1

Performance Levels of the Students in Biology

Test	Group	MeanSD	p-value	Description*
Pretest	CLM	15.40±4.93	.000	Fairly Satisfactory
	CBI	15.90±6.92	.000	Fairly Satisfactory
Posttest	CLM	25.13±6.10	.000	Satisfactory
	CBI	29.97±5.00	.000	Very Satisfactory

Legend: Below 9 (Did Not Expectation); 9-16 (Fairly Satisfactory);17-24 (Satisfactory); 25-32 (Very Satisfactory); 33-40 (Outstanding)

4.2 Mean Improvement of the Students' Performances in Biology from Pretest and Posttest

The mean improvement of the students' performance in Biology from pretest and posttest is presented in Table 2. Both groups had significantly higher posttest scores than the pretest scores, thus, gaining significant improvement in their performance. These significant mean improvements were due to students' acquiring concepts and skills about the Ecological Interactions brought about by exposure to CLM and CBI. CLM has helped the students to attain enhanced learning due to the active involvement of the teacher, which made students understand the concept. In the study of Gupta (2014), students consider the CLM beneficial for learning because they can interact and

connect with the teacher and their classmates. The ability to ask questions and receive rapid responses from the teacher is essential for those who learn best through cooperative activities and group work.

The use of CBI resulted in significant improvement because the students were peer-taught than self-taught during the learning exercises they had during the study. This supported the study of Birgin et al. (2015) and Serin (2011), who reported that significant improvement was caused by computer instruction compared to traditional instruction.

Table 2

Mean improvement of students' performances from pretest to posttest

Group	Pretest Mean	Posttest Mean	Difference	p-value
CLM	15.40	25.13	9.73	.000
CBI	15.90	29.97	14.07	.000

4.3 Comparison of the Mean Gains in Biology between CLM and CBI Groups

As compared in Table 3, there was a highly significant difference between the mean gains of CLM and CBI groups. The use of CBI was more effective in improving students' performance in biology than the students who were taught using the lecture method. This denoted that peer tutors and their tutees were directly involved in an active, friendly, and individualized learning process, as they supplemented what the teacher taught them.

These results supported Dubovi's (2018) studies that students have higher learning gains for computer-designed instruction than alternative learning approaches. The number of time students was engaged in learning with simulations was significantly associated with learning gains scores.

Table 3

Differences between the mean gains of CLM and CBI groups

Group	Mean Gain	Difference between Means	p-value
CLM	9.73	4.34	.002
CBI	14.07		

4.4 Level of students' Instructional Material Motivation on CBI

The level of students' instructional material motivation on the CBI in terms of attention, relevance, confidence, and satisfaction, which were the steps in promoting and sustaining the learners' motivation, was summarized in Table 4 with a verbal interpretation of Mostly Evident. It showed a positive perception of the students towards using CBI in the lesson Ecological Interactions.

The students commended the CBI for being a user-friendly, autonomous, self-paced, and self-regulating instructional design that helped them enhance their performance in the least learned competencies. The result showed that a good instructional design could improve the learning and implementation of the students and supported the study of Wang & Hsu (2014) that learners with higher flow experience in a computer-based instruction environment exhibited superior learning performance and satisfaction during learning.

Table 4

Summary of the Level of students' Instructional Material Motivation on CBI

Dimension	MeanSD	Interpretation
Attention	3.89±0.91	Mostly Evident
Relevance	3.92±0.90	Mostly Evident
Confidence	3.84±0.89	Mostly Evident
Satisfaction	3.82±0.87	Mostly Evident

4.5 Comments and Feedback on the Use of CBI

Students have positive feedback and comments on the use of CBI as they found it relevant in the learning Biology. It helped them understood the topics very well because of the interactive discussion. One of the students named Jane (*not the real name*) gave a positive comment regarding on the use CBI as an intervention tool in learning Biology.

Jane: *"Maglisud man ko ug English pero sa CBI kay sayonan ko kay simple ang words nga gigamit. Lipay kaayo ko magtan-aw kay interactive ang discussion."* (I have difficulty with English language but with the use of CBI I find the words simple. I am happy watching the interactive discussion.)

Another student commented that:

Joshua: *"Ganahan kaayo ko sa mga activity kay dali ra mahimo ug sayon sundon bisan ug walay teacher nga mo guide kay simple ang iyang mga steps ug kadiyot ra mahuman."*

(I like the activity because it is easy to follow even if the teacher is not around to guide me since the steps are simple and doable.)

All the respondents satisfied and approved the use of CBI in learning Science and Mathematics concepts like earthquakes, simplifying rationale expression. The simulations and interactive discussion were very relevant to their understanding of the lesson.

Claire: *"Ganahan ko sa discussion sa lesson sa computer kay naay mga simulations ug mas nakasabot ko sa lesson sa science. Na appreciate naku ang interactive discussion."* (I like the discussion of the lesson in the CBI because of the simulation and I understand the lessons more in science. I appreciate the interactive discussion).

Another respondent also added that easy activity makes the lesson interesting to do.

Joseph: *"Gisayunan raku sa mga activity gamit ang computer ug mahibaw-an dayun nimu ang results sa activity."* (I find it easy to answer the activity with the use of computer and I can immediately see the results of the activity.)

All the comments and feedback by the students can be supported in the study of Rachmadtullah et al., (2019) positing that learning using interactive computer-based interactive applications more effectively in comparison with conventional media. This is because learning using interactive multimedia computer-based, students can control the learning activities and students determine the speed of learning and choose the sequence of learning activities in accordance with needs. Conclusively, the CBI was perceived by the students positively and the appropriate to the topic and understanding of the students. CBI holds a promise for student learning and good news for teachers who plan to utilize the CBI in teaching Biology.

5 Conclusion

The use of Computer-Based Instruction was an effective tool for the seventh-grade students at a night school as seen in the change of students' performance from Fairly Satisfactory to Very Satisfactory, significant improvement of the student's performance levels after the intervention, and the significantly higher mean gain among the students than those who were exposed to the

conventional lecture method. Therefore, the students exposed to CBI manifested a more enhanced performance in learning the Ecological Interactions. Lowe & Holton's theory predicts effective learning using computer instruction interwoven with the units of computer self-efficacy, learning goal level, self-directedness, instructional design, and external support. A contextualized CBI in Biology was crafted to serve as a guide for teachers and enable the students to pave the way the mastery of the different competencies in Biology.

The study recommended that teachers use computer-based instruction as a form of instruction in teaching biology that Biology teachers utilize CBI and other strategies already employed in teaching. It is also recommended that the teachers handling science subjects undergo seminars and training for effective implementation of computer-based instruction to empower more specific student-centered learning experiences and environment to the students and that further studies on CBI be conducted using a large number of students as subjects in other science disciplines.

6   Acknowledgement/Any declaration

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Development and Implementation of Violence against Women and their Children Report System Mobile Application

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Abstract

Mobile application is a powerful tool that reduces the communication gap between individuals or organizations, which can also integrate many features like e-reporting. This study aims to develop and implement a web and mobile application for reporting Violence Against Women and their Children (VAWC) in the Province of Laguna intended for women who experienced violence from their partners. The mobile application has an e-reporting mechanism to contact pre-selected people in times of emergency and VAWC-related information translated in a local language. Moreover, the system has five major features such as emergency module, tracking module, reporting module, awareness/information dissemination module, assessment module, job and shelter module that are connected to web application. The agile methodology was used in the software development that integrates different Information, Communication, and Technology (ICT) tools and follows stages in the model like planning, requirements, analysis and design, testing, evaluation, and deployment. All the system features are working and passed the series of test casing like functionality test, performance test, system test, portability, and sharing test. The developed system achieved its primary purpose to help the community especially the women and children through a web and mobile application.

