ABSTRACT

This study was conducted to investigate the understanding of global warming of first-year high school students taking Integrated Science in Tacloban City, Leyte, Philippines. A 30-item questionnaire with a reliability coefficient value of ρKR20=0.8132 was administered to randomly chosen sample of 360 student-respondents from five public secondary schools. It was revealed that 3.89 % of the respondents got high scores (18-23), 54.44 % got moderate scores (12-17), 32.78 % obtained low scores (7-11) and 8.89 % got very low scores (1-6), with a mean of 11.95. Moreover, respondents’ age, sex, and economic status showed a positive relationship to their understanding of global warming. Consequently, the older the respondent and the higher the family income, the higher is the understanding of global warming. On the whole, the female had a higher score than the male participants.

Keywords: Freshmen secondary students, global warming, understanding, Tacloban City.

INTRODUCTION

Worldwide, the Philippines is the country that is most vulnerable to the impacts of climate change particularly typhoons, which always pose a constant threat to the people of this country. Historical data show that this country is visited by an average of 20 typhoons a year (ADRC, n.d). One of these typhoons that entered the record books and made the threat devastatingly real was Typhoon Haiyan which packed winds reaching 380 kilometers per hour (kph.) (Brown, 2013) when it made a landfall in the Philippines on November 8, 2013, passing directly over Tacloban City, the research locale of this study. The total number of deaths caused by this typhoon reached 6,293 with 1,991 missing. Property damage was estimated at US $864 million (McPherson, Counahan, & Hill, 2015).

According to experts, typhoons are significantly related to global warming and climate change (Anthes et al., 2006; Schiemeier, 2013; Vidal & Carrington, 2013). Placing this phenomenon in a broader context requires looking into the essentiality of knowing global warming which is increasingly becoming significant (Boyes & Stanisstreet, 2011) due to the rising level of greenhouse gases that increases the earth’s average surface temperature which, in turn, causes the melting of massive icebergs (Aydin, 2010). The warming is caused by the unceasing increase of carbon dioxide (CO2) in the atmosphere (Cox, Betts, Jones, Spall & Totterdell, 2010). This gas is reported to
constitute 63 percent of the greenhouse gases that warms the earth (May & Caron, 2009). The atmospheric CO2 intensity had amplified from 288 parts per million (ppm) before the modern age started to 373 ppm in 2002 (Mosteiro, 2012). The earth’s average surface temperature had gone up by 0.6 degrees Celsius during the 20th century. However, a different view was presented pointing to chlorofluorocarbons (CFCs) and not greenhouse gases as the cause of global warming (Lu, 2013).

The adverse consequences of global warming include: (a) a large percentage (20 to 30) of plant and animal species is at risk of extinction, (b) coasts will be exposed to increasing risks including coastal erosion, (c) increase in floods every year due to the rise of the sea level, (d) the health status of millions of people will deteriorate as indicated by an increase in malnutrition, disease and deaths due to heightened weather disturbances (Houghton et al., 1996; Zhang, Douglas, & Leatherman, 2004; Epstein, 2000; Thomas et al., 2004), and (e) effects on the physiology, distribution and phenology of species (Hughes, 2000).

In the light of the existence of global warming whereby the Philippines and other countries face negative consequences and impacts, the contribution of the education system to reducing global warming has generated considerable interest, studies, and actions (Cetin & Nisanci, 2010; Coertjens, Boeve-de Pauw, De Maeyer, & Van Petegem, 2010). Consequently, the importance of trying out approaches that will enhance the ability and willingness of students to apply scientific knowledge to their lives has come to the forefront in efforts to mitigate global warming. There is a perceived need for approaches in the education system that will enhance the ability of countries to face the challenge of future uncertainties in the environmental, economic and political spheres. Thus, appropriate responses are needed so that effective educational infrastructure and relevant knowledge and skills are made available to students (Bangay & Blum, 2010). In particular, it would be timely to improve the school science curriculum because it is no longer responsive to meet the interests and aspirations of the youth. It has also been recognized that there is a need to link science education, economic globalization, increasing production and unlimited expansion (Hodson, 2003).

