KONSERVA: ITS EFFECTIVENESS IN REDUCING CARBON DIOXIDE EMISSION OF THE RESIDENTS IN BARANGAY ANTIPOLO DEL NORTE, LIPA CITY

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ABSTRACT

In this research study, the technological application, KONSERVA, was implemented to determine its effectiveness in reducing the carbon dioxide emissions of the residents in Barangay Antipolo Del Norte. This study utilized a Concurrent Embedded mixed method research design, covering a pre-test, an intervention, and a post-test conducted upon a sample population from the mentioned area. The respondents of the study were chosen through Quota Sampling. Moreover, thirty (30) respondents participated in the quantitative data gathering at the pre and post tests while five (5) interviewees participated in the qualitative data gathering at the intervention and post-test. Self-administered questionnaires and one-on-one online interviews were employed for the quantitative and qualitative gatherings, respectively. In the data analysis, the quantitative data were analyzed through mean and Paired T-test whereas the qualitative data were analyzed through the Glaserian Grounded Theory Method. Through these methods, the null hypothesis was accepted as the findings highlights that there is no significant difference between the amount of carbon dioxide emissions of the respondents before and after the implementation of KONSERVA. However, despite such finding, results indicate that the respondents show a very high knowledge towards different environmentally responsible behavior (ERB) variables. Moreover, it was determined that there is a significant difference between the amount of carbon dioxide emission when grouped according to the number of household members. Also, the results presented the factors related to the effectiveness of KONSERVA wherein there are substantial features found within the application that helped its effectiveness, but the poor application development hindered its full efficacy. As a result, although there is an observed increase with all of the means, only the energy conservation practices obtained a significant difference while the other ERB variables did not. Despite the aforementioned results, the respondents still believe that KONSERVA contributed to their adaption of new ERB behaviors for the reduction of carbon dioxide emissions as it was able to provide informative content and other useful features.

KEYWORDS: KONSERVA; LIKHA enterprise; effectiveness; energy conservation; habits; practices; behavior; awareness; knowledge; carbon dioxide emission

INTRODUCTION

Electricity is one of the greatest innovations discovered in the modern world as it has spearheaded the development of many industries which created the means of improving the quality of people's lives. Electricity's significance to the world has continuously been growing as it paved the way for industrialization, advanced healthcare, and social welfare. Moreover, it has been the foundation of the energy supply around the world because it is widely utilized by various sectors of society for activities like heating and mobility (Davis, 2019). Although energy has contributed to the world's economic development by supporting the industrial sector, its discovery also led to different problems all over the world due to the high electricity consumption of people which causes a rise in the carbon dioxide emission trapped into the atmosphere.

According to Osmanski (2020), the high amount of carbon emissions has been affecting the environment and the lives of humans and animals negatively as it gets trapped in the atmosphere. MNH Media (2017) stated that the most significant consequence of excessive energy use is the increase in the amount of carbon dioxide and other substances discharged into the atmosphere which is referred to as the carbon footprint. Electricity is not terrible in and of itself because it is needed for so many things, including lights, home appliances, and charging the phones and other electronics which every individual do on a daily basis, however, negative consequences emerge when electricity is generated, for the greater the amount of electricity generated, the more carbon dioxide is emitted into the atmosphere, contributing to global warming. As of today, the electricity production of humans accounts for 25% of the 6,558 million metric tons of carbon dioxide equivalent and generates the second-largest share of greenhouse gas emissions alongside the transportation sector (EPA, 2019).

As the world progresses, technology advances, and the population increases, various modern human activities that require them to consume numerous resources like

energy which are essential to perform and operate such activities and make their daily living easier. However, some sectors tend to excessively consume electricity, posing threats to the environment and the health of people benefitting from it. One of the sectors that consume a large amount of electricity is the household sector in which family members use a variety of appliances like (e.g., air-conditioners, washing machines, and refrigerators) with different purposes to satisfy their basic and complex needs as individuals and as a family. Air conditioning is one of the most frequent causes of high consumption of electricity, especially during summer when the increase in temperature concerns the people (McCarthy, 2021).

From these mentioned reports, the researchers proposed the integration of an application named KONSERVA that was brought into existence by the LIKHA enterprise as a solution to the alarming problem of high electricity consumption by providing knowledge about the aforementioned issue, as well as on energy conservation habits to hopefully give its users the sense of responsibility in terms of reducing their carbon dioxide emissions that may help improve the quality of the environment.

In connection to the topics tackled above, the identified barangay that is concerned with the problem of high electricity consumption is Antipolo del Norte, Lipa City. As per the survey that was conducted by the researchers in 2021, it was concluded that there are three sub-problems that cause high electricity consumption among the households of the said target community namely the lack of energy conservation seminars and training, the lack of alternative energy solutions, and the lack of community engagement. Thus, this can be considered a good topic to investigate since the three stated problems experienced in the community are closely related to high electricity consumption and carbon emission. These three sub-problems are also the basis of the LIKHA enterprise in conceptualizing the three main features of KONSERVA particularly a module system, a tracking tool, and a communication platform. Further, Barangay Antipolo del Norte, Lipa City is located in a densely populated area with an average of 1,300 households and families (PhilAtlas, 2021). With this, many residents and multiple commercial establishments can be found in the

barangay who will be able to benefit from the technological application to be implemented to address the aforementioned problems.

Moreover, the main focus of the study is to evaluate the effectiveness of the KONSERVA application to the community of Antipolo del Norte, Lipa City, and determine whether the amount of carbon emissions being produced has gradually decreased with the help of the application in contrast with the number of carbon emissions being produced before using the mentioned technology application. Additionally, the main goal of LIKHA in creating KONSERVA is to provide the users with information that may enhance their knowledge of the topic on high electricity consumption and energy conservation and to assist the users in the reduction of their carbon dioxide emissions through the use of the application. Therefore, with the use of research instruments and a thorough analysis of the data gathered based on the app, the researchers would be able to identify whether the implementation of KONSERVA brought a significant difference on the production of carbon emissions within Antipolo del Norte, Lipa City. As the researchers are to test the efficacy to solve the problem through the utilization of 21st-century technologies, introducing KONSERVA of LIKHA as an innovative application presents itself as the true solution for the problem as it is made to bring awareness on the underlying issues on high electricity consumption and present energy-conserving habits that may be enforced by its users to aim for a less polluted environment.

In this present era, there have been amazing technological advancements that paved for a more progressive and developed world like modern machineries and mobile technologies. More so, according to Amoros (2021), apps are being developed and utilized to solve world problems by helping in expanding environmental awareness, reduce inefficiencies and find solutions as it provides features that allow users to check up on the brands they consume, advocate for change, and monitor pollution and carbon footprint (Pasternack, 2020). Like today, there are various issues that the world is experiencing such as global warming, climate change, and food insecurity (Young & Sauter, 2020) and although humans may be the cause of these, they can also be the

key to solving such existent and contemporary problems by generating solutions through building mobile applications. These days, mobile devices like phones and mobile applications are prevalently being utilized around the world, making them nearly universally available (Schwab & Langell, 2018).

Thus, the proposed project of the researchers, namely KONSERVA, is essential in addressing the problem of excessive energy consumption of the residents of the target community which is Antipolo del Norte, Lipa City. With all the gathered information about mobile technology and applications, it displays the significance and relation between all of the information and this study considering that the use of KONSERVA will aim to provide features and services in the mobile application to aid the users in knowing how to conserve energy, reduce their carbon dioxide emissions, have a positive impact to the environment and connect with energy providers and other energy users in the community.

With this, the researchers determined the demographic profile of the household members, the factors affecting the effectiveness of KONSERVA and the knowledge of the residents towards energy conservation in terms of the habits, practices, behavior, awareness, and knowledge. Moreover, the researchers also calculated the significant difference in the amount of carbon dioxide emission of each household before and after implementing KONSERVA and the significant difference of amount of carbon dioxide emitted when residents are grouped according to the number of household members. In the latter part of the paper, the results derived by researchers also revealed KONSERVA's contribution to new environmentally responsible behaviors adopted by household members, and if there is a significant difference in the knowledge of residents towards energy conservation.

In addition, considering that high electricity consumption truly poses numerous threats within the environment, the foundation of the current study is supported by the Theory of Environmentally Responsible Behavior (ERB). According to Akintunde (2017), this theory was proposed in 1987 by Hines, Hungerford and Tomera wherein it asserts

that a major factor influencing ERB is the possession of an intention of acting. The ERB model includes the variables: intention to act, locus of control, attitudes, sense of personal responsibility, and knowledge, suggesting whether a person would adopt a behavior or not. Furthermore, he stated that having knowledge is not enough for a person to be able to act responsibly towards the environment since some individuals experience internal and external control that influences the way they act such as strong beliefs and the actions that they see other people doing. However, it is also possible that knowledge about the environment could evoke people to have a good attitude which can later on be translated to good intentions to act. In relation to KONSERVA, the researchers can integrate this theory into the proposed mobile application since it includes features that provide knowledge and awareness about the environmental issues that the world is facing nowadays due to the high electricity consumption of humans; causing it to directly affect the control centre and attitudes of an individual which can pave the way to an improved intention of acting and positive and responsible behavior towards the environment.