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1. Introduction

For the past years, the cycle of violence against women and children has been an unending battle among victims, gender and development advocates, human rights group, law enforcement and government agencies. Even with the passage of RA 9262 or the Anti-Violence against Women Act of 2004 and despite concerted campaign attempts to promote public knowledge and awareness about violence against women (VAW) including its basic concepts, impact on victims, and the pressure put on the public about the consequences and legal hurdles associated with it, the rising cases of violence has not put into stop. All barangays or villages in the Philippines are even mandated to establish a VAW desk to ease access to justice and support services in incidents of violence. Even the procedure is generally facilitated through referral to the Women and Child Protection Desk (WCPD) at police stations (United Nations Women, 2020), putting an end to VAW still remains a lengthy and twisted road.

The Philippine Commission on Women (PCW) indicates that more work has to be done to reduce the number of documented and unreported VAW incidents in the country. Based from the Philippine National Police (PNP) report, the number of VAW cases around the country decreased to 18,685 in 2018, down from 25,805 cases in 2017 and 32,073 cases in 2016. That is down from 87 percent per day in 2016 and 70 percent per day in 2017, to 51 per day in 2018. In 2018, the most common type of VAW case reported to police was physical injury, followed by acts of lasciviousness and rape (Bagaoisan, 2019).

Even before the COVID-19 pandemic, as reported by Philippine Statistics Authority (PSA) in 2018, one (1) in three (3) women worldwide had experienced physical or sexual violence, the majority of which was perpetrated by an intimate relationship. In the Philippines, one (1) out of every four (4) Filipino women between the ages of 15 and 49 experience physical, emotional, or sexual assault from their husband or partner (National Demographic Health, 2017). Despite the fact that the PSA reported fewer occurrences of violence against women in 2020, the PNP documented 15,553 VAW crimes in 2020, down by 27.2 percent from the 21,366 cases in 2019. Physical abuse reports fell by 30.1 percent in 2020, from 16,251 in 2019 to 11,357 in 2020, while acts of lasciviousness fell by 24.8 percent, from 2,085 in 2019 to 1,568 in 2020. Rape cases reported increased by only six cases year over year, from 2,162 in 2019 to 2,168 in 2020 (Gomeza & Robredillo, 2021). Attorney Eric Paul Peralta, Drector of UPLB-GC, stated that crises create a climate for and are linked to increasing gender-based violence, such as VAW. He believes it is

high time to bring VAW to light, citing societal stigma and cultural considerations as reasons for its underreporting (UPLB, 2021).

To shed light, the drop in reported cases could be related to community restrictions, public transit suspension, victims being locked up with their attackers, a lack of communication channels, and a lack of knowledge on where/how to report (PCW, 2020). Further, non-reporting of VAW incident is primarily motivated by the victim's optimism that the case would be resolved inside the family and thus not have to be made public. The wife's concern for her children's emotional and physical well-being is also one of the main reasons why violence situations are not reported to the authorities (Ignacio, 2021).

According to Balahadia and Mortel (2020), there are several applications related to violence against women in many countries. Accordingly, these countries have embraced with enthusiasm emerging technology with common features such as information dissemination, identifying victim location based on GPS, SOS emergency features and immediate contact to selected relatives and friends. These are the common features of existing applications like VAW Free PH, Women's Hub, Ana Bella App, Circle of 6, Harras Map, Watch Over Me and Nidarr. However, these still have weaknesses that need to improve to make it more useful for both victims and related government agencies in taking immediate actions to respond to the violence.

The study of Eisenhut et al. (2019) supported the World Health Organization (WHO) in creating mobile application about violence against women that can help to raise awareness and support removal of taboos, especially in the generation of digital, empowerment through sharing and connecting (e.g. on social media), facilitation of interactions between VAW survivors and existing support institutions and provide an opportunity for comparably easy and quick access to information (multilingual). Innovative mobile phone applications that provide a lifeline for female victims of violence and abuse have been developed. However, not all apps have a flawless feature that can satisfy all of the community's and government agencies' requirements.

Information dissemination, victim location based on GPS, SOS emergency features, and immediate contact to selected relatives and friends are common features of existing applications as VAW Free PH, Women's Hub, Ana Bella App, Circle of 6, Harras Map, Watch Over Me, and Nidarr. However, there are still problems that need to be addressed in order for victims and relevant government institutions to be more effective in responding to violence (Mortel & Balahadia, 2020). Thus, this study adopted the mentioned studies and improved the composition of the developed application. The mobile application has a different integration of technology like the Global

Positioning System for tracking the location of the victim and the e-Reporting System. It also has a local language expressed information and questionnaire module. Additionally, the mobile application JUANAHELP provided a map for the temporary shelter of the VAWC victim and a module for the list of job opportunities. In developing the mobile application, the study used programming languages and software application like PHP, JavaScript, MySQL, Bootstrap, Font Awesome, jQuery, ChartJS, Google Maps API, Hostinger, Java, SQLite, Semaphore SMS API, Adobe XD, and Adobe Photoshop.

The development and implementation of a Violence against Women and their Children (VAWC) Report System Mobile Application for the Province of Laguna was thought to solve concerns with better data collection and the challenges of unreported incidents. With mobile applications, an increased opportunity for data access, promotion of new ideas, and connecting individuals around the world would open up (Association for Progressive Communications, 2013). This technology will facilitate quick and easy reporting for the victims and witnesses' quick response with just a click using their fingertip. As such, this study aims to develop JUANAHELP: E-Reporting System of VAWC Mobile Application. Specifically, it aims to construct a web and mobile application capable of reporting VAWC with emergency, awareness, assessment, job opportunities and shelter modules, and evaluate the performance of the system using the test casing particularly the functionality, sharing, installation, portability, and performance.

3. Literature Review

Mobile applications can easily be used, accessed, and moved from any location through handheld devices (Weichbroth, 2020). The proliferation of internet access, combined with advancements in smartphone technology, inclines the demand and fast-growing development of mobile applications for health, business, education, and reporting of different accidents and crime (Rotman et al., 2016; Plaza et al., 2013; El-Gayar et al., 2013; Wesley & Fizur, 2015; Peake, Kerr & Sullivan, 2018; Paramastri et al., 2020; Matthews, Win, Oinas-Kukkonen & Freeman, 2015; Agarwal et al., 2021; Veazie, 2018; Drigas & Angelidakis, 2017; Baharuddin et al., 2012; Raza & Rajamanickam, 2015; Fadaei & Bayazidi, 2019). In particular, accident and crime occur everywhere and an intervention of a mobile technology and reporting system can be applied in crime reporting for instance Kiruthika et al. (2021) designed an interactive mobile-based crime reporting system with a map function to aid in the tracking of crime scene location information,

Bhole et al. (2021) developed an interactive crime reporting mobile application that allows users to effortlessly and immediately report a crime or emergency, Jayasinghe & Perera (2021) suggested a reporting system can help enhance the effectiveness of police services, Perera (2016) created smartphone application incident reporting system that can assist people in reporting a road traffic collision, seeing an infringement on the road, or seeing anything illegal happen in a few simple steps, and Borandag et al. (2017) made an emergency position reporting system the aim of this application using GPS technology in mobile phones, lessen the challenges individuals face while dialing emergency numbers.

There are also several studies on using mobile application in reporting crimes. For example, Chand et al. (2015) created Women's safety app (WoSApp) that gives women a reliable option to contact the police in an emergency by shaking her phone or deliberately interacting with the application's user interface via a simple touch of a PANIC button on the screen. The user can effortlessly and discreetly start the calling feature, then the police receives an immediate communication providing the user's geographic location as well as the contact information for a pre-selected list of emergency contacts. Meanwhile, Rishta et al. (2015) proposed a location-based mobile application with privacy considerations that gives women the tools they need to fight sexual harassment in public places. The mobile app allows users to covertly record sexual harassment encounters on the street. Kharat et al. (2020) used REST API and face recognition to developed an android application that contains features such as real-time crime reporting (record crime) and the ability to view recent news or notifications from the police department. Similarly, Ignaco (2019) created a mobile app for reporting incidents that contains three categories: public disturbance, ordinance violation, and crime incidence.