While the importance of environmental education has been recognized and promoted (Venkataraman, 2008), there are many misconceptions about global warming that have been observed and, thus, need to be corrected (Meadows & Weisenmeyer, 1999). These misconceptions include: (a) confusion related to the depletion of the ozone layer and its link to the greenhouse effect and pollution of the atmosphere (Boyes & Stanisstreet, 1994; Taber & Taylor, 2009); (b) confusion on global warming’s causes and effects with those of the depletion of the ozone layer (Boyes & Stanisstreet, 1992, 1994; Pekel & Ozay, 2005; Leiserowitz, Smith, & Marlon, 2011); (c) there is a link between the greenhouse effect and health, specifically on the incidence of heart attacks and food poisoning (Boyes & Stanisstreet, 2001); (d) a decrease in the use of power from nuclear plants will diminish global warming (Boyes, Stanisstreet, & Daniel, 2004); (e) students know CO2 as the only greenhouse gas (Punter, Ochandro-Pardo, & Garcia, 2011); and (f) the use of lead-free gasoline reduces global warming (Boyes & Stanisstreet, 1992).

The existence of the misconceptions can be linked to the behavior of students and the actions they take to help solve environmental problems such as global warming. Schools have a critical role by way of subjects taught involving issues about the environment and by encouraging students to care for their surroundings (Taber
& Taylor, 2009). However, knowledge on environmental problems does not always lead to a willingness to take a pro-environment action (Kilinc, Boyes, & Stanisstreet, 2011). Also, the degree of willingness exceeded the extent to which students believed in the usefulness of the activity (Boyse, Skamp, & Stanisstreet, 2009). Moreover, knowledge of global warming can be transformed into a pro-environment behavior, but such an expected correlation may at times, not even exist (Negev, Sagy, Garb, Salzberg, & Tal, 2008). This fact could be partly traced to the inadequacy of understanding on the part of student-teachers (Ratinen, 2013).

Based on the above-mentioned studies, the education system has to undergo substantial changes to address the need to enhance understanding by relating these to pro-environment action. It is, therefore, imperative to determine how students can be encouraged to willingly act and contribute to the reduction of global warming (Skamp, Boyes, & Stanisstreet, 2009). In this regard, strengthening environmental education can be effective in improving student behavior and making them pro-environment (Rodríguez, Boyes, & Stanisstreet, 2010). As aptly stated by UNESCO, education is a major component of the global response to problems posed by climate change. Education helps the youth understand global warming and address its impact by promoting changes in behavior and attitudes (UNESCO, n.d.). It will also improve their vigilance and responsibility for stalling the increasing problem posed by global warming (Sah, Bellad, & Angolkar, 2015).

These efforts to improve different aspects of the education system to fill existing gaps can include: (a) developing theory-based learning materials that would foster a thorough understanding of the greenhouse effect and global warming (Reinfried, Aeschbacher, & Rottermann, 2012); (b) crafting a curricula for tertiary science designed to enhance knowledge and understanding of pre-service teachers (Boon, 2010); (c) involving students in hands-on activities or using appropriate visual aids (Taber & Taylor, 2009); (d) instilling students with skills in problem-solving, creative thinking and new values through learning methodologies which encourage participation and experimentation (UNESCO, n.d.); (e) beginning early the exposure of students to major problems pervading the environment before misconceptions become virtually permanent thereby affecting behavior and attitudes (Boyse, Stanisstreet, 1993); and (f) investigating further of the correlation of factors like income level (Torgler, Garcia-Valiñas, & Macintyre, 2008), gender (Yilmaz, Boone, & Andersen, 2004), and age (Taber & Taylor, 2009) to the understanding of global warming as a means of determining appropriate interventions.

