Research Paper

STUDENTS' PERCEPTIONS ABOUT CLIMATE CHANGE

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This study determined the science high school students' perceptions on the aspects of climate change. It involved randomly selected 122 science high school students who took the researcher-made multiple choice climate change test. In each item, the students circled their choice, provided brief explanation about their answer, and determined the source of information about the concept. The answers were coded to determine the students' climate change perceptions. The results showed that the students hold more correct perceptions on the basic concepts and causes of climate change but they have more lack of perceptions on the effects, mitigations and adaptations. Furthermore, the students had alternative perceptions and they had poor knowledge and comprehension on the aspects of climate change. Significant differences were found on the correct perceptions of male and female students on climate change mitigations. Similarly, significant differences were observed in the correct and alternative perceptions of first and second year students on the basic concepts of climate change. Information from the media and from home/community was related to the lack of perception and alternative perceptions on climate change basic concepts, effects, and mitigations.

Keywords: adaptation, alternative perceptions, climate change, correct perceptions, mitigation, perceptions

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INTRODUCTION

Climate change encompasses environmental issues like flooding, storm surges, sea level rise, temperature rise, variability of precipitation, and extreme weather conditions. It is attributed to the rising concentration of greenhouse gases and increasing environmental degradation. It becomes a concern of international organizations and government institutions because of its impacts on different sectors such as agriculture, ecosystems and biodiversity (IPCC 2007).

Investigations of students' climate change perceptions reveal important insights about their way of thinking and understanding of environmental issues and scientific concepts. Studies on climate change show that students have lack of perceptions on ozone layer depletion and global warming, on climate and weather (Lombardi and Sinatra 2012, Gowda *et al.* 1997), on the radiation involve in the greenhouse effect (Choi *et al.* 2010), and on the causes and consequence of climate change (Pruneau *et al.* 2001). These lack of perceptions persist even after recieveing instruction about climate change and weather (Cordero *et al.* 2008). The perceptions are affected by sources of information like the media and schools (Ho 2009, Kisoglu *et al.* 2010).

This study aims to find out the science high

school students' perceptions on the aspects of climate change and to determine the extent of their knowledge and comprehension on climate change. Specifically, it seeks to determine if the students' (1) correct perceptions (extent of knowledge and comprehension), (2) lack of perceptions, and (3) alternative perceptions on the different aspects of climate change are significantly related to the variables such as gender, religious affiliation, academic year level, family's monthly income, leisure time activities, and sources of information.

METHODS

The descriptive-qualitative-correlation type of research was employed in this study. Through stratified-random sampling, 122 high school students whose age ranges from 12-14 were taken from the first and second year levels of two science schools of the 10-year basic education curriculum of the Philippines. For data gathering, two types of research instruments were used: (1) a questionnaire that requires personal information (personal data sheet) and (2) a multiple test items on climate change. Each multiple choice item had four options in which the students circled the answer they think is correct, wrote explanation about their answer, and identified the source of information.

The test contained concepts on the aspects of climate change that include the basic concepts, causes, effects, mitigations and adaptations.

The answer and explanation for each item were the bases in determining the perceptions of the students. The correct perceptions were derived from the correct answer and explanations on the concepts while the lack of perceptions was from incorrect answer and explanations. The alternative perceptions were determined from answers that are either correct or incorrect and explanations that are neither correct nor incorrect. The alternative perceptions referred to students' personal ideas, views, and beliefs which are not considered to be errors or incor-

rect even if they are not consistent with scientifically accepted views (Read 2004). The extent of knowledge and comprehension was determined by identifying the percentage of correct perceptions about the different aspects of climate change (Mangawil 2007).

Using the Kuder-Richardson reliability formula, the computed coefficient alpha was equivalent to 0.82 which shows that the test had high reliability. Data were entered into an SPSS 16.0 for Windows data file and the accuracy of data input, missing values, and outliers were checked. The percentage of correct perceptions, lack of perceptions, and alternative perceptions was computed and compared. Descriptive statistics was used to determine the profile of the students while t-test for independent sample and One-Way ANOVA determined the differences on the perceptions of students when grouped according to gender, religious affiliations, academic year level, family's monthly income, and leisure time activities. Spearman rho determined the relationship of students' perceptions and the sources of information.

RESULTS AND DISCUSSION

The aspects of climate change include basic concepts, effects and causes of climate change, mitigation strategies to address the sources, and strategies to cope with the impacts of climate change. The concepts are related to different sectors such as coastal communities, human health, and ecosystem including agriculture, freshwater, forests, and biodiversity. Concepts, ideas and views related to greenhouse effects, greenhouse gases, global warming, and radiations are included in the identification of students' perceptions.