4. Methodology

In this study, the developmental design was used as a research method. The study focuses on the development of a mobile app for VAWC. In order to validate the study components, an online interview and survey through Google forms in the PNP Women Desk Officer and Gender and Development personnel were conducted. The survey assessed the preferences of respondents in reporting VAWC cases and the problem they experienced with their partners. The results of the

survey and interview were the basis of the features of the VAWC mobile application reporting system with benchmarking from the existing systems.

The developed system has user interface, which is the mobile application and administrator interface in the form of website as shown in figure 1. The figure shows that users are the VAWC victims and administrator is the official of Philippine National Police – Women's Desk or the Gender and Development Official.

Figure 1

Conceptual Framework of JUANAHELP
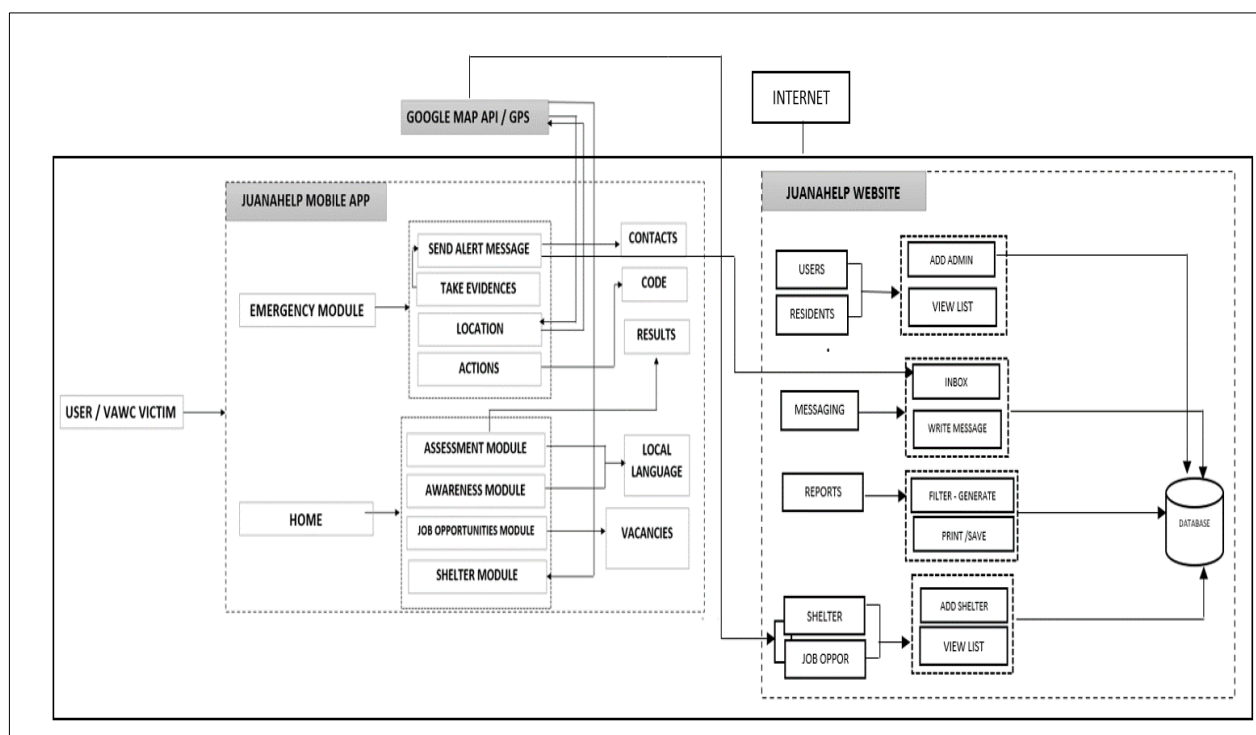
The "*e-reporting mobile application for violence against women and their children*" and "*web application*" were divided into two categories with different modules within the conceptual framework. The mobile application for e-reporting has five Modules: the *emergency module, awareness module, assessment module, job opportunities module, and shelter module.* The system features have administrators to track incidences of VAWC. The user must register in order to log in to the application.

The "***emergency module***" is the reporting portion of the mobile application for the user to send help to the pre-selected individuals in their contacts saved in the system. E-reporting has the

capabilities to include pictures, getting the locations, and sending reports. It includes the "*awareness module*" which contains information about their legal rights, legal assistance, and legal defense. This module's content was translated into tagalog to make it simpler for them to understand. The user can evaluate whether they are being abused by their partner using the "*assessment module*". To get the results, the user must choose a response to the application's provided question. The assistance services for VAWC victims are displayed in the "*job opportunities*" module. This element of the support program helps the victim begin to meet their financial needs again. The user of this feature may utilize the application to look for open positions. The "*shelter module*" is one of the mobile application's additional assistance features. In this module, the victim can hover on a map the location of the shelter that is offered to them if they need a place to remain temporarily away from their attacker.

The "*website applications*" allows the victim to be monitored by the appropriate authorities. The officials (administration) can keep tabs on the VAWC incidents in a certain location, track the data by municipality, and update the victim assistance services. There are two different categories of administrators: the *super administrator*, who is a Gender and Development Provincial Official or PNP Laguna Women Desk Officer, and the *Administrator*, who is a Gender and Development Municipal PNP Women Desk Officer. The super admin can get the consolidated report of Laguna while the admin can only view the report for their municipalities.

The system's "*home*" page displays a dashboard with information on the number of registered admin user accounts, registered resident accounts, total messages received, and the number of account logs. Additionally, it views a graph showing the number of VAWC incidents on a daily and monthly basis, the number of incidents in each municipality, and commonly asked questions. The system's "*user*" interface allows users to view a list of administrators, add new administrators for certain towns, and archive. The **"residents"** option allows users to browse the list of existing inhabitants as well as add new ones. The user's ability to respond to messages and victim alert messages is provided through the **"messaging"** feature. The Provincial GAD official or Provincial PNP Women Desk Officer may generate reports using the **"reports"** option feature. The resulting report can be printed and saved, and it can be filtered by date. The Provincial PNP Women Desk Officer or Provincial GAD official can view reported occurrences using the "*incident maps*" option feature. It displays both the prior and the most recent reports to the

locations where the incident is said to have occurred. The "***add and confirm shelter***" option features allow the Provincial PNP Officer or Provincial GAD official to verify the list of shelters in the region and add new shelter lists to the map. Through "***job opportunities***", the Provincial PNP Women Desk Officer or Provincial GAD official can modify job data, add users, and update job openings.

System Development Model

The gathered data also led to the use of an Agile Model in the process of developing the system. Figure 2 shows the applied methodology for software development.

Figure 2

Agile Methodology Phases
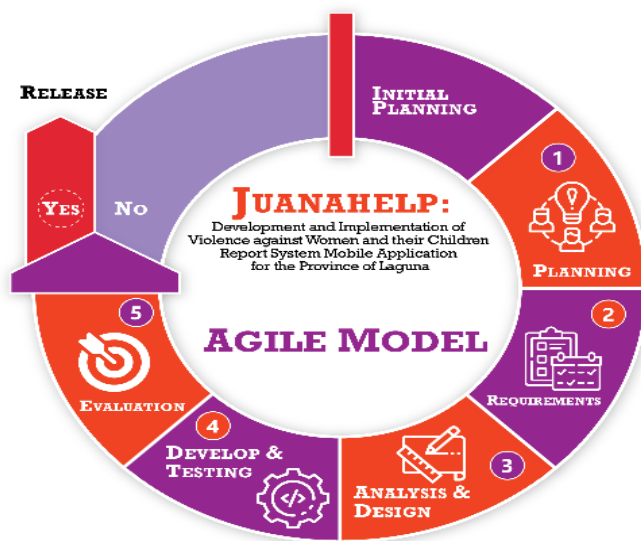
The agile methodology was used to quickly adapt changes and to continually improve each phase of the development, which include planning, requirements, analysis and design, development and testing, evaluation, and deployment. The system was released once completed but it iterates the process if there are some changes.