Going to the locale of this study, it is noted that public schools in Tacloban City undertake activities which support environmental protection such as trainings that focus on solid waste management, planting of Philippine indigenous trees like Narra, Molave, Philippine Teak, Acacia and Kamagong, recycling, entrepreneurship, clean-up drive within and outside the school premises, reusing and reducing waste generation and establishing a school-based award system for students’ exemplary environmental action. Memorandum Order No.25 s. 2007 of the Department of Education identified these activities.

Complementing the activities cited earlier, the Department of Education issued Memorandum No. 38 s. 2012 directing the conduct of the Youth for Environment Summer Camp, in partnership with Department of Environment and Natural Resources. This camp intended to impart environmental principles to pupils and students.

Thus, there is a need to assess students’ understanding of global warming in Tacloban
City, Philippines. Specifically, this study attempts to:

1. Determine the environment-related organization activities of the respondents;
2. Verify the level of knowledge of student-respondents in global warming; and
3. Determine the relationship between the profile variables and knowledge of global warming.

METHODOLOGY

This study was conducted in 2010, three years before Typhoon Haiyan struck Tacloban City. Data were collected from 360 freshmen students randomly selected from five (5) purposively chosen public secondary schools in Tacloban City, Leyte, Philippines as follows: Eastern Visayas State University Integrated Laboratory School, a special science school; Philippine Science High School; and three national high schools, Leyte National High School, San Jose National High School, and Sagkahan National High School. The national government’s Department of Education supervises these public secondary schools. The teachers are employees of this Department. They follow the same curriculum which is the Basic Education Curriculum (BEC). The Slovin’s formula was used to determine the number of respondents from 3,595 total student population of the five secondary schools.

Table 1 presents the respondents’ profile as to their age, sex, socio-economic status (SES), and parents’ monthly income.

The students’ ages range from 11 to 19 years old. Most of them (85.4%) are 11-13 years old. Majority are female 231 (64.2%). A large number (320) of the parents receive monthly income of P 10,099, and below, only a few of them (8.33%) fall within the P 10,100-50,099 monthly income bracket.

A researcher-made survey instrument served as the primary tool for gathering the data of the study which consisted of 30 questions with multiple choice answers used as an inventory of knowledge related to the nature, causes, effects of global warming and consequent mitigating actions.

A draft of the questionnaire was presented to science experts at the Leyte Normal University, Tacloban City, the Philippines for further analysis of questions and consequent improvement. The revised draft was pilot tested to 150 first-year students in Marasbaras National High School in Tacloban City who were not respondents in this study. Item analyses of the results determined the difficulty level of the items in the inventory and to provide for revisions towards improvement. The

<table>
<thead>
<tr>
<th>Variable</th>
<th>F</th>
<th>%</th>
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<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-13</td>
<td>307</td>
<td>85.4</td>
</tr>
<tr>
<td>14-16</td>
<td>51</td>
<td>14.0</td>
</tr>
<tr>
<td>17-19</td>
<td>2</td>
<td>0.60</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>129</td>
<td>35.8</td>
</tr>
<tr>
<td>Female</td>
<td>231</td>
<td>64.2</td>
</tr>
<tr>
<td>Socio-Economic Status (SES)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parents’ monthly income in Philippine pesos (Php)100-10,099 (US$ 2.28-230.62) — Low Income</td>
<td>320</td>
<td>88.9</td>
</tr>
<tr>
<td>10,100-20,099 (230.64-458.98) — Lower Middle Income</td>
<td>30</td>
<td>8.33</td>
</tr>
<tr>
<td>20,100-30,099 (459-687.34) - Middle Income</td>
<td>6</td>
<td>1.66</td>
</tr>
<tr>
<td>30,100-40,099 (687.37-915.71) - Higher-middle Income</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>40,100-50,099 (915.73-1144.07)- High Income</td>
<td>4</td>
<td>1.11</td>
</tr>
</tbody>
</table>
reliability index of the inventory was ascertained through Kuder and Richardson Formula 20 with a \( \rho_{KR20} \) value of 0.8132.

