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Development of a School-Based Environmental Program Through Elementary Pupils' Carbon Footprints

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ABSTRACT

This study crafted a school-based environmental program that aims to mitigate the harsh effect of too much carbon emission through pupils' carbon footprints. This study used quantitative descriptive research. A basic survey questionnaire, climate change knowledge test, carbon footprint calculator, and qualitative validation of the material were the research instruments. Data were analyzed using percentages, one-way ANOVA, and thematic coding. The result showed that pupils were aware of the concepts of climate change however they are average contributors of carbon. This implied that whether they will receive climate change education they are still contributors this is due to the distance they travel using their private vehicles and the distance per liter of fuel consumption (of their private vehicles) contribute to their average level of individual carbon footprints. Hence, the School-based Environmental Program was crafted and validated and should be utilized by the pupils either in the school or in their houses due to the Homebased Learning mode of this pandemic.

INTRODUCTION

Climate change refers to the change in the state of the climate as manifested by the change in the mean or the variability of its properties that persists for an extended period, typically decades or longer (IPCC, 2014) as cited by Caparoso et al, 2018.

According to a worldwide study performed by Lee et al. (2015), 90% of the population in more developed nations such as North America and Europe is aware of climate change, compared to just a handful in poor countries. They discovered that education is the single most powerful predictor of climate change awareness. While it is critical to determine if climate change education results in climate change awareness, it is equally necessary to determine whether parents' educational attainment influences their children's individual carbon footprint.

This study aimed to calculate the carbon footprint of all elementary pupils using the Philippine version of the Carbon Footprint Calculator developed by World Wildlife Fund (WWF). The result was used as basis for the drafting of the school-based environmental program that seeks to promote awareness to pupils and will serve as guide in proper implementation of conserving the environment. This school-based environmental program will be used as basis in promoting proper waste management system of the unit and will eventually be shared to the community through trainings from experts.

RESEARCH QUESTIONS

1. What is the climate change knowledge of the participants?

2. What is the individual carbon footprint of the participants?

3. Is there a significant difference in the climate change knowledge of students who have received formal instruction on climate change and those who have not?

4. Is there a significant difference between participant demographics (e.g. gender, household size, and household income, parents' highest educational attainment, level of urbanization) and individual carbon footprint?

5. What school-based environmental program will be produced?

REVIEW OF LITERATURE

Adapting to climate change entails anticipating its negative consequences and taking proper action to mitigate any harm that may result, as well as capitalizing on any possibilities that may emerge. Numerous examples demonstrate that a well-planned adaptation activity saves money and lives (European Commission, 2017). Before a person to adapt successfully, he or she must gain knowledge via formal or informal education or training.

In a global survey conducted by Lee, et al (2015), 90% of the public in the more developed countries of North America and Europe are aware of climate change while only few in the developing countries are aware of the issue. They found that educational attainment is the single strongest predictor of climate change awareness. While it is important to investigate whether climate change education translates into climate change knowledge, it must also be checked whether educational attainment of parents affect their children's individual carbon footprint.

According to a research in 2021, Climate change mitigation refers to policies and actions aimed at reducing the climate system's greenhouse gas forcing. Significant intervention points include decreasing greenhouse gas sources, such as deforestation; emissions, such as low carbon energy production; and improving greenhouse gas sinks, such as land use modifications.

Suggested by Schawanen et. (2011) that a more sustained engagement with theoretical insights from the social sciences will result in more nuanced understandings of

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transportation mitigation, and briefly describe some of the contributions that thinking about socio-technical transitions and practice theories may offer.

Climate change, according to PAGASA, is occurring these days. The evidence gathered so far indicate that the shift cannot be explained only by natural variation. Recent scientific assessments have confirmed that the observed warming of the climate system since the mid-20th century is most likely due to human activities, specifically the observed increase in greenhouse gas concentrations associated with human activities such as fossil fuel combustion and land use change. Current warming has posed a growing number of significant problems to man and the environment and will do so in the future. While some autonomous adaptation is occurring now, we must explore a more proactive adaptation strategy to guarantee sustainable growth.

In the Philippines, Republic Act No. 9512, or the National Environmental Awareness and Education Act, provides that the Department of Education (DepEd), the Commission on Higher Education (CHED), the Technical Education and Skills Development Authority (TESDA), and the Department of Social Welfare and Development (DSWD), in collaboration with the Department of Environment and Natural Resources (DENR) (Official Gazette, 2008).

On the other hand, The Department of Education (DepEd) renews its commitment to increase climate awareness and promote climate action in the basic education sector. DRRMS aims to develop climate-literate students and staff who support resilient and sustainable schools. The evaluation and improvement of climate change skills is under underway and will be published in 2021. This collection of selected climate change teaching materials aims to help instructors better integrate climate change into their curricula (DepEd, 2020).