The study identified different tools for the software development. The application and programming language used were PHP, JavaScript, MySQL, Bootstrap, Font Awesome, jQuery, ChartJS, Google Maps API, Hostinger, Java, SQLite, Semaphore SMS API, Adobe XD, and Adobe Photoshop.
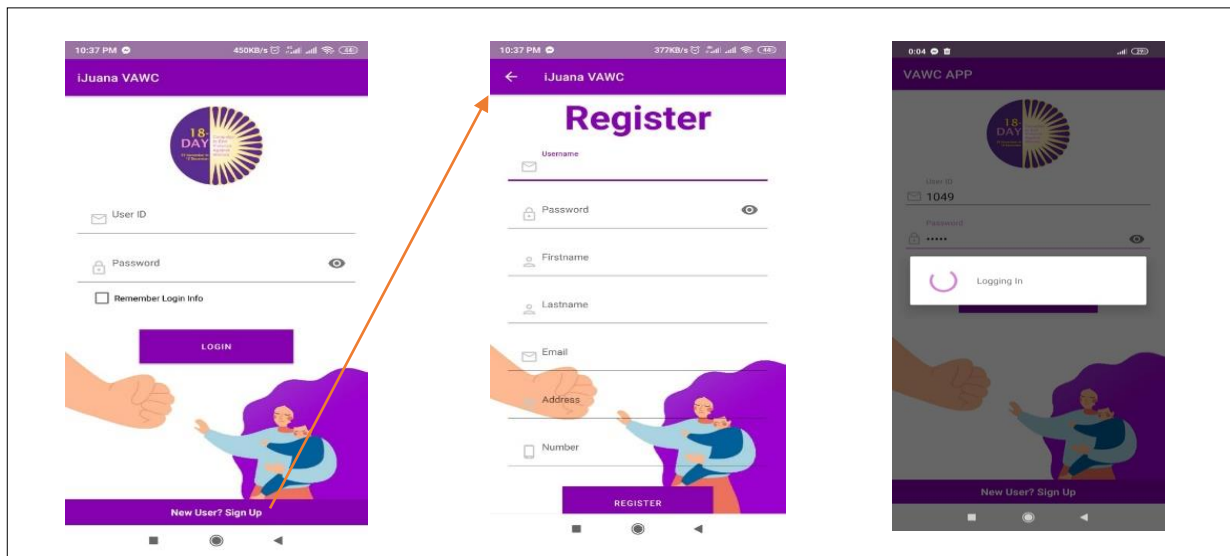
5. Results and Discussion

5.1. Mobile Application (User)

In order to log-in to the application, the user needs to sign up as shown in figure 3.

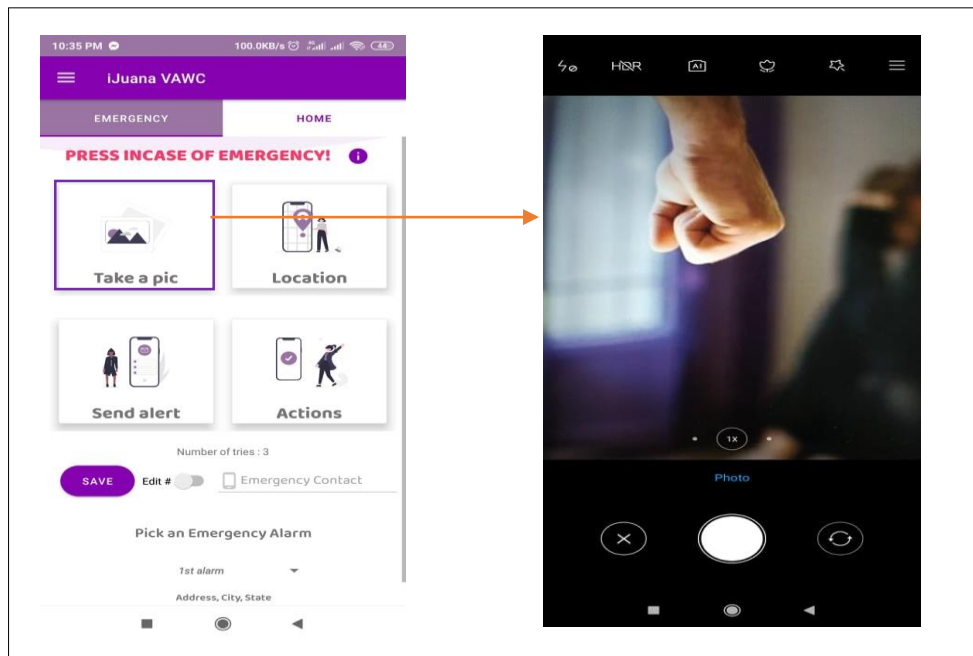**Figure 3**

Registration and Log-in

The developed e-reporting mobile application contains emergency module, awareness module, assessment module, job opportunities module, and shelter module as shown in the succeeding figures. In addition, the system has an admin page to monitor the VAWC incidents.

Emergency Module

This module is the reporting part of the mobile application and the user can send help to the pre-selected person in their contacts saved in the system. Some of the features of the e-reporting are attaching evidences using *Take a pic* (figure 4). The user can capture images of the incidents and can be sent as an attachment to the report.
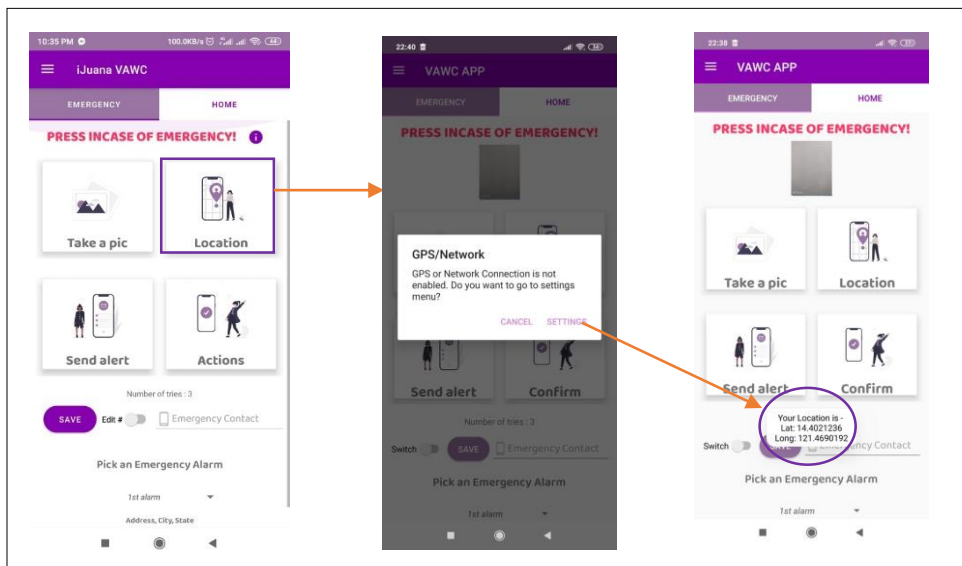
Figure 4

Capture Image Evidences

The second feature of emergency module is identifying the user's / victim's **Location** by opening the mobile phone GPS (figure 5). Using this option, the rescuer can locate the exact position of the victim.
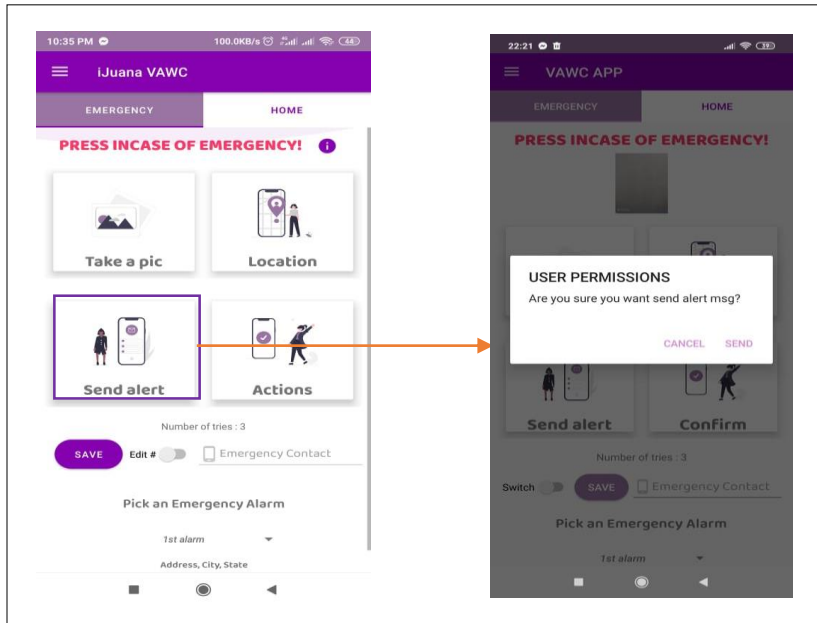
Figure 5