METHODOLOGY

Through the Quota Sampling design, the researchers were able to collect data from selected household members who reside in the locale of Antipolo del Norte, Lipa City. The said barangay is where the problem of high electricity consumption was identified and where the proposed project prototype was implemented. There were thirty (30) respondents in total who were capable of using technological devices, had internet access, and are 15 years old and above that took part in the data gathering process. With this, the researchers utilized the mixed method research design, particularly the Concurrent Embedded design for data collection. Moreover, the chosen type of research design consists of three stages particularly the pre-test, intervention and post-test stages. The pre-test was conducted to the target beneficiaries before the implementation proper of the KONSERVA application wherein self-administered online questionnaires were distributed to determine the basic information of the household members, the household's electricity consumption and their current habits. For the

intervention, midway through the implementation period, online interviews was conducted to gather information on the preliminary thoughts of the respondents regarding the use of the application. For the post-test, both qualitative and quantitative data were collected using questionnaires and interviews, respectively, to highlight the household members' final electricity consumption, habits, and reviews on KONSERVA.

For the quantitative data, a 4-point Likert-scale pre-test and post-test questionnaire were administered to the 30 respondents and statistically treaded with IBM SPSS using Paired T-test wherein the pre-test and post-test results were analyzed and compared to see its significant difference. This generated a value of p that represents the significant difference between the pre-test and post-test electricity bills of the households which is the determining factor of the effectiveness of the KONSERVA technology application. In addition to this, a critical significance level of 0.05 is used as a basis for the acceptance of the hypothesis which imposes a 95% acceptance level to the derived results. With such, if the value of p or the probability value of the two tail-tests is more than 0.05, the null hypothesis will be accepted which signifies that there is no significant difference between the two values, but if the value of p is less than 0.05, the null hypothesis will be rejected which signifies that there is a significant difference between the two values. On the other hand, the qualitative data gathered from the interviews of the 5 respondents for both the intervention and post-test stage via Google Meet were transcribed, summarized, and coded using the Glaserian Grounded Theory Method resulting to a representative theoretical code. Both the intervention and post-test interviews had a set of 4 questions revealing their thoughts on the app's features and content, suggestions for improvement, positive and negative experiences with it, acquired knowledge, perspectives, habits and practices, and how it helped them in their personal daily energy consumption.

RESULTS & DISCUSSION

Demographic Profile of the Respondents

Table 1
Profile of the Respondents in Terms of Gender

GENDER	FREQUENCY	PERCENTAGE
MALE	17	56.67%
FEMALE	13	43.33%
TOTAL	**30**	**100.00%**

Table 1 presents the profile of the respondents in terms of gender wherein it shows that among the 30 respondents, the male group ranks one as they obtained a frequency of 17 or 56.67%, while the remaining frequency of 13 or 43.33% belongs to the female group in rank two.

Table 2
Profile of the Respondents in Terms of Generation

GENERATION	FREQUENCY	PERCENTAGE
GEN Z (1997 – 2012)	24	80.00%
MILLENNIALS (1981 – 1996)	2	6.67%
GEN X (1965 – 1980)	3	10.00%
BOOMERS (1946 – 1964)	1	3.34%
TOTAL	**30**	**100.00%**

Table 2 depicts the profile of the respondents in terms of generation where the respondents belong to. This shows that there is a frequency of 24 respondents or 80.00% who were born between the years 1997 to 2012; hence, they belong to GEN Z, the youngest among the target generations of the study. Meanwhile, GEN X, or those who are born within the years of 1965 to 1980 ranks two as it obtained a frequency of 3 respondents or 10.00%, followed by Millennials who were born on 1981 to 1996 with a frequency of 2 respondents or 6.67%, and Boomers, born on 1946 to 1964, with a frequency of 1 respondent or 3.34% It can be observed from this result that the majority of the KONSERVA users belong to the GEN Z Generation of people in between the

ages of 10 and 25 because according to Petrock (2021), they are the first generation to have all-day internet access, connected gadgets, and social media platforms ever since they were born. In addition, Piciarelli (2017) stated that although technology is utilized by almost all ages and generations, the youth are the ones who are commonly associated with new inventions and modern technologies. He also added that they are now often the main users of technologies in this 21st century compared to the older generations. This could be the reason why most of the respondents, who are also KONSERVA users, are from the GEN Z Generation.

Table 3
Profile of the Respondents in Terms of Monthly Income

MONTHLY INCOME	FREQUENCY	PERCENTAGE
Below 10,999	3	10.00%
11,000 to 21,999	6	20.00%
22,000 to 43,999	6	20.00%
44,000 to 76,999	3	10.00%
77,000 to 131,999	5	16.70%
132,000 to 219,999	4	13.30%
220,000 Above	3	10.0%
TOTAL	**30**	**100.00%**

Table 3 demonstrates the profile of the respondents in terms of their monthly income. Twenty percent of the sample population or a frequency of 6 respondents has an income of 11,000 to 21,999, and another twenty percent have an income ranging from 22,000 to 43,999. Next to these is a frequency of 5 or 16.70% which has a 77,000 to 131,999 amount of income, followed by the frequency of 4 or 13.30% which has an income of 132,000 to 219,999. Finally, the incomes with the least frequency of 3 respondents or 10.00% each are below 10,999, 44,000 to 76,999, and 220,000 above. This result implies that the monthly income of the majority of the sample population is around 11,000 to 43,999. In support to these findings, the most recent Philippine Statistics Authority Family Income Expenditure Survey (2020) last 2018 revealed that the average annual income of families is around 257,000 per year which is equal to 22,250 per month.

Table 4
Profile of the Respondents in Terms of Educational Attainment

EDUCATIONAL ATTAINMENT	FREQUENCY	PERCENTAGE
Junior High School Graduate	5	16.67%
Senior High School Undergraduate	13	43.34%
Senior High School Graduate	1	3.34%
College Undergraduate	6	20.00%
College Graduate	5	16.67%
TOTAL	**30**	**100.00%**

Table 4 presents the profile of the respondents in terms of educational attainment, with the Senior High School undergraduate group garnering a high frequency of 13 or 43.37%, making them to rank first among the 30 respondents. Moreover, the college undergraduate group acquired a frequency of 6 or 20.00%, while the Junior High School graduate group obtained a frequency of 5 or 16.67%, along with the college graduate group which obtained the same frequency or percentage. Lastly, the Senior High School graduate group had a frequency of 1 respondent or 3.34%, being the lowest among these. From this, it appears that the majority of the respondents are Senior High School undergraduates as it is proven by Punzalan (2020) that Senior High School students are indeed aware of environmental problems because the results from his study that there is a positive correlation between environmental awareness and practice of the students. In connection to this, he also revealed that the Senior High School students have a high level of environmental awareness because it is proven by the study that they have the capacity to transform their existing knowledge into actions and habits which enables them to solve the issues that the society faces environmentally. Thus, this is possibly why they agreed to participate in this research and use KONSERVA as an environmentally-benefitting application.

Table 5
Profile of the Respondents in Terms of Number of Family Members

NUMBER OF FAMILY MEMBERS	FREQUENCY	PERCENTAGE
2	2	6.70%
3	6	20.00%
4	11	36.70%
5	5	16.70%
6	2	6.70%
7	2	6.70
8	1	3.30%
12	1	3.30%
TOTAL	**30**	**100.00%**

Table 5 shows the profile of the respondents in terms of the number of family members, with those with 4 family members acquiring the highest frequency of 11 or 36.70%, followed by 3 family members with a frequency of 6 or 20.00%, 5 family members with a frequency of 5 or 16.70%, and those having 2, 6, and 7 family members with a frequency of 2 or 6.70% each. On the other hand, those with 8 and 12 family members each obtained the lowest frequency of 1 respondent or 3.30%. Based on this, the majority of them have 4 family members in their household. This can be supported by Statists Research Department (2022), stating that the average size of households in the Philippines based on the 2021 population census was 4.1. In addition, in the latter part of the research, this data will be essential in determining if there is a significant difference in the amount of carbon dioxide emission when they are grouped according to the number of household members.

Factors that Helped and Hindered the Effectiveness of KONSERVA

Most of the interview responses garnered shows that many of the application users from Barangay Antipolo del Norte experienced more hindrances rather than helpful factors towards the efficacy of the KONSERVA application wherein:

"Substantial features helped KONSERVA towards its effectiveness while poor application development hindered its full efficacy."