To facilitate the smooth conduct of the survey, the researcher wrote a formal letter-request to the Tacloban City Schools Division Superintendent seeking to field the questionnaires. After approval, copies of the letter-request were delivered to five secondary school principals in the participating schools. The researcher administered the survey instrument herself with the help of the class advisers. The respondents answered the questionnaires immediately after the researcher distributed them.

MEASURES

Dependent variable

Understanding of global warming. The respondents’ understanding of global warming was measured using 30 researcher-made multiple choice questions. The book of May and Caron (2009) and researches conducted by Ricci, Flyn, and Bellaby (2006), Uitto, Juuti, Lavonen, and Meisalo (2004) and Jarette (2013) guided the crafting of the questions. The answers were evaluated whether they were correct or wrong. The scores of the respondents were summed up, and the mean was computed to determine the average score. The categories of the scores are: “Very high (VL),” High (H), Moderate (M), Low (L) and Very Low (VL).”

Independent variables

Sex was coded as “Male=1” and “Female=2”. Age in years was coded as follows: “11-13 = 1”, “14-16 = 2” and “17-19 = 3”. The socio-economic status was measured based on parents’ monthly income in Philippine pesos (Php) and coded as follows: “100-10,099 = 1”, “10,100-20,099 = 2”, “20,100-30,099 = 3”, “30,100-40,099 = 4” and “40,100-50,099 = 5”.

RESULTS

When asked as to what organization the respondents belong, the majority of the students (98.32%) stated that they did not belong to any organization. Figure 1 shows this finding.

The community groups or organizations that the students belong are: altar boys (0.56%), Sabang Youth (a village youth group) (0.56%) and Children’s Choir (0.56%). Altar boys are recruited for activities such as assisting the priest in the celebration of the mass in Catholic churches. Sabang refers to an area near the public market of Tacloban City where teenage members have organized themselves into a group called “Sabang Youth” which engages in activities like holding sports tournaments. These data show that students are not involved in any organization–based community activity that promotes environmental conservation.

Knowledge of Respondents Related to Global Warming

Among the items included in the inventory are the following: (a) What is global warming? (b) What is greenhouse effect? (c) What are greenhouse gases? (d) What are the natural and anthropogenic factors that contribute to the formation of greenhouse gases? (e) How do greenhouse gases accelerate global warming? (f) What are the effects of global warming on human health, agriculture and marine ecosystem? (g) What changes occur in the climate as a result of global warming? And (h) What are the ways to minimize the impact of global warming?

Figure 2 shows the scores of the respondents in the knowledge inventory about global warming. The results reveal that no student participants
had a perfect score. The highest scores obtained are within the range of 18-23, out of the 30 items in the knowledge inventory. Only 14 (3.89%) students got these scores. The majority of the students (54.44%) garnered scores within the range of 12-17. A large number of students (118 or 32.78%) obtained the scores within the range of 7-11 and a small number (32 or 8.89%) obtained the scores within 1-6. Taken as a whole, the students showed a “low” level knowledge in global warming supported by the mean of 11.95 and standard deviation of 3.95.

**Association between Students’ Profile Variables and Global Warming Indicators**

Table 2 reveals the correlation analysis between the profile variables of the students and their knowledge of global warming. It can be gleaned that all selected personal characteristics of the students posted a significant relationship with their knowledge on global warming. This finding is manifested by the following: Pearson Chi-square values on age which stood at 240.8, sex which reached 70.89 and parents’ income which stood at 966.5. All of these are higher than the critical values of age which are 124.3 at df = 16 and parent’s income which is 124.3 at df = 395.5. To determine the degree of correlation, the values for Cramer’s V are: age is .335, sex is .446 and income is .681. These indicate a significant association between the student profile variables and knowledge on global warming.

**DISCUSSION**

This study assessed the level of understanding on global warming of first-year secondary students in Tacloban City, Philippines and determined the relationship between the participants’ profile and knowledge of global warming. The membership of students in environment-related organization was also studied. Achieving these objectives will produce inputs to ways of enhancing the effectiveness of integrated science subjects in improving such knowledge.