Setting Location

Meanwhile, figure 6 is the report sending option. The user can tap the *Send alert* button and it will ask confirmation if they want to send it. If the user confirms the report, the message will be sent to their save contact.
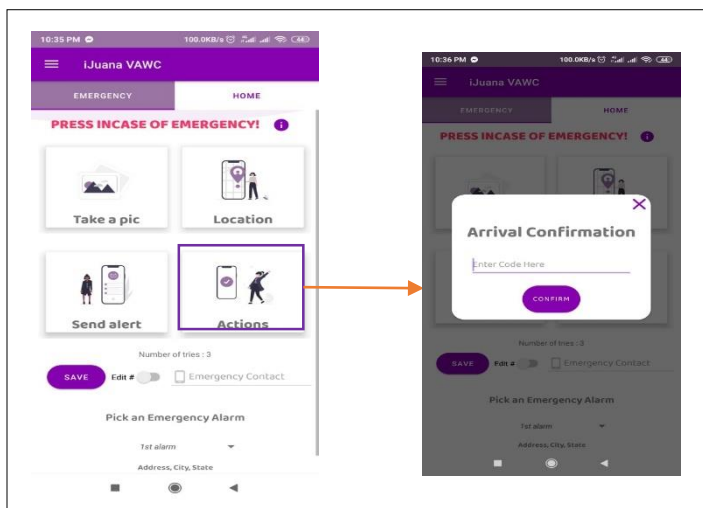
Figure 6

Sending Alert Message

The last part of the emergency module is the *Action* shown in figure 7. This receives the official's response to the user's alert message. The user can input the arrival code of the rescuers if they were rescued. This feature determines if their emergency and messages were given proper action by the officials involve in VAWC.
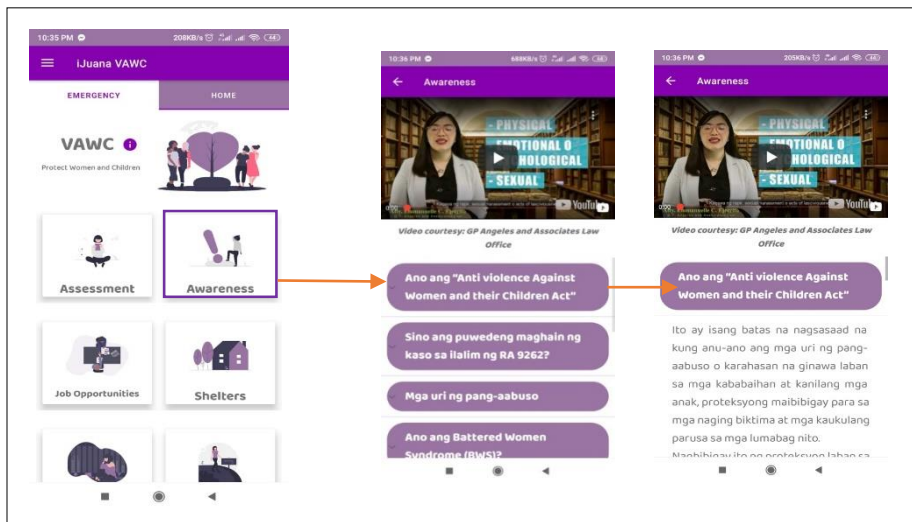
Figure 7

Actions

Awareness Module

In this module, the users can view and read the essential information connected to VAWC. The content of the awareness module is related to their rights, laws, support, and protection as shown in figure 8. The contents were transcribed in tagalog language to make them easily understand.
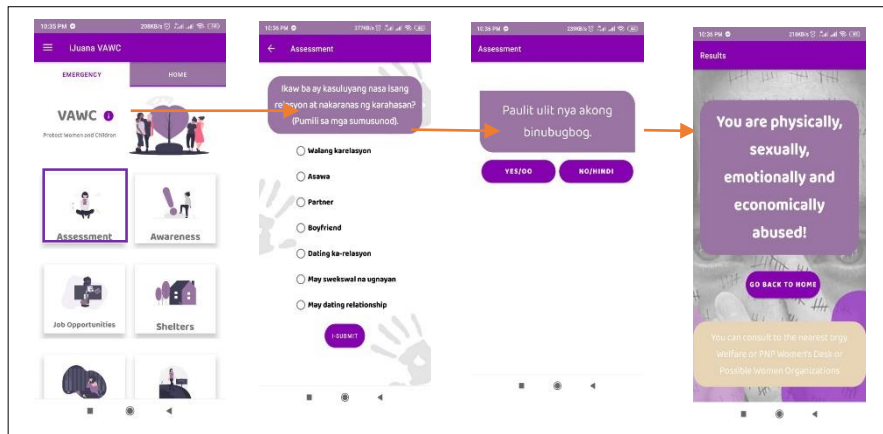
Figure 8

Awareness Module

Assessment Module

Figure 9 depicts the content of assessment module. In this module, the user can assess the early signs of abuse. In order to get the results, the user answers the questions provided in the application that identify the kinds of violence under Republic Act 9262. The results are based from the validated questions of VAWC officials. The questions are written in tagalog.
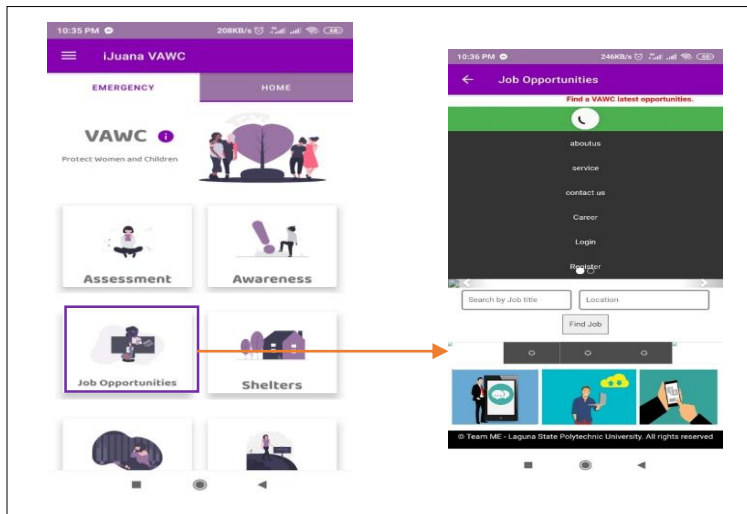
Figure 9

Assessment Module

Job Opportunities Module

Figure 10 shows the support services for the victim of VAWC. Job Opportunities Module is a support service to the victim to start rebuilding their economic needs. In this feature, the user can look for job vacancies.