Based on the responses of the participants, the researchers were able to identify six (6) hindrances and four (4) helpful factors related to the effectiveness of KONSERVA. These responses were equally garnered from the interviews of both the intervention and the post-test stages. Moreover, the generated open and selective codes from the interview are provided in the appendix, specifically in table 1. From such, the respondents stated that some of the hindrances that they have experienced were the lack of new user introduction, lack of other features and the unorganized presentation of the application while some of the helpful factors indicated were the provisions of the module system, the suggested conservation solutions and other external factors.

In terms of the stated hindrances, many of the respondents believed that the lack of other features was a factor that hindered KONSERVA's effectiveness. This response was likely garnered given that when the application was implemented to the target area of the researchers, only two (2) out of the three (3) primary features of the application was launched. The features that came with the application were the module system and the communication platform while the tracking system was removed, largely due to limitations imposed by the platform being utilized by the developers. In addition to this, another hindrance that the respondents experienced was the lack of new user introduction. Some of the respondents implied that given they are new users, not having the beginner tutorials and instructions hindered their use of the app. This is in line with the claim of Campbell (2019) who stated that application introductions play an important role in the user interface of an application as it boosts interest, inspires the users, and showcases the important concepts and contents of the application wherein the lack of it may affect its functionality. Moreover, some respondents also believed that the confusing and tedious commands of the application also played a role in the hindered effectivity of KONSERVA as they have difficulties navigating the features of the application which they described as "excessive" and "repetitive". According to Cordasco

(2017), survey data shows that 26.8 percent of users uninstall application because they were poorly designed and overly difficult to use. Such information is aligned with the experience and thoughts of the respondents towards the navigation of the application. These presented factors stated by the respondents sum up to a major factor that hindered the effectiveness of KONSERVA which is the poor development of the application. Additionally, this bad user interface will make the user feel that the application is complicated and difficult to operate and altogether bring a sense of confusion, frustration and even anger (Dai, 2018).

On the other hand, many of the respondents noticed that the addition of the module system is a factor that helped the effectiveness of KONSERVA. According to Atha (2021), studying in a module based course is highly beneficial in retaining information as the user will study in smaller chunks and not take the knowledge all at once which might cause exhaustion. From the generated codes, the application users described that the module system was comprehensive and substantial as it has a wide topic coverage related to energy conservation. Furthermore, the respondents think that the suggested conservation solutions offered by the application were also helpful to its effectiveness. According to the respondents, the suggestions provided were practical and feasible to do towards adapting to their energy conservation habits and sees it as a helpful factor to the app. This response is supported by IED (2021) who stated that having realistic goals maximizes a person's time and resources, boosts their self-esteem and helps them keep motivated. These positive benefits of adapting feasible actions are likely the reasoning why many of the respondents think that the suggested energy conservation solutions are helpful.

In addition, the respondents conveyed that beyond the features offered by the application, some of the factors that helped the effectiveness of KONSERVA were external. These external factors are the person's initiative and the person's access to internet connection. Firstly, in terms of the person's initiative, having such is vital in the effectiveness of the application given that the use of the application is self-administered.

As supported by Hulleman and Hulleman (2018), they asserted that a person's initiative is not only important in its own right but is also an important predictor of learning and achievement. They added that the people who have the initiative persists longer, produces higher quality effort and learn more deeply; values which are essential to the effectiveness of KONSERVA. Secondly, as stated by the respondents, a person's access to internet connection is another external factor to KONSERVA's efficacy. From the start, KONSERVA was an application developed through web-based platforms meaning that the users can only take advantage of the features of the application if connected to the internet. This is likely the reason why some of the respondents state that having internet access is helpful as it is required for the application's functionality. According to Device Altas (2017), 44% of publishers only offer a native application, in contrast to the 22 percent that offers web-based application and the 35 percent that offer both. Moreover, Magic Web Solutions (n.d.) stated that web-based applications offer a range of business advantages over traditional application as such is accessible anywhere, easily customizable, accessible for a range of devices, easier installation and maintenance, and increased security; advantages where KONSERVA is founded upon. All in all, these substantial features offered by KONSERA are important factors that helped the effectivity of the application.

The Knowledge of the Residents Towards Energy Conservation in Terms of:

Table 6
Knowledge of the Residents in Terms of Energy Conservation Habits

STATEMENTS	PRE-IMPLEMENTATION	INTERP.	POST-IMPLEMENTATION	INTERP.
1. Turns off appliances when not in use.	3.53	Strongly Agree	3.60	Strongly Agree
2. Prefers energy-efficient appliances.	3.70	Strongly Agree	3.73	Strongly Agree
3. Does energy-saving work.	3.60	Strongly Agree	3.77	Strongly Agree
4. Uses natural sunlight in the mornings.	3.53	Strongly Agree	3.73	Strongly Agree
5. Does not use ACs when windy or cold.	3.43	Agree	3.57	Strongly Agree
Overall	**3.56**	**Strongly Agree**	**3.68**	**Strongly Agree**

Table 6 shows the residents' knowledge in terms of their energy conservation habits before and after the implementation of KONSERVA in their community. As seen in the table, all the statements experienced an increase in their means after the implementation of the technological application. In the pre-implementation, the statements regarding residents' knowledge that obtained a verbal interpretation of "strongly agree" are statements 1 to 4. Meanwhile, the fifth statement about their habit of not using air condition when windy and cold resulted in a verbal interpretation of "agree" as it acquired a mean of 3.43. This result could mean that some still use air condition units even in cold weather. On the other hand, in the post-implementation results, all the statements resulted in a verbal interpretation of "strongly agree" which implies that the respondents acquired understanding on the importance of how their habits impact their electricity bill and can help them lessen their expenses (SaskPower,

2022). Moreover, the post-implementation results seem to deliver that the respondents “strongly agree” to all the statements presented. With this, considering the results of each statement, this could mean that they perform these habits even more after using the app and its features. According to Brauer and Douglas, (2020), an app could help plan an efficient, safe route, and prove an incentive structure to help maintain the habit.

Since the pre and post implementation results are to be compared, the statements that have the biggest or lowest amount of changes were determined. With this, it can be observed that the statement that resulted to the highest amount of change from 3.53 to 3.73, obtaining a 0.20 difference, is the fourth statement which is about their habit of using natural sunlight in the mornings. Also, as previously mentioned, this statement obtained “strongly agree” as verbal interpretations for both the pre- and post-implementation periods. This could be because sunlight is known to be one of the most naturally available sources for people and it enables them to have light while saving energy and expenses (Sorensen, 2020) Moreover, having light bulbs turned on during mornings will only produce more additional heat especially within a small space. This can be associated to Brgy. Antipolo del Norte since it is located in the Philippines which has a humid and hot weather, so light bulbs will only add to the heat experienced in the morning. Moreover, in terms of which of these obtained the lowest amount of change, the statement that shows this characteristic is the habit of using energy-efficient appliances since it only has a difference of 0.03 as it went from a mean of 3.70 to 3.73, implying that it did not change much compared to the other items. Also, the statement obtained “strongly agree” interpretations before and after implementation so this could mean that they already have energy-efficiency appliances at home even before the introduction of KONSERVA. Alongside this, it can be seen that all the statements obtained changes which are an increase from the pre-implementation means to the post-implementation means. According to Ismail et al. (2018), the use of the mobile application is considered as one of the effective methods to deliver knowledge to its users. With this result, this could mean that KONSERVA, as an environmental technology application, alongside with its features that provides an avenue for learning,

was able to impart knowledge regarding energy conservation habits to its users from the community.

Overall, in terms of the overall results, with a total mean of 3.56 during the pre-implementation and 3.68 in the post-implementation that indicates a 0.12 increase in their results before and after the implementation, the respondents strongly agree with all of the 5 statements, and they are definitely equipped with knowledge about energy conservation habits. Moreover, this overall result implies that their knowledge about energy conservation habits indeed increased after KONSERVA was implemented which can be a testament with regards to the effectiveness of the app. In fact, the study conducted by Awooda, Dafalla and Meragany (2021) proved that mobile applications are an effective tool for learning, gaining, and increasing knowledge among users.