Consequently, the results reveal that their level of understanding of global warming is low and there is a positive correlation between age, gender and family income level and the understanding of global warming. That is, the older students, females, and students coming from higher income families show higher levels.
Figure 2. Percent distribution of scores obtained by respondents

Mean: 11.95 (L)
S.D.: 3.95

Legend:

Range of Scores | Interpretation
--- | ---
24-30 | Very High Level (VHL)
18-23 | High Level (HL)
12-17 | Moderate (M)
7-11 | Low Level (LL)
1-6 | Very Low Level (VLL)

Table 2. Correlation analysis between the students profile variables and their knowledge level on global warming.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VL (n=32)</th>
<th>L (n=118)</th>
<th>M (n=196)</th>
<th>H (n=14)</th>
<th>VH X2 (n=0)</th>
<th>Pearson Chi-Square</th>
<th>df</th>
<th>Critical Value</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
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<tr>
<td>11-13</td>
<td>31</td>
<td>109</td>
<td>165</td>
<td>2</td>
<td>0</td>
<td></td>
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<tr>
<td>14-16</td>
<td>1</td>
<td>9</td>
<td>31</td>
<td>10</td>
<td>0</td>
<td>240.8</td>
<td>96</td>
<td>124.3</td>
<td>.335</td>
</tr>
<tr>
<td>17-19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Sex</td>
<td></td>
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<td></td>
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<tr>
<td>Male</td>
<td>12</td>
<td>51</td>
<td>62</td>
<td>4</td>
<td>0</td>
<td>70.89</td>
<td>16</td>
<td>26.30</td>
<td>.446</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>67</td>
<td>134</td>
<td>10</td>
<td>0</td>
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<tr>
<td>SES (Income)</td>
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<td></td>
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<tr>
<td>Low</td>
<td>15</td>
<td>115</td>
<td>190</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Below average</td>
<td>17</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>966.5</td>
<td>395.5</td>
<td>124.3</td>
<td>.681</td>
</tr>
<tr>
<td>Average</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Above average</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
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</table>
of understanding on global warming. Moreover, membership of secondary school students in environment-related organizations is virtually nil.

As noted earlier, when it comes to gender, females have higher levels of understanding on global warming than males. This situation means that any intervention that will promote understanding of global warming will have to take into account female students who may be relied upon to take the lead in class activities to upgrade knowledge on global warming. An alternative approach would be, to encourage learning by making the males and females learn from smarter members of their gender. Both genders have a role to play, and they should decide on this role according to their capacities and interests (Haynes, Lassa, & Towers, 2010).

It has been observed that females have more positive attitudes towards finding solutions to environmental issues like global warming than males (Uitto et al., 2004; Yilmaz et al., 2004; Torgleret al., 2008; Tranter & Skrbis, 2011) probably because they are more apprehensive of the effects of global warming than the male respondents (Kılınç, Boyes & Stanisstreet, 2011). In the same vein, females have dominant roles in society and this is so because they utilize a significant portion of their time providing care and kindness (Henderson, Bialeschki, Shaw, & Freysinger, 1996) and undergoing extensive exposure to the protection of the environment even during childhood (Zelenzy, Chua, & Aldrich, 2000).

Students with low economic status exhibit a low understanding of global warming. Therefore, interventions must be focused on and attuned to the family income level of students. This emphasis has implications on the learning strategies and the kind of hands-on activities (Chawla & Cushing, 2007) that promote collective environmental accomplishment (Lester et al., 2006). Students from low and middle-income families should embark on and learn how to adapt to the effects of global warming on their poverty, among other aspects, make them vulnerable (Brown & Dodman, 2014). This could include (a) acquiring survival skills that will save them from typhoons, floods and droughts, (b) obtaining basic skills that will sustain life such as farming and fishing, and (c) learning how to acquire information on disaster preparedness and adaptation through social media and other sources such as government agencies (Back, Cameron & Tanner, 2009; Haynes & Tanner, 2015; Gautam & Oswald, 2008). Students from high-income families can undertake mitigation measures such as (a) recycling solid wastes into raw materials that will potentially reduce greenhouse gas emissions (Challcharoenwattana & Pharino, 2015), (b) using public transport and bicycle to school (Change, 2007), and (c) using energy saving lamps (Gardner & Stern, 2008).