Figure 10
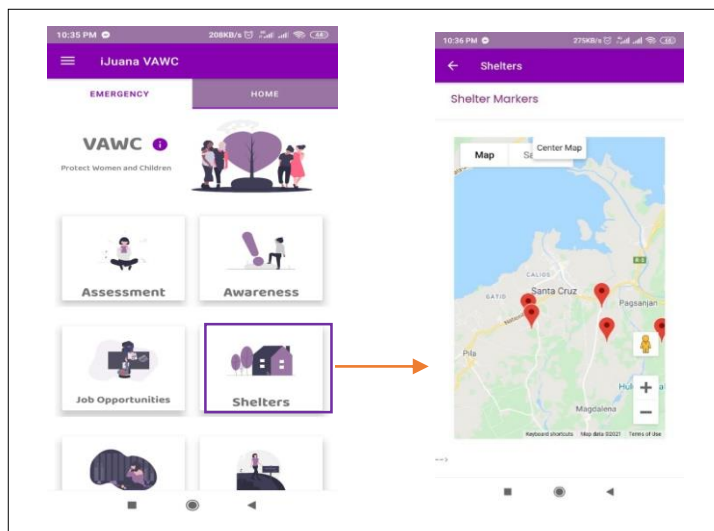
Job Opportunities Module

Shelter Module

Another support service of the mobile application is Shelter Module shown in figure 11. In this module, the victim can view through the map the location of the shelter available for them to stay temporarily.

Figure 11

Shelter Module

5.2. Web Application (*Super Admin and Admin*)

The application also secures a way that the victim can be monitored by the right officials. The officials (administrator) can monitor the VAWC incidents in the particular area, track the record per municipality and update the support services for the victims. There are two types of administrators, super administrator, PNP Laguna Women Desk or Gender and Development Provincial Official, and the administrator, Municipal PNP Women Desk Officer and Municipal GAD officer. These are the following features of the system. The super admin can get the consolidated report of Laguna while the admin can only view the report for their municipalities. Figure 12 shows the ***Log-In*** for administrator. The user can input the username and password to log-in.
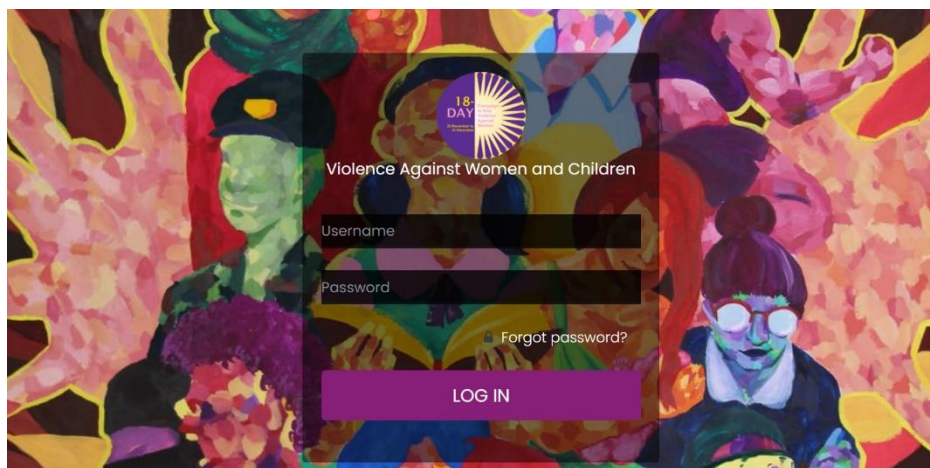
Figure 12

Admin Log-in

Figure 13 shows the ***Home*** of the system. It shows the dashboard of the number of admin user account registered, the number of residents registered accounts, the total messages received and the number of account logs. It also views the graph of daily and monthly incidents of VAWC, the number of VAWC incident per municipality and the frequently ask question.
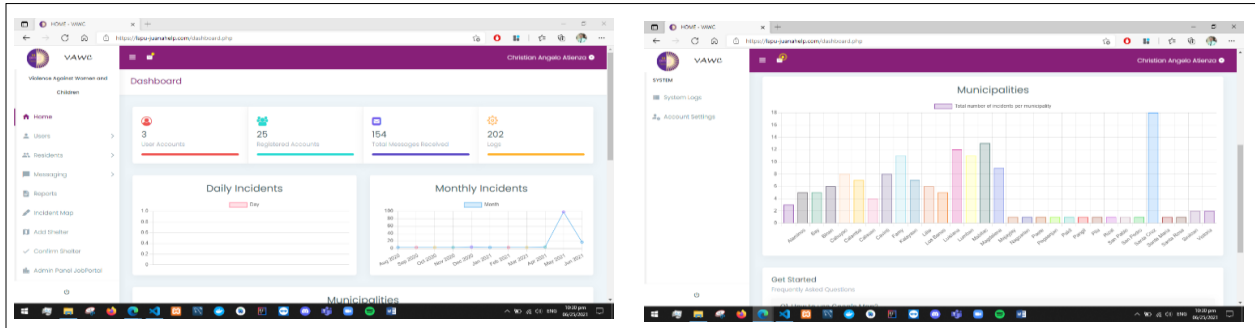
Figure 13

Home

Figure 14 shows the *Users* of the system. It consists of adding new admin for certain municipality, view the list of admin and archive.
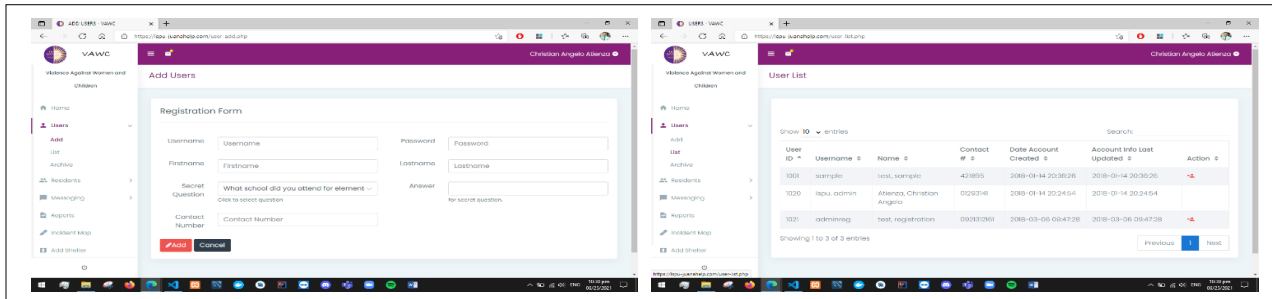
Figure 14

Users

Figure 15 shows the *Residents* option. It consists of adding new residents, viewing the list and archive.
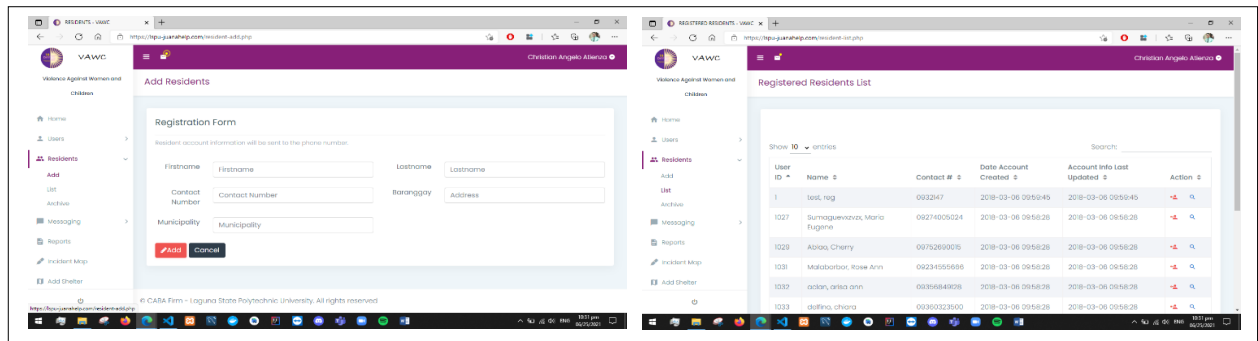
Figure 15

Residents

Figure 16 shows the ***Messaging*** option. It allows the user to reply to the messages and received alert messages of the victims.

Figure 16

Messaging

Figure 17 shows the generation of the incident ***Reports*** option. This feature allows the Provincial PNP Women Desk Officer or Provincial GAD official to generate reports. They can filter the report by the date and they can print and save the generated report.