Table 7
Knowledge of the Residents in Terms of Energy Conservation Practices

STATEMENTS	PRE-IMPLEMENTATION	INTERP.	POST-IMPLEMENTATION	INTERP.
1. Practices energy conservation	3.33	Agree	3.60	Strongly Agree
2. Avoids the overconsumption.	3.27	Agree	3.77	Strongly Agree
3. Encourages others to conserve.	3.20	Agree	3.53	Strongly Agree
4. Drives less and use other transportation	3.33	Agree	3.57	Strongly Agree
5. Have a “Green Day”	2.53	Agree	2.97	Agree
Overall	**3.23**	**Agree**	**3.56**	**Strongly Agree**

Table 7 also shows the means and interpretations of the residents' responses regarding their knowledge in terms of energy conservation practices. As observed in the table, all the items during the pre-implementation have acquired a verbal interpretation of "agree" which could mean that not all respondents know about the mentioned conservation practices, or they are not enforced strongly and performed at all times before the implementation. In fact, there are at least four who disagreed on the conservation practices. According to Nodalo (2020), the challenge that hinders some Filipinos to participate in doing practices for the benefit of the environment is insufficient knowledge regarding sustainable practices and environmental solutions. Also, first to fourth statements are found to have an increase from "agree" to "strongly agree" interpretations which could mean that these practices were strengthened and are done more by the residents after the implementation of KONSERVA within their household and community. On the other hand, the last item remained with a verbal interpretation of "agree" before and after the implementation of KONSERVA. This implies that not all of the respondents are willing to stop using electricity for 24 hours every month. According to Rose-Innes (2017), many people think that hours in itself does not make a significant contribution to energy saving. She added that green and earth hours are meant primarily not as a pragmatic action but a symbolic gesture, aimed at keeping people's collective attention focused on unsustainable resource use and anthropogenic climate change, the greatest threats humanity has ever faced. Such perception is likely the reason why some of the respondents does not fully commit to the green day.

Similar with Table 6, the pre and post-implementation results of Table 7 were compared and the highest and lowest amounts of change were determined. The highest change was obtained by the second statement about trying to avoid the overconsumption of energy which went from 3.27 to 3.77 with a 0.5 increase, Also, it can be seen that all the results increased for all statements and the statement that obtained the highest amount of increase is the second statement about trying to avoid their overconsumption of electricity. This could mean that more of the respondents are applying practices like unplugging devices and appliance when not in use in avoidance

of excess electricity consumption. This finding is aligned with a survey done by Good News Network (2020) which showed that four out of ten surveyed participants reported making an environmentally conscious decision at least once a week and nearly one in three people state they do so daily. Included in these decisions are actions towards the avoidance of excess electricity consumption where many of the respondents use bicycles or walking as their main way of transportation. Meanwhile, the least amount of change in terms of energy conservation practices was observed by the fourth statement which is about driving less and uses other forms of transportation to reduce carbon emissions. The reason behind this could be because there are reports stating that the Philippines' experience difficulties in terms of transportation such as poor quality of road network, lack of quality urban transport systems and lack of lanes for bicycles (Abad, 2019). This suggests a preference of the people to continue using private vehicles for convenience.

Overall, it can be observed that there is indeed a significant positive change in the energy conservation practices as the overall average mean increased from 3.23 before the implementation to 3.65 after the implementation, indicating a 0.33 increase. Also, it is evident that the residents' responses went from "agree" to "strongly agree" verbal interpretations. These could mean that KONSERVA indeed helped them gain more knowledge aside from their pre-existing knowledge in terms of energy conservation practices and they apply it greater than before the app was introduced to them.

Table 8
Knowledge of the Residents in Terms of Energy Conservation Behavior

STATEMENTS	PRE-IMPLEMENTATION	INTERP.	POST-IMPLEMENTATION	INTERP.
1. Changes lifestyle to solve climate change.	3.57	Strongly Agree	3.73	Strongly Agree
2. Conscious of monthly energy consumption.	3.4	Agree	3.73	Strongly Agree
3. Motivated to conserve energy.	3.37	Agree	3.67	Strongly Agree
4. Humans are responsible for Climate Change	3.67	Strongly Agree	3.87	Strongly Agree
5. My consumption contributes to climate change.	3.63	Strongly Agree	3.80	Strongly Agree
Overall	**3.51**	**Strongly Agree**	**3.73**	**Strongly Agree**

Table 8 presents the results of the residents' responses regarding their knowledge in terms of energy conservation behavior. In the pre-implementation, the first, fourth and fifth statements resulted to a verbal interpretation of strongly agree as they obtained means of 3.57, 3.67, and 3.63 respectively. As observed in these statements, all concerns global warming and climate change so this could mean that they know human responsibility and the consequences and implications of human actions even before the implementation of KONSERVA. Moreover, these three also resulted to a verbal interpretation of "strongly agree" in the post-implementation with means that are evidently higher compared to the means of the pre-implementation. This implies that although they already know well the three energy conservation behaviors,

their knowledge are found to still continue to increase as they navigated the application and learn from its contents and features.

Meanwhile, the two statements that obtained a verbal interpretation of “agree” during pre-implementation and changed to the verbal interpretation of “strongly agree” in the post-implementation are the second and third statements. Given this result, it seems that these numbers are also the ones that obtained the highest increase as it went from “Agree” to “Strongly Agree” interpretation. The second statement went from 3.4 to 3.73 as it has an increase of 0.33 on its mean and the third statement went from 3.37 to 3.67, having a 0.30 increase as well. This shows a change in the behavior of the residents after the implementation of the application which is likely caused by the knowledge imparted by different energy conservation related topics within the module systems that impacted the user’s behavior. According to Ludwig (2021), awareness can drive behavioral change given that behaviors are aligned with people’s goals and values wherein incurring more knowledge equates to the creation and reinforcement of a behavior. Such findings correlate to the interpretation garnered from the data which supports the claim. Moreover, with the app’s help, the other statements which are the first second and fifth statements also experienced an increase in their means after implementing KONSERVA. These statements observed an increase of 0.16, 0.2 and 0.15 in their means which suggests an inclination in changing one’s consumption lifestyle, a view on human’s responsibility for climate change and the belief that one’s consumption contributes to climate change, respectively.

In terms of the overall results, the verbal interpretation remained to be “strongly agree” after the implementation and it garnered an increasing change of 0.22 in the mean as it went from 3.51 to 3.73. According to Geelen et al. (2019), an application designed to achieve change in a household’s energy-related behavior must guide users towards becoming aware of how and where to save energy in ways that match the household’s needs and abilities. Evident from the mentioned result, it indicates that the respondents are already well-equipped with their knowledge regarding energy

conservation behavior before the implementation but with the help of an energy conservation-related application which is KONSERVA, they were able to understand better and acquire more knowledge about energy-saving behaviors.

Table 9
Knowledge of the Residents in Terms of Energy Conservation Awareness

STATEMENTS	PRE-IMPLEMENTATION	INTERP.	POST-IMPLEMENTATION	INTERP.
1. Aware of the energy costs.	3.17	Agree	3.13	Agree
2. Know the consequences of electricity consumption.	3.53	Strongly Agree	3.73	Strongly Agree
3. Notices issues about energy consumption.	3.53	Strongly Agree	3.70	Strongly Agree
4. Aware of the benefits of using solar.	3.50	Strongly Agree	3.77	Strongly Agree
5. Knows the “greenhouse effect”.	3.50	Strongly Agree	3.70	Strongly Agree
Overall	**3.45**	**Strongly Agree**	**3.57**	**Strongly Agree**

Table 9 shows the results of the resident’s responses regarding their knowledge in terms of energy conservation awareness before and after the implementation of KONSERVA in their community. As seen within the statements regarding the pre-implementation, statements 2 to 5 all garnered the means which is interpreted as “Strongly Agree” that shows their very high awareness about these topics. Although, out of the five statements, only statement one garnered an interpretation of “Agree” with a mean of 3.17. This statement is regarding the awareness of the respondents about the energy costs in their community. With this interpretation, the data implies that some respondents may not be fully sure or unaware about the energy costs of their electricity

distributors. This result is in line with a study done by Trotta (2020) wherein he found out that there are low levels of “electric awareness” among the respondents of the surveys which includes the awareness of the respondents on the prices and costs of electricity. He then added that two-thirds of these respondents would like to receive additional information about energy consumption and how to save energy.

Moreover, after the implementation of KONSERVA, it can be seen that not every statement indicated in table 9 has shown an increase in results. If the means of the statements within the pre-implementation were to be subtracted to the means of the post-implementation, the amount of change brought by the KONSERVA application after its implementation can be garnered. From this, it shows that statement 4 garnered the highest change for its mean with an increase of 0.22 which indicates an increased awareness in the topic of solar energy and it benefits. Furthermore, statements 2, 3 and 5 also garnered an increased change in their means which makes these four statements fortify their interpretation of “Strongly Agree”. However, if the mean of statement 1’s pre-implementation of 3.17 is subtracted to its post-implementation mean of 3.13,the result shows a change of negative 0.04. This implies a decrease in the awareness of the respondents regarding their community’s energy costs. As mentioned, a large amount of people are “electricity unaware” which is the main reason why many people do not know their energy costs. Although beyond this, one factor to their awareness is the ever-changing prices of electricity. As stated by WorldSolar (n.d.), homeowners are more likely to see bigger seasonal fluctuations when paying monthly electricity bills because of the changing maintenance costs, fuel availability and wholesale energy prices. Prices can change sporadically which makes rising utility costs hard to keep up but also make it harder to budget for power and reduce the energy usage of homes. Furthermore, in terms of the post implementation, it can be seen that statement 4 which is about the benefits of solar still showed the highest mean of 3.77 while statement one still garnered the lowest mean of 3.13 which indicates the least amount of awareness compared to the other statements. Out of the five statements assessed, four of which indicated an increase in their results. This result may imply that

KONSERVA as an application was able to impart and improve the respondent's energy conservation awareness. Given that mobile applications give people access to information right from the fingertips, access to information from anywhere at any time makes the learning process convenient and easy (Vidyalankar, 2021).