To have a meaningful influence on future climate, knowledge must be transformed into actions. A high degree of awareness about climate change should result in a reduced carbon footprint. The term "carbon footprint" refers to the entire amount of greenhouse gases emitted because of human activity, represented in tons of carbon dioxide (Vidallo, et al, 2015).

METHODOLOGY
Research Design
Quantitative Descriptive Research is a quantitative research method that attempts to collect quantifiable information for statistical analysis of the population sample. This type of research measures data trend and can be conducted online. Descriptive research help to ascertain the research object's prevailing conditions and underlying patterns. Due to the non-invasive research method and the use of quantitative observation and some aspects of qualitative observation, researchers observe each variable and conduct an in-depth analysis. Researchers also use it to validate the data. The analysis can be conducted at different periods to ascertain any

similarities or differences. This also allows any number of variables to be evaluated. Hence, this type of research design was used by the researchers.

Research Instrument
Basic Survey Questionnaire. This questionnaire asks for the participants' demographics such as gender, household size, and household income, and parents' highest educational attainment. The questionnaire was adopted from the study of Caparoso et.al. (2018).

Climate Change Knowledge Test. This test is a modified version of the Knowledge on Climate Change Survey Questionnaire by Leiserowitz, et al, (2010). It is a 20-item combination of multiple choice and true or false questions. A score of 1 is assigned to every correct answer and 0 for every incorrect answer. The obtained score indicates the level of knowledge the pupils have on climate change

Carbon Footprint Calculator. To measure individual carbon footprint, the Philippine version of the Carbon Footprint Calculator developed by World Wildlife Fund was used the calculator is available in spreadsheet format wherein formula is enabled. It has 5 sheets namely, Carbon Footprint Calculator, My Carbon Footprint, Flight Distance, Calculation Table, Country Benchmark and Sustainability. Values were encoded in the Carbon Footprint Calculator sheet. The 4 other sheets served either as outputs sheet or reference. Input sections include About You, Your Home, Transport-Flight, Transport-Land, and Waste. Once completed, the calculated carbon footprint of the participant (in tons of CO2 per year) was shown in the upper right-hand corner of the Carbon Footprint Calculator sheet. The My Carbon Footprint sheet provided the reference values and corresponding interpretation.

Qualitative Validation of the Material. The open-ended evaluation of the material was answered by experts in science. Experts in science education were graduates of the MAED Science program, master teachers or teachers teaching science for the past 5 years.

Population and Sampling
Pupils from Grade 4 to Grade 6 of MMSU LES Laoag with their parents were the population of the study. The parents were the one to answer the carbon footprint calculator since the pupils are not yet fully aware of how they manage their energy consumptions.

Inclusion/Exclusion Criteria
Pupils and parents of the Grade 4 to Grade 6 classes of MMSU LES are included in the study. The nursery to Grade 2 pupils are not included in the study because Science is not yet part of their curriculum, hence the technical definition of Environmental Education is not yet clear to them.

Data Collection Procedure
The researchers sought permission from campus administration. The participants are grade school pupils therefore parents' consent is asked. The consent form, which required the student and parent's signatures was distributed together with the basic survey questionnaire,

climate change knowledge test, and carbon footprint calculator. Due to the pandemic the data gathering were limited to online survey using the MvLE as the online platform of the university. The consents were electronically sent to the researchers. The participants limit their involvement by answering the consent form, basic survey questionnaire and carbon footprint calculator.

Statistical Analysis Plan/ Data Analysis Plan

Profile of participants was presented in percentages. One-way ANOVA was used to determine differences between individual carbon footprint and the factors that were hypothesized to have influenced it.

Responses from the validation were qualitatively analyzed through coding.

Ethical Considerations

The researcher secured permission from authorities, imposed confidentiality and anonymity of all respondents, inform the consent individuals. The inform consent obtained through online letter. The results of the study will be disseminated through published journals and research fora.

On the other hand, the research data will be stored until the duration of the data analysis and will be deleted in the database after.

Risk

There are no hazards associated with this study for the researchers or responders. The researchers preserved anonymity by excluding the subject's real name from any part of the study. Participants may withdraw from the research at any time and may request that their data not be utilized in the study.

Due to the pandemic, everything has been conducted online; therefore, data collecting has been conducted online and is compatible with smartphone and computer applications; furthermore, it is not time-bound to prevent issues related to a lack of internet and device availability.

RESULTS AND DISCUSSION

It is shown in Figure 1 that majority of the pupils (53.8%) has a high level of climate change knowledge. It means that in the climate change knowledge assessment that consists 20 items, the pupils obtained scores that are
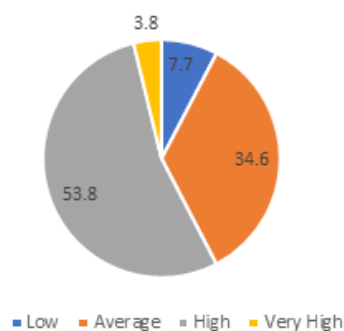

*Range of scores: 1-5 – Low; 6-10 – Average; 11-15 – High; 16-20 – Very High

Figure 1: Percentage distribution of the level of the pupils' climate change knowledge

within the range of 11-15. It implies that at a young age, pupils are aware of the concepts of climate change. Further, learning the concepts of climate change in their science course has been regarded in their curriculum as one of the most essential learning competencies.