Figure 17

Reports
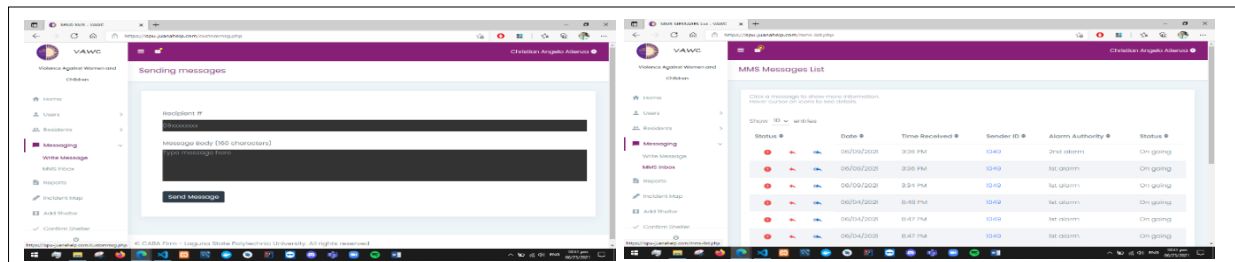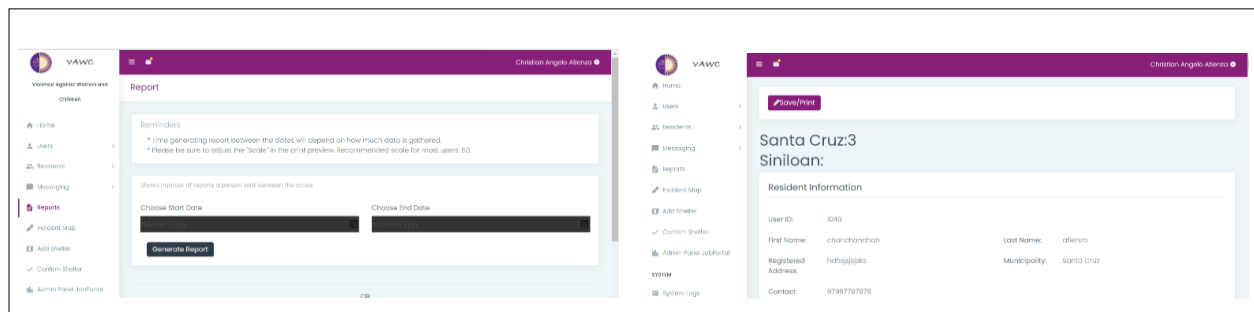

Figure 18 shows the generation of the ***Incident Maps*** option. This feature allows the Provincial PNP Women Desk Officer or Provincial GAD official to view the reported incidents through the map. It shows the previous report and actual report where the reported incident happened. This feature was connected to the Location set in the mobile application.
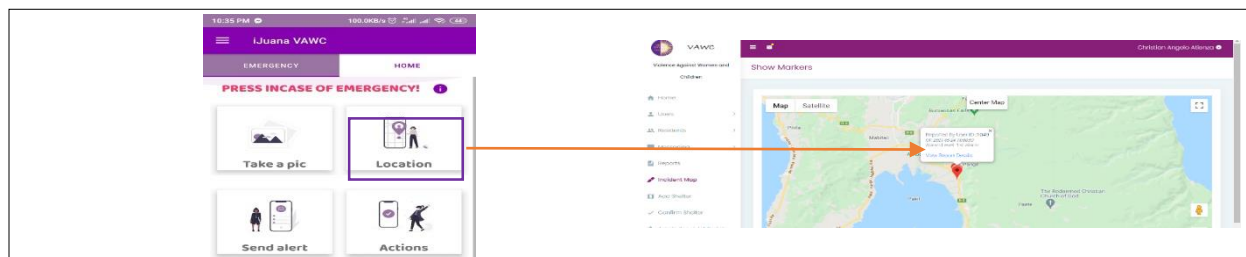
Figure 18

Incident Maps

Figure 19 shows the generation of the ***Add and Confirm Shelter*** option. This feature allows the Provincial PNP Women Desk Officer or Provincial GAD official to add new list of shelter to the map and view the list of the shelter available in the area.

Figure 19

Shelter
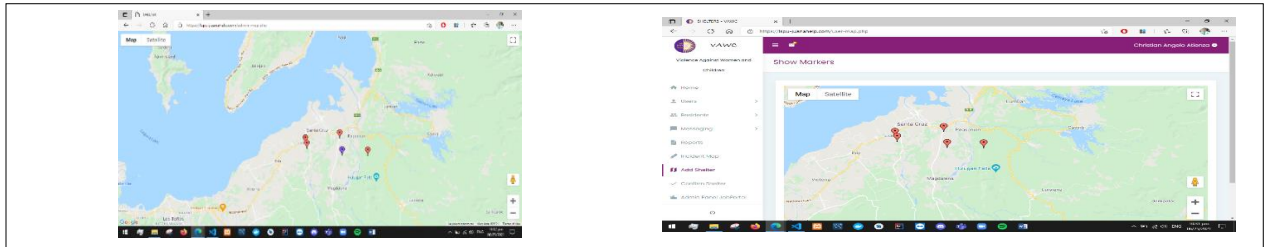
Figure 20 is a feature for ***Job Opportunities***. This feature allows the Provincial PNP Women Desk Officer or Provincial GAD official to update the jobs vacancies, add users and edit job details.

Figure 20

Job Opportunities
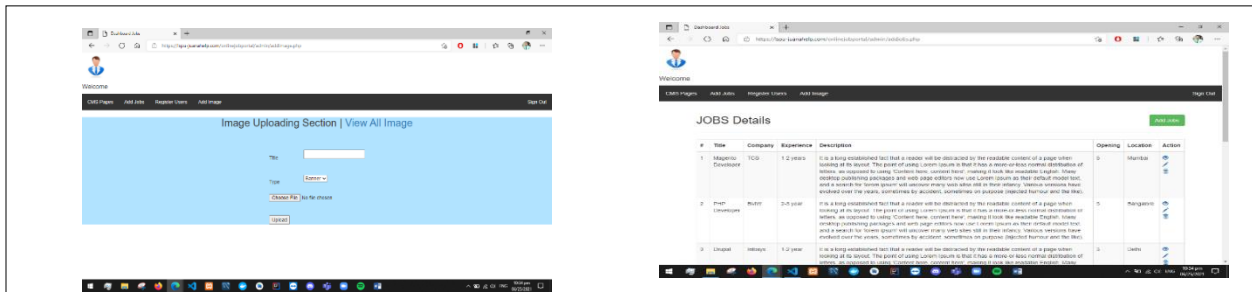
The JuanaHelp application greatly benefits the people of the Province of Laguna. Through this app, the incidence of VAWC will be easily reported and monitored. It also made possible to help individuals who are being abused in real-time. Along with the other modules, the emergency module will be of significant use to the police or any authority looking into the abuse case. The application is an easy way to give victims a voice and help them feel safe in their communities. The app also provides a mechanism for the authorities to collaborate better and prevent future VAWC incidents. It will also be a great way to raise awareness among the public. The victims can begin a new life because the application can help them find any job opportunities and a place to

live. Furthermore, this application will educate victims and make them aware if they are being abused by someone.

The study also creates a webpage that the Laguna PNP Women Desk or GAD Provincial Officials can access with ease. It proved highly beneficial for the authorities to keep track of incidents of VAWC reports, as well as updates, add shelters and job vacancies in the area. Having this type of application will allow victims to change their lives and no longer be afraid of abusive partners and others. The use of this project helps bring a sense of safety and security to those who need it most. The application also helps to improve the processes of the department, which will help to keep the department ahead of the curve in the fight against VAWC. This project has the potential to change the ways that the department operates, which will have a positive impact on the community.