Figure 1 shows that the number of students who have correct perception on each of the aspects of climate change is below 50%. According to Mangawil (2007), the level of knowledge and comprehension is considered to be "poor" if the percentage of correct perceptions is between

30% and 49%. Therefore, based on the mean percentage of the correct perceptions, Figure 1 indicates students' poor level of knowledge and comprehension on all the aspects of climate change.

To improve the level of understanding of students and to eliminate their lack of percep-

tions, Cordero *et al.* (2008) suggested active learning methods. Students should be involved in the teaching and learning process. Climate change education should be scientifically and socially oriented to increase the knowledge and comprehension of students on the different aspects.
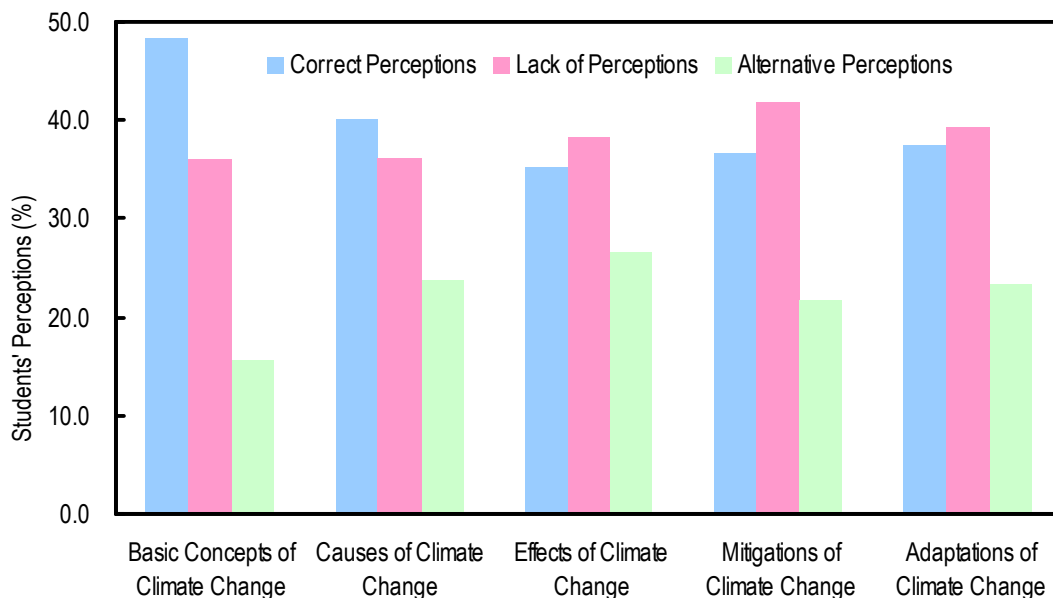
Figure 1 Students' perceptions on the aspects of climate change
The level of knowledge and comprehension based on correct perceptions: 30%-Below (Very poor); 30-49% (Poor); 50-69% (Moderate); 70-89% (High); 90% and above (Very high)

Correct perceptions

Table 1 shows the perceptions of students on the different aspects of climate change. The correct perceptions include the awareness of the students on the intensification of typhoons (IPCC 2007), the different aspects of climate change, and concepts of temperature rise, greenhouse effect and greenhouse gases (Choi *et al.* 2010)

The students identify human activities associated with climate change. Slash and burn farming system denudes forests that sequester atmospheric carbon dioxide. In addition, the conversion of forests into agricultural lands and land development decrease of carbon dioxide

sequestration and increase of greenhouse gas production (ADB 2009). Greenhouse gases are the main factor that contributes to the intensification of global warming and climate change (IPCC 2007). Methane from rice fields, wetlands and animal wastes also act as a greenhouse gas (Bogner *et al.* 2007).

Mitigation strategies are promoted to reduce the production of greenhouse gases from the different sectors. Table 1 shows the activities (IPCC 2007), strategies, and practices (ADB 2009) that the students perceived as related to the reduction of greenhouse gas concentration in the atmosphere.