To summarize in an overall view, the total mean of the statements within the pre-implementation was 3.45 and the total mean of the post-implementation is 3.57 which shows a 0.12 increase in the overall means before and after the implementation of KONSERVA. The respondents "Strongly Agree" with four of the statements and "Agree" with only one which is about their awareness about the energy costs of their community. This result implies that the respondents have a very high awareness regarding energy conservation related topics. In addition, with the overall means of the statements, the increase in the respondents' awareness about energy conservation is evident after the implementation of KONSERVA which shows the app's efficacy within such area.

Table 10
Knowledge of the Residents in Terms of Energy Conservation Knowledge

STATEMENTS	PRE-IMPLEMENTATION	INTERP.	POST-IMPLEMENTATION	INTERP.
1. Knows how to conserve energy properly.	3.30	Agree	3.50	Strongly Agree
2. Know how to compute carbon dioxide emissions	2.57	Agree	3.07	Agree
3. Aware of the implications of electricity consumption.	3.50	Strongly Agree	3.67	Strongly Agree
4. Knows how electricity is sourced.	2.80	Agree	3.23	Agree
5. Knows the consumption rates of appliances	3.10	Agree	3.33	Agree
Overall	**3.05**	**Agree**	**3.36**	**Strongly Agree**

Table 10 shows the results of the resident's responses regarding their knowledge in terms of energy conservation knowledge before and after the implementation of KONSERVA in their community. Shown within the pre-implementation area of the table are the means and interpretation of the statements wherein four of the five statements garnered an interpretation of "Agree" particularly statements 1, 2, 4 and 5. From these four statements, statement 2 garnered the lowest mean indicated at 2.57 which is about the knowledge on how to compute carbon dioxide emissions. Although statement 2showed the lowest mean, it is still classified as "Agree" which suggests a high amount of knowledge regarding carbon dioxide computation. This is in line with a new study across 24 countries which reveals that more than half (54%) of adults believe that they

have been more aware on how to track and reduce their own carbon footprint since the start of COVID-19 (Newsroom, 2021). This “Agree” interpretation for the four statement’s means indicates a high amount of knowledge of the respondents regarding these topics. Furthermore, statement 3 garnered an interpretation of “Strongly Agree” with a mean of 3.50 showing the highest mean compared to the other statements within the pre-implementation. The third statement tackles the knowledge of the respondents regarding the long-term consequences of their electricity consumption. This interpretation implies that the respondents have a very high knowledge regarding such topic. This is validated by a survey done by BCG (2020) which saw that after COVID-19 started, some 70% of survey participants say that they are more knowledgeable now than before regarding the consequences of their actions and how human activity threatens the climate and the degradation of the environment.

It can be seen from the table that all statements showed a respective increase in all of their means. Although, there are also some notable statements which did not garner a high difference compared to the other statements or only retained its verbal interpretation after the use of KONSERVA. To assert such amount of change in the means of the different statements provided regarding the knowledge of the respondents, the means of each statement, particularly the post-test and pre-test will subtract from each other. Out of the five statements, the least amount of change seen is on statement 3 which only increased by 0.17 from 3.50 to 3.67. This result for statement three may imply that given that the respondents already have a high degree of knowledge regarding the long-term implications of their electricity consumption, such knowledge translated to a low increase in its mean after the use of the application. This low but understandable improvement in the knowledge of the people regarding such statement is likely anchored to the inclusion of substantial topics and videos regarding carbon footprint computation seen within the module system from the application.

Furthermore, two other statements which garnered a low increase are statements 1 and 5. For statement 1, it can be seen that it only had an increase of 0.20

increasing from 3.30 to 3.50. Despite having a low change in its results, the verbal interpretation for this statement still changed from “Agree” to “Strongly Agree” suggesting a very high knowledge of the respondents regarding the proper ways of energy conservation. Along with this is statement 5 which increased from 3.10 to 3.33,only showing a change of 0.23 in its mean. In terms of the verbal interpretation of this statement, it is observed that it is still encompassed by “Agree” as it did not garner enough of a change to surpass into having a strong agreement from the residents. Similar to the change in statement five is the retention of the verbal interpretation within statement four. Although this statement garnered the second highest change in its mean, the results show that the residents retained the same classification of knowledge as it resulted to “agree” about the source of electricity within their community, both for the pre- and post-implementation phases. Moreover, the post-implementation means shows that statement 2, despite having the highest amount of change in its means, still has the lowest amount of mean after the implementation of KONSERVA. This result implies more opportunity for education for those people who are still unknowledgeable about such topic. However, it can still be seen that each statement had a change in its results, particularly an increase from the pre-implementation to the post-implementation. This shows that KONSERVA, through its provided features, was able to increase the knowledge of the respondents on energy conservation.

All in all, the five statements were able to show a 0.31 increase in its means before and after the implementation of KONSERVA from a 3.05 mean within the pre-implementation to a 3.36 mean in the post-implementation. Form this, the interpretation of the overall knowledge changed from “Agree” to “Strongly Agree” which correspondingly represents the increase of means in all of the five statements provided. After the implementation of KONSERVA, the respondents “Agree” with three of the statements and “Strongly Agree” with the other two. These results confirm the positive increase in the overall knowledge of the respondents regarding energy conservation after the implementation of the KONSERVA application which highlights the app’s effectiveness in improving the knowledge of its users.

Significant Difference in the Amount of Carbon Dioxide Emission of Each Household Before and After Using the KONSERVA Tech App

Table 11
Significant Difference in the Amount of Carbon Dioxide Emission Before and After Using the KONSERVA Tech App

	KONSERVA Use	
	p-value	**Interpretation**
Amount of Carbon Emission	0.191	Not Significant

Table 11 shows the statistical results of the difference between the amount of carbon dioxide emission of each household before and after using the KONSERVA tech application. The researchers were able to get the carbon dioxide emission of each household by collecting their electricity bills during the pre-test and post-test periods and computing such bills to get the carbon dioxide emission through dividing it by Php9.25 (BATELEC, 2022) which is the generation rate of the electricity provider of the respondents in order to get the total kilo-watt hours consumed by the household. After such, the total kilo-watt consumption will be multiplied by 0.43kg (BlueSkyModel, n.d.) to garner the carbon dioxide emission of the residents. With this, the p-value which is 0.191 implies that the null hypothesis is accepted given that it does not satisfy the less than 0.05 rate of acceptance. Therefore, there is no significant difference in the amount of carbon dioxide emission of a household before and after using the tech app.

These findings can be related to previous research about educational applications like institutional and medical apps as well as their effectiveness in delivering information and applying what the users learned from them. Based on the findings of Ansari and Tripathi (2017) in their study that investigates the effectiveness of mobile learning apps in higher education, they found out that mobile learning apps can indeed be useful for students in their educational environment as they have sufficient knowledge in the usage of the internet and mobile apps. However, Agrawal et al. (2021) found out that a nurse-driven teaching mobile application used as an intervention did

not have much beneficial effect on the medication compliance of its users. In connection to KONSERVA, these studies imply that the effectiveness and success of the application in bringing significant differences between the before and after usage could either be a success or not in delivering their purpose, depending on various factors. For instance, Goyal (2019) mentioned that balance within the features of the application is crucial. The designed features should neither be too many nor less, and the features must be of value as well. Therefore, not being able to strategize for the allotment of features may result in the inadequateness of the application. Hence, this could mean that one of the factors that lead to this result towards the carbon dioxide emission change of the household users is the poor development of the app. In addition, another factor that may lead to this result could be the app's interface. EcoGrocer app is one of the environmental apps like KONSERVA that contains features about environmentally-friendly food. Based on the case study by Ron (2019) about the mentioned app, there were problems encountered regarding the app's usability, interface and features and for each problem identified, the app developing team provided the necessary revisions and improvement for the app to cater its effectiveness in serving its purpose. Therefore, all of the studies mentioned imply that the application, KONSERVA, may also need such further improvement, specifically in terms of the app's lacking features and user interface.

Significant Difference in the Amount of Carbon Dioxide Emission When Grouped According to the Number of Household Members

Table 12
Significant Difference in the Amount of Carbon Dioxide Emission When Grouped According to Number of Household Members

	Number of Household Members	
	p-value	**Interpretation**
Amount of Carbon Dioxide Emission	0.001	Significant

Table 12 presents the significant difference in the amount of carbon dioxide emission when grouped according to the number of household members. The

researchers arrived to this result by comparing the number of family members of the respondents, together with the means of their carbon dioxide emissions during the pre-test and post-test phases. Given a p-value of 0.001, it resulted to a significant difference between the two variables as it satisfies the 0.05 acceptance value.