5.3. System Evaluation

Functionality Test

Table 1 shows the android device use to test the functionality of the mobile application JUANAHELP while Table 2 summary of functionality test for the application of JUANAHELP. The 6 different modules of the application passed all the tests proving that it was successfully developed. The test casing evaluation helps determine if the desired output have been met. Every testing was comprehensively checked and monitored by some colleagues to avoid bias. Once the system meets all the criteria such as time speed of execution, match to the number of functionalities, and response time, it is marked "PASSED." There are 92 total test results for the six modules, which were marked passed in the whole duration of the evaluation.

Table 1

List of android phones used in testing the JUANAHELP Mobile Application

Device	Android Version	Ram	Processor
Mobile Phone no. 1	Oreo 8.1	4gb	Mediatek Helio G85
Mobile Phone no. 2	Pie 9.1	4gb	Samsung Exynos 9610
Mobile Phone no. 3	Q 10.0	6gb	Snapdragon 732g
Mobile Phone no. 4	Lollipop 5.1	3gb	Mediatek MT6750

Table 2

Overall Functionality Test Case

Module/Activity	No. Of Functionality Requirements	Total Number Of Test Case	Status
Home	7	7	PASSED
Emergency Module	20	20	PASSED
Awareness Module	10	10	PASSED
Assessment Module	36	36	PASSED
Job Opportunities Module	12	12	PASSED
Shelter Module	5	5	PASSED
Hotlines	1	1	PASSED
Instruction	1	1	PASSED
TOTAL	92	92	PASSED

Sharing Test

The sharing capability of four mobile phone to Bluetooth and Share It was also tested. The application was transferred in the apk format with the size of 6.77mb. Table 3 shows the speed transfer for 4 mobile phones. Based on the result, it is faster to send the apk of JUANAHELP to *share it* because the slowest speed of sending is only 46 seconds while in Bluetooth is 19 minutes and 27 seconds

Table 3

Sharing Test Results for Share it and Bluetooth

Activity	Expected Result	Result On Different Android Devices			
		Mobile Phone No.1	Mobile Phone No.2	Mobile Phone No.3	Mobile Phone No.4
SHAREit	Must share the application successfully	(PASSED) 40 secs	(PASSED) 38secs	(PASSED) 32 secs	(PASSED) 46secs
Bluetooth	Must share the application successfully	(PASSED) 16 mins & 20secs	(PASSED) 14 mins & 12secs	(PASSED) 11 mins & 2secs	(PASSED) 19 mins & 27 secs

Installation Test

During the testing of the installation of apk format of JUANAHELP, table 4 shows that the application was successfully installed on 4 different mobile phones. The Mobile no. 3 was the fastest in terms of installation with the results of 10.21 seconds. Mobile Phone 2 has the slowest installation time with a result of 27.19.

Table 4

Installation Test Results

Activity	Expected Result	Result On Different Android Devices			
		Mobile Phone No.1	Mobile Phone No.2	Mobile Phone No.3	Mobile Phone No.4
Installation	Must install the application successfully	(PASSED) 13.24secs	(PASSED) 27.19 secs	(PASSED) 10.21 secs	(PASSED) 14.22secs
Uninstallation	Must uninstall the application successfully	(PASSED) 1.12secs	(PASSED) 1.43secs	(PASSED) 0.47 secs	(PASSED) 1.29secs

Load Test

Table 5 shows the loading test results for four mobile devices. The fastest application in all features is mobile phone 3 and the slowest loading is mobile phone 4.

Table 5

Load Test Results for JUANAHELP Application

Activity/Module	Result On Different Android Devices			
	Mobile Phone 1	Mobile Phone 2	Mobile Phone 3	Mobile Phone 4
Clicking App Icon	5.21secs	5.02secs	4.13secs	6.10secs
Clicking Log-in Button	19ms	19ms	14ms	25ms
Clicking Sign-up Button	17ms	17ms	12ms	27ms
Clicking Home button	15ms	15ms	12ms	17ms
Clicking Awareness Button	16ms	15ms	11ms	17ms
Clicking Assessment Button	14ms	14ms	12ms	16ms
Clicking Next Button	16ms	14ms	12ms	20ms
Clicking Job Opportunities Module	25ms	19ms	15ms	26ms
Clicking Shelter Module	14ms	14ms	12ms	16ms
Clicking Contact Module	14ms	14ms	12ms	16ms
Clicking Emergency Button	14ms	15ms	12ms	16ms
Taking a picture	20ms	22ms	17ms	28ms
Clicking Location Button	16ms	16ms	12ms	19ms
Send alert message	10ms	12ms	8ms	16ms

Portability Test

Table 6 shows that the application JUANAHELP was successfully working in the four different specifications of mobile phones. The devices differ in their version, RAM and phone brand.

Table 6

Portability Test Result

Device	Android Version			Ram
Mobile Phone no. 1	Oreo 8.1	4gb	Mediatek Helio G85	Mobile Phone no. 1
Mobile Phone no. 2	Pie 9.1	4gb	Samsung Exynos 9610	Mobile Phone no. 2
Mobile Phone no. 3	Q 10.0	6gb	Snapdragon 732g	Mobile Phone no. 3
Mobile Phone no. 4	Lollipop 5.1	3gb	Mediatek MT6750	Mobile Phone no. 4

Performance Test

Table 7 shows the JUANAHELP responsiveness. After the different tests, the application did not show any complications as it processed the commands in real-time.

Table 7

Performance Test Result

Input	Process	Expected Response Time	Actual Response Time	Remarks
Camera	Taking Picture	1 – 2 seconds	1 – 2 seconds	PASSED
GPS	Set the User Location	3 – 5 seconds	3 – 5 seconds	PASSED
MESSAGE	Sending alert to admin and contacts	2- 3 seconds	1 – 2 seconds	PASSED
Home Manual Buttons	Show Assessment Module, Awareness Module, Job Opportunities Module and Shelter Module	1 – 2 seconds	1 – 2 seconds	PASSED
Violence Reporting	Sending Reports to the save emergency contacts	5-10 seconds	5-7 seconds	PASSED

The study also determined the performance of the system through different test casing such functionality, sharing, installation, load, portability, and performance test. The majority of test cases produced a favorable result labelled 'passed'. All of the app's features function as intended and pass all functionality tests. The mobile app has been successfully shared and loaded

on four different types of mobile phones. The three final tests, load, portability, and performance, verified that the mobile application's functions and buttons work properly. According to the results of the testing, the application works well on four mobile devices and passes all tests but it runs smoothly on mobile phone number 3 with an Android version of Q 10.0, 6 GB of RAM, and a snapdragon processor in terms of sharing, installing, and loading. Therefore, it would be preferable to use high version of android devices for the application to install, share and load fast. Since the expected response time and the actual response time of the testing are identical, the performance test was also passed. Overall, the test results showed that the JUANAHELP: E-Reporting System mobile application was effectively completed, with all modules and features working properly. The method has shown to be extremely beneficial to the community, particularly to women and their children who have been victims of domestic violence.

6. Conclusion

This study is focus on the development of web and mobile application named JUANAHELP: E-Reporting System of Violence against Women and their Children. This is a good tool for reporting violence against women that can add photo as supporting evidence of the report, raising awareness on women's right and laws, and assessing the level of community perception on their violent experiences. Moreover, the system can also identify the location of the victims or person who send reports, and provide opportunities through job opportunity and shelter modules that can empower women and provide them home. The web application of the system can help the authorities to identify the different reports of the VAWC and locations through geo-mapping and its type. The developed system achieved its main purpose to help the community especially the women and children through a web and mobile application.

This study is beneficial to the Province of Laguna, especially to the offices of Provincial of Laguna- DILG, DSWD, GAD, PNP-Women Desk, and LGU for a centralized database of VAWC cases. It can also lead to the development of activities and programs in gender equality and violence, and policy statement informing all government agencies to conduct data monitoring violence in the community. As such, this study recommends for another series of tests and evaluation from the related government agencies to gather different inputs in assessing the developed system. Additionally, the response of the IT expert to collect more informative and technical features to deliver good application in the community especially to the VAWC. It is also

highly recommended to conduct pilot testing in the local community or municipalities as basis and evidence in formulating specific ordinance and campaigns.

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