Table 1 Students' perceptions on the different aspects of climate change

Aspects of Climate Change	Correct Perception
Basic Concepts	• Typhoons have higher frequency, strength, wind speed and heavy precipitation • Climatic changes do not cause volcanic activities (weather and climate do not lead to eruption of volcanoes) • Global warming is an aspect of climate change • The greenhouse effect involves heat and greenhouse gases in the atmosphere • Greenhouse gases cause climate change
Causes	• Slash and burn or kaingin system of farming reduces carbon sequestration • Microorganisms in freshwater/rice fields and in animal wastes produce methane, a greenhouse gas • Greenhouse gases cause global warming and climate change • Land development and land use change produce greenhouse gases
Effects	• Sea level rise leads to salt water intrusion on coastal areas • Temperature rise makes coastal areas and ecosystem vulnerable • Higher temperature increases population of disease-causing vectors like mosquitoes • Precipitation variability, temperature rise, and drought affect water supply • Drought, flooding and stronger storms decrease agricultural yields
Mitigations	• Tree planting activities help carbon dioxide sequestration • The Philippine government promotes the use of biofuel like ethanol and other alternative source of energy (RA 9367) • Efficiency of new machines produces less greenhouse gases • Recycling practices help mitigate the impacts of climate change
Adaptations	• Improvement of building technology and sea wall constructions lessen the impact of climate change in coastal areas • Management of restricted areas and natural sanctuaries lessen the vulnerability of endangered species • Propagation of drought resistant species allows forest to cope with climate change • Adjustment of the dates of planting for farmers minimizes loss in agricultural yields
Aspects of Climate Change	**Lack of Perceptions**
Basic concepts	• Climate change is defined as the condition of an areas over long period of time or a result of bad weather condition • Climate change is the effect of global warning • Greenhouse gases produce heat
Causes	• Concentration of carbon dioxide in the atmosphere is a result of volcanic activities • Global warming and greenhouse effect cause climate change • Radiations increase the hole of the ozone layer • Wetlands/rice fields produce water vapor that causes climate change
Effects	• Climate change causes freshwater contamination and pollution • Carbon dioxide concentration in the atmosphere poisons forest plants • Increased number of stronger storms is the impact of climate change on coastal areas • Climate change has no effect on water supply • Climate change has no effect on endangered plants and animals • Adjustments in farming/cultivation decrease agricultural yields
Mitigations	• Waste segregation lessens the impact of climate change such as flooding • Paper products such as paper bags do not produce GHG even if they are burned • Usage of recycled materials in industrial productions lessens carbon dioxide • Recycled materials do not produces carbon dioxide • Waste management stops carbon dioxide production
Adaptations	• People in coastal areas should change their source of living from fishing to farming • Freshwater water supply in rural areas should be controlled • Endangered species should be collected and placed in sanctuaries • New species of trees should be introduced into the Philippine forests • More fisheries should be constructed in bodies of water

Table 1 (continued)

Aspects of Climate change	Alternative perceptions (Perceptions that are neither correct nor incorrect)
Basic concepts	• Flooding is associated with garbage and poor drainage system • Ozone hole causes climate change • Greenhouse gases pollute the environment
Causes	• Radiation from the sun causes climate change • Ozone layer depletion is the factor that changes the Earth's climate change • Increasing human population increases carbon dioxide concentration in the environment
Effects	• Day and night temperature variability in coastal areas is an effect of climate change • Increasing concentration of greenhouse gases and rising temperature increase cases of skin cancer and skin diseases • Changes in farming practices increase crop yields
Mitigations	• Recycling of materials lessen harmful gases • Biodegradable materials are safe to use • Efficient machines are safe and eco-friendly
Adaptations	• Water distribution is based on the need of the community • Natural sanctuaries are converted into eco-tourist parks • Birth control and family planning lessen production of wastes and greenhouse gases

The students recognize the climate change impacts on human health conditions (Akerlof *et al*. 2010), coastal communities (ADB 2009), and ecosystems that include agriculture, freshwater, forest (Hawkins *et al*. 2008), and biodiversity (IPCC 2007).

Adaptation strategies are necessary to cope with the consequences or potential damages of climate change. Table 1 shows that students focused on adaptation strategies to cope with the impacts of climate change on coastal areas, agriculture (Lansigan 2005) and ecosystems that include biodiversity and forests (IPCC, 2007).

Lack of perception

Similar with the findings of Cordero *et al*. (2008), the students are unable to differentiate the following terms, climate change, global warming, climate, and weather. Table 1 indicates that understanding of the mechanism of greenhouse effect and global warming is problematic (Choi *et al*. 2010).

Without considering the impacts of precipitation variability and temperature rise (IPCC 2007), the students wrote that climate change does not alter water supply in many parts of the country and it has no impact on agricultural activities, biodiversity, and ecosystem.

The students inaccurately associate waste clean-up as more related strategy to climate change mitigation than tree planting activities. They focus on environmental-friendly activities such as recycling and waste management. In addition, many of them admit lack of knowledge and awareness on the different mitigation strategies to lessen the production of carbon dioxide from the different sectors.

Changes in livelihood of fishermen, collection of endangered species, introduction of tree species, and construction of fisheries are proposed to cope with the impacts of climate change. These suggestions are made without consideration of the effects on temperature rise and variability, intensification of typhoons, vulnerability of organisms (IPCC 2007), and invasion of introduced species.

Alternative perceptions

The students identify garbage and poor drainage system as the observable indicator of climate change, climate change and the hole of the ozone layer as related concepts and greenhouse gases as pollutant. Solar radiation and ozone layer depletion cause changes in the atmosphere. Temperature rise and variability is associated with skin cancer and diseases.