Therefore, the confluence of environment-related strategies in the education system should be designed to improve sources of income and alleviate economic and social conditions (Wilson, Vellis & Cheeseman, 2006), a direction which may be a central part of overall national development strategies.

The findings also show that the student-respondents in Integrated Science need to know and understand facts about global warming so that they can achieve a score higher than the mean score of 11.95 (out of 30 items). In a study conducted in India the level of knowledge was determined to be average (Sah et al., 2015). Obviously, more inputs on the basic concepts of global warming are needed in lessons covered by Integrated Science. As cited in related studies, the low result may be traced to school-age children’s conceptions regarding the nature of this phenomenon which are incomplete or irregular when compared with common scientific understanding (Meadows & Wiesenmayer, 1999).
A negative consequence is that this situation could lead to confusion in recognizing ecological problems (Punter, Ochando-Pardo & Garcia, 2011). Thus, there is a need for effective teaching-learning instruction on environmental issues so that first-year students will fully understand the global warming phenomenon and be in a position to help solve environmental problems and consequently become conscientious youths and mature persons (Lester et al., 2006).

In the analysis of the association of the variables, it was indicated that there is a high correlation between the profile variables (age, sex, and socio-economic status) and students’ knowledge about global warming. This relation can be construed to mean that older individuals are more knowledgeable than younger ones about environmental problems such as global warming and may lead to an increase in caring for the environment (Ogunbode & Arnold, 2012).

In addition, with regard to socio-economic status, the higher the income of the family of the respondent the higher is the understanding on global warming. Perhaps, this relationship exists because families with higher income could provide their children with reading materials and other facilities like computers to access information related to global warming via the Internet (Takahashi & Tandoc, 2015). Improving such understanding would, therefore, need emphasis on students’ coming from low-income families. Also, class activities should consider this factor so that method adapted does not involve expenses on the part of the students. Moreover, students from high-income families can help their peers from low and middle-income families by teaching them concepts on global warming which would trigger discussions leading to an increased awareness and knowledge. In this way, students from different income classes can help each other and understand better their strengths, weaknesses, and limitations.

All of the findings mentioned above may be considered trail-blazing in the Philippines. Organization-based youth activities on global warming have not been scrutinized from this perspective. For one, the problems that contribute to global warming are of a magnitude, as earlier pointed out, that requires concerted, organized and deliberately orchestrated actions. Unless this is done on environmental issues, there is little hope for any community effort to gain headway.

The low level of understanding of concepts and practices associated with or as part of global warming should raise alarm bells. From the viewpoint of the local education system, the secondary schools in Tacloban City, Philippines may be a small part of the number of such schools in the country, but the findings send a resonating signal similar to those discovered in many areas of the world. This result being the case, these students cannot be expected to make any substantial effort to alleviating this environmental malady unless changes in the curriculum are undertaken to make it relevant, updated and effective. As users of the curriculum, teachers should exert sincere efforts to adjust their pedagogical approaches and enrich the content of their science subjects by making them appropriate to the age, gender and the economic situation of their students.

Modifications could be done at the secondary level of the education system in the Philippines to take into account the findings of this study particularly in raising the level of awareness of the concepts and realities of global warming in a manner that will encourage and motivate students to do their share in school and community activities. Considering the importance of the education system in mobilizing the youth, any slack in this regard will be detrimental over the long term to the environmental conditions in the country.