The findings mentioned above are supported by existing research about how the household becomes the drivers of carbon emissions. Household size, according to Druckman and Jackson (2016), is a key driver of household carbon emissions since larger households benefit from economies of scale. Household consumption such as food, clothing, housing, services, energy, transport etc. contributes significantly to greenhouse gas emissions. Based on the findings from the study of Ali et al. (2021), as household size increases, electricity consumption increases. They also indicated that household size significantly contributes to the high electricity consumption of the residential sector since a larger household would require more energy than a smaller household, especially for heating and cooling. Since the KONSERVA application consists of a module system that educates its users (household members) regarding the carbon emissions, it could mean that it helps them to become aware how they can reduce it as well as it has a tracking feature that can help them to monitor their carbon emissions as a household. Through these features of the application it could mean that it assisted them in reducing their carbon emissions and be committed to manage their consumption together as a household. According to Hartono et al. (2022), the effect of household size on household energy consumption is dependent on number of air-conditioning units and the effect of number of air conditioning units on household energy consumption is dependent on household size. With this, their study also resulted to household size having a positive correlation with household energy consumption which indeed supports the findings of the current study as it suggests that as the household size increases, the higher the household energy consumption will be. In connection to this, Kotsila (2021) found out that people with large household size are more willing to conserve energy. With such significance, it can be implied that larger households have

higher carbon emission but if they have the willingness to conserve energy, lessening their electricity consumption is achievable.

Significant Difference in the Knowledge of the Residents towards Energy Conservation

Table 13
Significant Difference in the Knowledge of the Residents towards Energy Conservation

Knowledge on Energy Conservation	Knowledge of the Residents	
	p-value	Interpretation
Habits	0.248	Not Significant
Practices	0.002	Significant
Behavior	0.067	Not Significant
Awareness	0.304	Not Significant
Knowledge	0.082	Not Significant

Table 13 shows the significant difference of the respondent's overall knowledge towards energy conservation before and after the implementation of the application, KONSERVA. Seen in the table is that out of the five different sub-variables related to the adaptation of an environmentally responsible behavior, there is only one statement which showcased a significant difference when it comes to the comparisons of the data collected before and after the implementation of KONSERVA. Furthermore, the other four statements indicate a garnered verbal interpretation of "Not Significant" as it did not meet the required parameters of the analysis. From this, only the sub-variable of "Knowledge on Energy Conservation Practices" was able to meet such parameters and be interpreted as "Significant". Through the use of a paired t-test, it was derived that the p-value of the practices' data before and after the implementation of KONSERVA comes at a rate of 0.002 which is more than sufficient to be acknowledged as significant in relation to the 0.05 acceptance rate. With this, it can be said that there is a significant difference in the knowledge of the residents towards energy conservation practices after the use of the application. As mentioned by Oza (2017), different applications that were created for mobile phones have become an integral part of many individuals. He added that the reason behind this is it makes their life feel more manageable, organized and

productive. Given that KONSERVA is an application that focuses on bringing light to the issue of high electricity consumption, the users were able to grasp their role in addressing the mentioned problem. Thus, they either continue on educating themselves on the issue or take action in dealing with their electricity consumption. Using table 7 as reference, it can be seen in its overall means that there is also a change as it highlights an increase of 0.33 which also altered its verbal interpretation as the residents “Strongly Agree” to the statements making it the sub-variable which has the biggest change in its means. Additionally, the top 3 statements in this table which showed the biggest variation and contributed to the significant change of the sub-variable are statements 2, 3, and 5 which implies an improved avoidance of overconsumption, encouragement to conserve and observance of “green day”. This shows that KONSERVA was able to help the residents improve their energy conservation practices.

One the other hand, 4 of these 5 sub-variables garnered a verbal interpretation of “Not Significant” as these sub-variables did not show an acknowledgeable change in its results. These sub-variables are the knowledge of the respondents towards energy conservation habits, behavior, awareness and knowledge. Firstly, in terms of energy conservation habits, it can be seen that it only garnered a p-value of 0.248 which is beyond the value of 0.05 to be viable for acceptance. This implies that there was no significant difference in the habits of residents after the use of KONSERVA compared to before its use. Although the paired T-test of this data shows such results, Table 6, which shows the specific statements under the habits of the residents, indicates an improved mean increasing from 3.56 to 3.68 but still staying classified as strongly agree. This implies that although the residents are a sample group, each individual did not have enough of a significant change to be able to classify the whole group in showcasing a significant difference. As seen in table 6, statements such as statements 1, 2, and 5 only showed an increase of 0.07, 0.03 and 0.14 which indicates not enough of a difference despites its change in verbal interpretation. Such suggests that there were no drastic changes in the habits of turning of electricity when not in use, preferring efficient appliances and turning off ACs when it is windy. This means that KONSERVA was not

able to change the resident's habits towards energy conservation. According to Li (2022), people find it challenging to change habits instantly, especially if its deeply ingrained because it basically changes a person's behavior, way of thinking, and interactions with their surroundings to fit to the target behavior. This could be the reason why KONSERVA users' energy conservation did not have drastic changes as it is considered a difficult and complex process to achieve and it may take time or effort to change and improve one.

Furthermore, the same can be said for the sub-variable of energy conservation behaviors as it garnered a p-value of 0.067. Compared to the statement on habits, the difference in the behaviors of the residents was the closest out of the four to achieve the 0.05 acceptance rate but is still left short with its p-value. Despite its close number, the behaviors of respondents after the use of KONSERVA are still not significant enough to be classified as such. Although lacking in such area, a decent increase in its mean within table 8 is seen as it gained 0.22 in its overall mean with a verbal interpretation of "Strongly Agree". Statements such as statement 2 gained 0.33 in its mean that implies the increased consciousness of the residents in their consumption and statement 3 which increased by 0.30 where the residents felt more motivated to conserve energy. These actions imposed by KONSERVA are the factors affecting the improved behavior of the residents even though it is not significant as a whole. Additionally, one of the limitations of persuasive applications is that it lacks a ground for good behavior change theory, which is supposed to reduce its effectiveness on practical behavior change (Cellina et. al, 2019). The same can be said for KONSERVA, which is an example of a persuasive application that fosters environmental behavioral change. Although it gives its users a module system and a tracking system to help them change their behavior, it falls short of boosting their likelihood of changing their consumption. In addition, another sub-variable that did show a significant change is the knowledge of the residents towards energy conservation awareness which garnered a p-value of 0.304 that is considered as the least significant difference compared to the other variables. When table 9 is observed, which shows the specific statements related to energy conservation

awareness, it can be seen from an overall view that the mean of the awareness of the residents also garnered the least amount of change of only a 0.12 increase.

Clearly, this suggests that KONSERVA was not able to raise the awareness of the users regarding energy conservation and fortifies the interpretation of not having a significant difference after the application use. One of the reasons that attempts to the failure of raising awareness is due to the inability to greatly engage with its users. A lot of organizations focus on raising awareness as if it was the goal without considering how they would get the people to act. (Durham & Founder, 2021). In addition, they also mentioned that the email addresses that are collected from the participants should be put to use since those could have been used as a medium to remind and incite app engagement. This could have been the things that KONSERVA took into consideration to greatly raise energy conservation awareness to its users. Further, out of all the statements within the sub-variable, only in the awareness variable is where a statement is seen that degraded in its means. Statement 1's mean which highlights the awareness of the residents in their electricity cost decreased from 3.17 to 3.13 that showcases a negative 0.04 difference. Statements with changes such as this are a factor in the overall low significance of the awareness variable of the study which implies a needed improvement of KONSERVA in such regards. Lastly, in terms of the knowledge of the respondents towards energy conservation knowledge, the data garnered a result of 0.082 as a p-value which also signifies a not significant difference after the use of KONSERVA. The 0.082 value, even though being close to the 0.05 acceptance value is still interpreted as "Not Significant".

Table 10, or the table that shows the knowledge of the residents towards energy conservation knowledge highlights some factors that played into the resulted p-value of the variable. Seen in the table are statements 2 and 4 which garnered an increase in their means of 0.50 and 0.43 respectively which suggests an increase in the knowledge of the regarding the computation of carbon dioxide and the sourcing of electricity in one's community. Both of these statements garnered one of the highest increase in the

means compared to other statements. Although despite having large changes in means, in an overall view, KONSERVA was not able to increase the knowledge of the residents after its use. This result can be associated to the findings from the study of Kang, Shen, Lin, Elwyn et. al (2019) which investigated a mobile app's effectiveness in improving patients' knowledge. In the aforementioned study, they also did not find a significant difference in their variables and one of the factors they identified which caused the hampering of knowledge improvement is that the app-based intervention only lasted for approximately 30 days which is similar to KONSERVA's implementation duration. They also added that regular monitoring of app compliance could have been integrated which was a shortcoming of the developers as well. Hence, this could be the factors that led to this result in terms of KONSERVA's ability in increasing and improving its users' knowledge.