While it is revealed in Figure 2 that most of the pupils (53.8%) have an average level of individual carbon footprints. It means that in their responses to the items that have been equated and calculated by the WWF carbon footprint calculator, they obtained scores that fall within the range of 1.0-3.99. It is implied that at their young age, they are already having an average rate of contribution to the increase of carbon.

Table 1 reveals that there is no significant difference
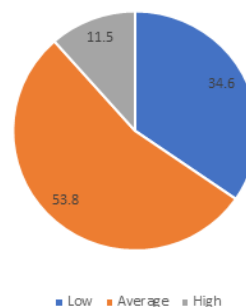
Figure 1: Percentage distribution of the individual carbon footprints of the pupils

between the climate change knowledge of the pupils and their status of receiving climate change instruction [$F_{(1,24)}$, p=.904]. This means that the status of receiving climate change instruction has no significant effect on the pupils' carbon footprint. It is implied that whether (the pupils) received climate change instruction or not, they contribute to the increase of the earth's carbon at an average level.

Table 2 indicates that among the demographic profiles and (hypothesized) factors, daily private car travel distance [$F_{(2,23)}$, p = .000] and distance travelled/liter [$F_{(2,23)}$, p = .043] show significant difference on the individual carbon footprints of the pupils. It means that the two factors significantly affect their individual carbon footprints. It implies that the distance they travel using their private vehicles and the distance per liter of fuel consumption (of their private vehicles) contribute to their average level of individual carbon footprints

Qualitative Validation of the Material

The crafted school-based environmental program was subjected to qualitative content and construct validation. Five (5) evaluators composed of (3) Master Teachers and Two (2) Head Teachers from the Department of Education that specialize in Science Teaching reviewed the document (of the program) and the following are their comments and recommendations:

Comments (on the content and structure)

• Parallelism on the enumeration of the environmental principles. The statements need to be shortened.

• On the concept of "water", the idea is incomplete. Rather, the concepts of "water conservation" and "water wastage management" must be included.

Table 1: One-Way ANOVA on the difference between the climate change knowledge of the pupils and their status of receiving climate change instruction

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.162	1	.162	.015	.904
Within Groups	262.338	24	10.931		
Total	262.500	25			

Table 2: One-Way ANOVA on the difference between the profile of the pupils and their carbon footprints

Profile	Sum of Squares	df	Mean Square	F	Sig.
Age	9.191	3	3.064	.886	.463
Gender	2.335	1	2.335	.676	.419
Grade Level	2.088	2	1.044	.289	.752
Household Size	4.259	2	2.129	.605	.555
Monthly Electric Bill	.864	3	.288	.075	.973
LPG Tank Usage	16.173	2	8.087	2.694	.089
Domestic and International Flights	9.292	2	4.646	1.407	.265
Car Type	3.906	2	1.953	.552	.583
Daily Private Car Travel Distance	48.175	2	24.087	14.954	.000**
Ride Sharing	11.001	2	5.501	1.705	.204
Distance Travelled/Liter	25.907	3	8.636	3.203	.043*
Public Transport Ride	5.141	1	5.141	1.541	.226
Public Transport Mileage	4.428	2	2.214	.630	.541
Solid Waste Generation	12.827	2	6.413	2.038	.153
Climate Change Knowledge	49.031	10	4.903	2.032	.104

*$p = < .05$

**$p = < .01$

RECOMMENDATIONS

• Inclusion of locally endemic species in the province (of Ilocos Norte) upon the introduction of the concept of biodiversity to the learners.

• Clear elaboration and induction of environmental principles. The use of definition of terms in the document is necessary.

• Development of monitoring tool on the proposed activities of the program apart from the tracking of individual carbon footprints.

• Further analysis involving comparisons of the quantitative data on the individual carbon footprints before and after the implantation of the school-based environmental program

SUMMARY AND CONCLUSION

The following conclusion was made based on the study's findings: The results indicated that although pupils were aware of climate change ideas, they are average carbon contributors. This implies that regardless of whether they receive climate change education, they are still contributors, as the distance traveled in their private vehicles and the distance traveled per liter of fuel consumed in their private vehicles contribute to their average level of individual carbon footprints. Climate change education should not only be about discussion but also about action, such as exposure to real-world situations since their efforts will strengthen their ability to minimize the harmful effects of climate change. Due to the pandemic's Homebased Learning mode, the School-based Environmental Program was developed and verified to be used by students either in school or at home. This will help lessen and mitigates the average carbon contribution of pupils in the school and in the community.

It is recommended that environmental education should also be done to further enhance the environmental program of the school.

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