In the context of this study, it is important to consider that environment-related strategies
should include a primordial role to organize efforts to bring into motion a synergistic approach. This course of action will rely on the collective accomplishments needed for enhancing understanding of global warming. Concerted action of the youth will demonstrate a higher level of pro-environment activism (Lester, Ma, Lee, & Lambert, 2006). It is advisable to involve students in activities conducted by organizations. This participation in organizations will highlight the role of the youth in community development by actively taking part in social and civic activities that improve the wellbeing of communities (Brennan, Barnett, & Baugh, 2007). In this manner, the youth can contribute to the fight against global warming by engaging in actions to safeguard the planet from deterioration (Pandve, Deshmunk, Pandve & Patil, 2009).

In the Philippines, in an effort to encourage the establishment of student organizations which are pro-environment, the Department of Education issued Order No. 72, series of 2003 that established co-curricular clubs or organizations in schools called — Youth for Environment Summer (YES) with the primary objective of enriching the active involvement of the youth in activities that address environmental issues and concerns. Following the line of reasoning in this study, students are expected to be more active in efforts towards environmental protection, particularly the mitigation of the effects of global warming since the majority of the students are 11 – 13 years old. It has been cited that the youth are more conscious about addressing environmental issues than people who are more advanced in age (Howell & Laska, 1992). They can also focus their efforts on adaptation measures given the findings that the Philippines has one of the smallest carbon footprints in the world (UNFCCC, 2015).

The purposive sampling method used which focused on public schools limits the ability of this study to generalize the results but are very instructive about the present weaknesses and sets a path towards future research. This study has described a situation and pointed to a scenario that should be given weight. It provides a direction that can be taken given the various facets of the variables described and analyzed. Overcoming the weaknesses will undoubtedly be beneficial to the social, environmental and economic well-being of the Philippines. This study has implicitly brought forward the proposition that a multi-faceted research approach is needed to enable secondary school students to gain a better understanding of and to actively engage in environmental action and become environmental advocates who will contribute significantly to mitigating the effects of global warming or proactively reduce its impact.

However, since the Philippines has the least carbon footprints in the world (UNFCCC, 2015), it is also important to deepen the understanding of climate change adaptation measures which may be more relevant compared to mitigation measures. Moreover, there is a need to look at specific methods and particularize the topics in the subjects that need to be enhanced to make the phenomena of global warming comprehensively understood at the secondary level.

It is also important to note that additional research can be undertaken to include respondents in the older age and high family income brackets since only a few respondents from this brackets participated in this study.

CONCLUSION

This study has three major and interrelated findings of first-year secondary students about knowledge of global warming. These are: (a) level of knowledge is low, (b) knowledge is directly related to age, gender and family income level, and (c) membership in environment-related organizations is absent. Specifically, the older the student, the higher is his/her knowledge of global
warming. The younger students lagged behind. Therefore, the younger students should be the focus of interventions to improve knowledge. When it comes to gender, female students have a higher level of understanding than the male students. Particular attention has to be directed at the male students so they can catch up. Also, the students from families who are poor need more attention than those who are economically well off since the former have a lower level of knowledge than the latter. When it comes to organization-based activities, the students have a lot of ground to cover since their involvement is zero. There is a glaring need to establish working organizations in school and in the community where students can be members and have a chance to take active parts in preserving the environment.

Overall, the linchpin of the above efforts is the Integrated Science subject. It is the focal point so that the variables in this study can move positively. The curriculum needs to be enhanced to accommodate an extensive coverage of global warming. It is also necessary to strengthen other factors that influence the youth in their transformation into agents of change. These would include improving the capacity of teachers, teaching methods, and access to education materials (Amri, Bird, Ronan, Haynes & Towers, 2016; Johnson, Ronan, Johnston, & Peace, 2014), and the role of adults, especially parents and local leaders (Haynes & Tanner, 2015; Seballos & Tanner, 2011; Tanner et al., 2009; Towers, Haynes, Sewell, Bailie,&Cross, 2014). Furthermore, effective approaches have to be devised in a way that would encourage secondary school students not only to improve their knowledge but to take action.

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