In relation to the table showed above, the essence of the researcher's theory is becoming clearer. As discussed in the introduction, the foundation of this research is based upon the Theory of Environmentally Responsible Behavior (ERB) which asserts that a major factor that affects the adaptation of an environmentally responsible behavior is the possession of a person of the intention of acting. This area is where KONSERVA is applied upon as the researchers try to create an application that can help the respondents reduce their carbon dioxide through multiple deliverables based on actions. Furthermore, this theory implies that having knowledge as the sole variable is not enough for a person to be able to act responsibly towards the environment given that different individuals experience factors that influences how a person acts. The ERB model includes the variables of intention to act, locus of control, attitudes, sense of personal responsibility, and knowledge, which suggests whether a person would adopt a behavior or not. The researchers have adapted these variables in the creation of the variable showcased statements within table 13.

With the garnered results of the data analysis done, the researchers can say that the Theory of Environmentally Responsible Behavior (ERB) is aligned with the findings

of the research. Seen in the table of the significant difference in the knowledge of the residents towards energy conservation, only one out of the five presented variables showed a significant difference before and after using the application with the other four variables failing to reach the acceptance value. Along with this, it can also be seen in table 11 that there is also no significant difference in the amount of carbon dioxide emitted by the residents after the use of KONSERVA which signifies that there was not enough of a change brought by the changes in the environmentally responsible behavior adapted by the residents. This data highlights the mentioned foundation of the ERB Theory that knowledge itself alone, or only one variable is not enough in the adaptation of the residents of environmentally responsible behavior but rather an accumulation of such variables. This implication is evident in the findings of the researchers as KONSERVA was not yet effective in adapting environmentally responsible behaviors in the lifestyles of the residents which resulted to an insignificant difference in the amount of carbon dioxide in their households.

How KONSERVA Contributed to the New Environmentally Responsible Behaviors Adapted by the Household Members to Reduce Carbon Dioxide Emission

In tables 12 and 13, the researchers were able to find out important information, particularly the significant difference of the amount of carbon dioxide emission when grouped according to the number of household members and the significant difference in the knowledge of the residents towards energy conservation, both of which is imperative in analyzing the implication of the application to the residents and their actions. Firstly, from the results, the researchers was able to assert that there is a significant difference when it comes to the amount of carbon dioxide emitted to the number of its members as it was shown that there was a 0.001 p-value which implies that with the given sample population, the number of household members is proportional to the amount of carbon dioxide they emit wherein more members equates a bigger consumption and vice versa. Additionally, in terms of the knowledge of the residents towards energy conservation, the researchers saw that there was only one variable where the residents showed a significant difference which is on the energy

conservation practice. Although despite having four variables showing low significance, the results still show some changes in adapting the different variables which highlights the extent of KONSERVA's efficacy. With this given data regarding the proportional difference of the size of a family to their carbon emissions along with the quantified results showing the effects of KONSERVA on the different variables and actions of the users, the researchers sought to understand what was the contribution or role of KONSERVA in helping the household members adapt to the new environmentally responsible behaviors.

With this, the respondents were asked about their insights on how they think KONSERVA contributed to their newly adapted environmentally responsible behaviors in reducing carbon dioxide emissions. In this regard, many of the respondents think that KONSERVA as a whole contributed to the adaptation of new behaviors through the presented content and features wherein:

"Through the provision of informative content and other useful features, KONSERVA was able to contribute to the newly adapted environmentally responsible behaviors of the household members"

The respondents stated that given that KONSERVA provided a module system, added other features, raised their knowledge, suggested feasible solutions, reminded them of energy conservation habits, and imposed the reduction of electricity use, they as the users of the application were able to adapt new environmentally responsible behaviors in reducing their carbon dioxide emissions. For added reference, the open codes generated to achieve these selective codes are referenced in the appendix, specifically in table 2.

Firstly, in terms of the module system, the respondents think that the provision of such greatly contributed to newly found behaviors because of the provided substantial information within the different topics distributed throughout the modules. One

respondent said that this feature of the application contributed a lot to their enlightenment:

> *"As an application, KONSERVA aims to provide substantial knowledge and information for us to be aware diba, so I can say it is really effective in reducing high energy consumption because it has a lot of information that could change our minds."*

This statement is supported by a study which stated that the nature of learning modules would ensure students receive a rich educational skill set by which to enhance effective learning in today's context of higher learning (Cramer et al., 2018). Secondly, the respondents also believe that the addition of other features within the application such as trackers contributed as well to their changed behaviors. A respondent stated that the other features were useful beyond the provision of the module system:

> *"With the tracker, besides the modules, I do think it is helpful but I feel like once the user is finished with it, it's kind of hard to keep using it since there's nothing else much to do. So with the tracker, I think it would help users like me. Like once we download it, it would help us in our daily lives more."*

A study conducted by Munro (2018) emphasized the importance of new features by stating that such features can enhance the application and potentially streamline one's work or even provide a function that one was not able to before, bringing an added value to one's actions. In addition to this, another respondent said that these features such as the tracking system were instrumental to the improvement of their habits saying:

> *"KONSERVA helped me improve my habits and practices on energy consumption through the use of tracking technology. I was able to monitor my electricity usage for the month, track the usage of appliances in the rooms of my house as well as calculate the possible monthly bill my household would receive."*

Although beyond these features enjoyed by the users, the answers of the respondents suggest that the implications of the application itself also contributed to a lot of the knowledge and behaviors that the respondents garnered from the features. Applications are effective tools to improve the behaviors of individuals, although a better control of their development and implementation, associates to other promotion strategies. This will impact in the behavioral change and in the improvement of positive states (Thais, Nirla, & Sena, 2020). An example of this is that many of the respondents believe that the application raised their awareness and knowledge regarding the issue of energy consumption. One respondent said that the KONSERVA features greatly contributed to their knowledge:

> *"Siguro dun sa KONSERVA application I think yung content and features like yung modules help me become educated and aware sa energy consumption. For me yung application ay it adds lang more knowledge sa residents since it is more on a module system."*

Moreover, one respondent believe that through these features, KONSERVA was able to achieve its goals:

> *"I think [KONSERVA] is exactly able to do just that which is to raise awareness and provide knowledge for the users like myself."*

Furthermore, the respondents added that another aspect that contributed to their new adapted behaviors are the feasible and applicable solutions on conservation in real life provided by the application. Some respondents stated that:

> *"The solutions provided from the module were feasible enough for me to do around my household."*

> *"With the given information within your application which has multiple suggestion at ways on how I will contribute the issues, so it helped me to try since its feasible, uh like turning off appliances when not in use, uh switching to solar appliances, and even using LED light and so much more."*

Through having feasible actions, the respondents can apply the practical knowledge and likely adapt it easier to their lifestyles. As supported by Stirling (2017), which states that getting out and applying a practical theory to a situation enables you to build upon existing skills such as problem-solving, which is imperative in the use of KONSERVA. Aside from this, another respondent emphasized this claim on its applicability in real life:

> *"Honestly, madali naman syang i-apply, katulad nung may nabasa ako na about sa television na kapag hindi ginagamit, tapos sa mga appliances na wala naman talagang gumagamit, yung naka-on lang sya katulad ng mga electric fan, tv na some individual ay nagaaksaya ng energy which I think is madali lang naman syang i-apply sa daily life natin kaso some people are just lazy."*

Additionally, the respondents think that through the usage of the application and its different features, they were reminded of the adaptation of energy conservation habits within their households. A respondent claimed that using the application improved their behavior on decision making:

> *"I think KONSERVA has helped me by reminding me based on its lessons. I think it serves as a reminder on the habits that I do have. Since we have learned all these topics in like earth science in high school. I think it really helps in reminding us about these different habits that we do need to follow in order to conserve more energy so I think it's about staying conscious or staying… yeah I think that's a good word, conscious on your decisions every day."*

The improvement of one's decision stems from learning experiences. It is imperative for an individual to have that awareness and acquire enough knowledge in order to be successful in constructing a change in their decision (Leigh, 2017). Lastly, even with the different reasoning of KONSERVA's contributions, generally, the respondents believe that application was able to contribute to their changed behaviors as it imposed the reduction of electricity consumption and usage which is the main purpose of the app. According to a study done by Balinska, Jaska and Werenowska

(2021), mobile applications have a significant impact on the action of individuals. The interactive new media have become the main determinant of changes regarding the availability and reception of media content and its impact on the user's attitudes.

As KONSERVA tries to help the residents of Barangay Antipolo Del Norte reduce their carbon dioxide emissions, the respondents highlight that through the provision of informative content and other useful features within the app, KONSERVA was able to contribute in helping them adapt new environmentally responsible behaviors. Although there were some unspecific reasoning answering the different contributions of KONSERVA such as the implications it brought to the overall lifestyles of the respondents, the answers from the selective codes suggests that the root causes of the implications is derived from the provided features of the application which is highlighted as the main contribution of the application to the adaptation of the respondents of their environmentally responsible behaviors. Moreover, Zrix (2021) described application features as the soul of an application as these elements makes a good application worth more than its actual value. Developing applications features straightforward and intuitive make the application simple to utilize and make the application experience pleasurable for the clients; thus increasing its significance in achieving its intended goal. With this, it can be said that the members of the family was able to showcase their increase in the means of the different variables regarding their knowledge towards energy conservation through the utilization of the module system and the different features provided by the KONSERVA technology application.

CONCLUSION

The study sought to determine the effectiveness of KONSERVA in reducing the carbon dioxide emissions of the residents in Barangay Antipolo Del Norte, Lipa City. Based on the quantitative and qualitative results and findings of the study, there were conclusions formulated. First, in terms of the factors related to the effectiveness of KONSERVA, substantial features found within the application helped its effectiveness, but the poor application development hindered its full efficacy. Second, after using

KONSERVA, all five variables related to the environmentally responsible behavior showed an increase in its results indicating a very high knowledge of the residents towards energy conservation habits, practices, behavior, awareness, and knowledge. Third, the result of the paired T-test based upon the carbon dioxide emissions of the household before and after the implementation of KONSERVA garnered an interpretation that there is no significant difference between the two variables. Therefore, the null hypothesis of the study is accepted. Fourth, it was determined that there is a significant difference between the amount of carbon dioxide emission when grouped according to the number of household members. Fifth, in terms of the significant difference in the knowledge of the residents towards energy conservation, results show that only the energy conservation practices variable exhibits a significant difference while the energy conservation habits, behavior, awareness and knowledge variables does not. Lastly, the respondents stated that KONSERVA contributed to their adaption of new environmentally responsible behaviors for the reduction of carbon dioxide emissions through its provision of informative content and other useful features.

RECOMMENDATION

With the results and findings of the study, it is identified that there is no significant difference in the amount of carbon dioxide emitted by the residents of Barangay, Antipolo Del Norte. Furthermore, with the data and results garnered, the researchers hereby forward their recommendations. First, in the sampling of the population, it is recommended to require every family member in a household to participate in the usage of KONSERVA. This is to identify the changes in the energy consumption of the household with all its members contributing to the conservation for a better data gathering. Second, in finding participants for the study, it is recommended to carefully review each participant and assess their intent in the participation of the study along with the usage of the app. This is to assure the participation of people who are committed and attentive in the use of KONSERVA. Third, for the duration for the study, it is recommended to lengthen the period of usage of the application. The researchers suggest a minimum of a six-month use of KONSERVA. This is to evaluate the effect of

the application in a long-term basis and to assure the participant's immersion into the app. Fourth, for the usage of the application, it is recommended to collect information in terms of the frequency of the app's use. This is to assert the significant difference between the overall time of application use towards the knowledge acquired by the participant. Fifth, on consumption data gathering, it is recommended to strictly require the submission of the original electricity receipt. This is to assure a legitimate and accurate gathering of consumption compared to self-inputted forms. Sixth, for quantitative data gathering, if the study is to be conducted with the same instruments, it is recommended to provide more specified statements for the sub-variable statements. This is to understand better the behaviors of the participants in a bigger scope. Lastly, for qualitative data gathering, it is recommended to perform it face-to-face rather than through online platforms in order to more accurately capture the responses of the participants.

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APPENDIX

Table 1

Factors that Helped and Hindered the Effectiveness of KONSERVA

Open Codes	Selective Codes	Theoretical Code
R1:Comprehensive Module System	Complete and Substantial and Up-to-date Information within the modules	Substantial features helped KONSERVA towards its effectiveness while poor app development hindered its full efficacy.
R4: Comprehensive Module System		
R4: New Information		
R2: Provides substantial information		
R1: Relevant Content		
R2: Easily Digestible Topics		
R2: Wide Topic Coverage		
R5: Wide Topic Coverage		
R5: Provision of Features		
R3: Interesting		
R1: User-friendly UI	Convenient User Interface	
R2: User-friendly UI		
R1: Use of Media		
R4: Smooth Navigation		
R5: Smooth Navigation		
R2: Practical Application of Solution / Conservation Habits	The Suggested Feasible and Applicable Conservation Solutions	
R4: Provide solution to high electricity bills		
R5: Provision of Suggested Conservation Solutions		
R3: Frequent Use of The App	Personal Initiative and External Factors	

R4: Stable Internet Connection	
R1: Lack of Instructions	Lack of New User Introduction
R2: Lack of Tutorial	
R3: Lack of Instruction	
R3: Lack of Tutorials	
R4: Lack of Beginner Instruction	
R2: Lack of Email Utilization	Lack of Reminder, Updates, and Announcement Features
R2: Lack of reminders	
R1: Lack of Updates and Announcements on Power Interruption	
R1: Tracking Feature Dependency	Lacking Long Term Features
R1: Lack of Future Proof Features	
R2: Lack of Working Tracking Tool	Incomplete or Lacking More Convenient Features
R3: Lack of Working Tracking Tool	
R4: Lack of Tracker	
R5: Lacking Features	
R3: Lack of Dual Language Option	
R2: Lack of Offline Accessibility	
R4: Lack of Automatic Grading	Lack of Progress Monitor
R5: Lack of Scoring System	
R4: Lack of Progress Monitor	
R3: Excessive Number of Modules	Confusing, Tedious and Unorganized Commands and Features
R1: Poor Module Organization	

R1: Difficulty on Navigating Quizzes		
R3: Repetitive		
R3: Boring		

Table 2

How KONSERVA Contributed to the New Environmentally Responsible Behaviors Adapted by the Household Members

Open Codes	Selective Codes	Theoretical Code
R5: Presented information on consumption	Through the provision of a module system which presented substantial information.	Through the provision of informative content and other useful features.
R4: Re-accessible modules		
R4: Challenging quizzes		
R5: Provision of conservation information		
R3: Creation of module system		
R3: Provision of detailed information		
R4: Provision of modules		
R4: Organized information		
R1: Provision of modules		
R1: Sufficient information		
R2: Provides substantial information		
R4: Refreshing topics		
R3: Frequent use of the app	Through the addition of other useful and accessible features such as trackers.	
R5: Provision of features		
R1: Provided a tracker for use		
R4: Easy accessibility		
R2: Effective problem-solving app		
R2: Universal accessibility		
R4: Provide solution to high electricity bills		
R1: Accomplishment of activities		
R2: Addresses environment problems		

R4: Inspired from its creators and activists	
R1: Raised awareness	It raised the awareness and knowledge of the users regarding the issue of energy consumption.
R2: Increased knowledge	
R2: Spread awareness	
R3: Increased consumption awareness	
R4: Fossil fuel implication awareness	
R4: Informed about solutions	
R4: Increase knowledge	
R4: Increase consumption awareness	
R5: Increase knowledge	
R5: Increase awareness	
R5: Awareness of limitations	
R2: Increases awareness	
R2: Increase knowledge	
R3: Increase awareness	
R3: Awareness of the problem's effects	
R4: Imparted knowledge	
R4: Raised awareness	
R4: Highlighted issues	
R1: Realization of problems and solutions	
R5: Provided awareness	
R4: Provides awareness	
R1: Gained understanding of consumption	
R5: Increases awareness	
R4: Increase knowledge	
R4: Climate change awareness	
R4: Awareness of poor habits and consequences	
R1: Raised consciousness	
R4: Made conscious of actions	
R5: Made conscious on conservation	
R2: Call to action	

R1: Application of solutions to real life situations	It provided feasible and applicable solutions on conservation in real life.
R4: Informed about feasible solutions	
R4: Application of solutions to real life situations	
R3: Gave multiple solutions on conservation	
R3: Created feasible actions	
R1: Feasible solution suggestions	
R1: Reminded of habits	Reminded the adaptation of energy conservation habits.
R1: Realized importance of habits	
R2: Motivated to perform conservation habits	
R2: Driven to change routine	
R2: Pushes Recycling	
R2: Use of LED lights	
R4: Pushes Use of renewable sources (solar)	
R4: Be wary of electric bills	
R5: Limiting energy usage	
R1: Reminding conservation	
R1: Helped track monthly bills	
R1: Helped track appliance usage	
R1: Helped calculate monthly bill	
R1: Recalling the users with habits	
R2: Changes perspectives and habits	
R2: Build routines and habits	
R2: Future interest	
R5: Boosts self-initiation and responsibility	
R2: Imposed reflection on energy usage	

R2: Used less AC and lights.	
R2: Using of renewable sources (solar)	
R3: Setting targets	
R2: Imposes electricity conservation	
R2: Lessens the cost of electricity	Imposed the reduction of electricity consumption and usage.
R4: Reduced electricity usage	
R3: Reduced electricity consumption	