The increasing human population is a factor that increases the carbon dioxide concentration in the atmosphere. The students recommend birth control and family planning program as tools to control the population. They believe that biodegradable materials release less greenhouse gases and efficient machines decrease the energy consumption. In addition, they propose proper distribution of freshwater supply and conversion of natural sanctuaries into eco-tourist parks as adaptation strategies.

Students' perceptions and their socio-demographic characteristics

The perceptions of the students on the different aspects of climate change are not related to their religious affiliation, family's monthly income, and leisure time activities. However,

Table 2 shows that the students' correct perceptions and lack of perceptions on the mitigation of climate change are related to gender. It indicates that male and female differ on their perceptions on strategies to stop the production of greenhouse gases from the different sectors.

Table 3 shows that perceptions of students on the basic concepts and causes of climate change are related to their academic year level. Second year students have more correct perception on basic concepts than the first year students who have more lack of perceptions on the causes. First year students have more alternative perceptions on basic concepts. This could be associated with the exposure of second year students to different environmental issues integrated in their science subjects.

Table 2 Science High School students' perceptions on the different aspects of climate change when grouped according to gender

Perceptions	Aspect of Climate Change	Gender	N	Mean	SD	Mean Difference	t	Sig. (2-tailed)
Correct Perception	Mitigations	Male	51	45	22.0	14	3.9	0.0001
		Female	71	31	18.2			
Lack of Perception	Mitigations	Male	51	36	24.4	-10	-2.2	0.03
		Female	71	46	24.4			

Table 3 Science High School Students' Perceptions on the Different Aspects of Climate Change when grouped according to Academic Year Level

Perceptions	Aspects of Climate Change	Academic Year Level	N	Mean	SD	Mean Difference	t	Sig. (2-tailed)
Correct Perception	Basic Concepts	First Year High School	59	43	22.6	-9	-2.3	0.026
		Second Year High School	63	52	22.4			
Lack of Perception	Causes	First Year High School	59	40	17.2	8	2.2	0.03
		Second Year High School	63	32	20.5			
Alternative Perception	Basic Concepts	First Year High School	59	20	14.0	8	3.1	0.002
		Second Year High School	63	12	12.8			

Relationship of Students' perceptions and the sources of information

The correct perceptions of the students on the aspects of climate change are not influenced

by the different sources of information such as the media, home and community, and academic institutions. However, Table 4 shows that the lack of perceptions and alternative perceptions

are related to the sources of information.

The media that include television programs, documentary films, newspapers, and other printed media remain to be one of the important sources of information about climate change for the students (Filho 2010), although the media sometimes provide vague and incomplete information on climate change (Fortner 2001).

Table 4 indicates that information from home/community lessened the lack of perceptions of the students on the basic concepts. It further implies that family and community members are providing information that could remove or correct lack of perceptions of students about climate change.

Information from schools increased the lack of perception of students about climate change mitigations. The development of lack of perceptions might be due to association of environmental-friendly activities with climate change

mitigations and adaptations (Fortner 2001). The activities might include community clean-up, wastes segregation scheme and recycling. The association contributes to the lack of perceptions of the students. Such lack of perceptions will continue to persist if the correct relationship is not established.

Information from the media decreased the alternative perceptions of the students on effects and adaptations. Information from schools removed the alternative perceptions of students on the basic concepts.

The complexity of climate system and the broadness of climate change concepts produce students' lack of perceptions and alternative perceptions. The diversity of information from the media, home/community, and school could deepen or eliminate incomplete understanding on climate change (Fortner 2001).

Table 4 Correlation of Students' Perceptions on the Aspects of Climate Change and the sources of information (n=122)

Aspects of Climate Change			Lack of perceptions			Alternative Perceptions		
			MEDIA	HOME	SCHOOL	MEDIA	HOME	SCHOOL
Basic Concepts	Correlation Coefficient		-0.098	-0.199*	0.086	-0.084	-0.028	-0.260**
	Sig. (2-tailed)		0.281	0.028	0.344	0.358	0.756	0.004
Effects	Correlation Coefficient		0.227*	-0.069	0.008	-0.232*	0.163	-0.013
	Sig. (2-tailed)		0.012	0.448	0.929	0.010	0.073	0.887
Mitigations	Correlation Coefficient		0.051	-0.005	0.214*	-0.123	-0.084	-0.164
	Sig. (2-tailed)		0.579	0.958	0.018	0.178	0.356	0.070
Adaptations	Correlation Coefficient		0.128	-0.002	0.048	-0.186*	-0.098	-0.058
	Sig. (2-tailed)		0.161	0.982	0.602	0.040	0.284	0.529

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Conclusions

The students hold correct perception, lack of perceptions, and alternative perceptions on the different aspects of climate change. They have more correct perceptions on the basic con-

cepts of climate change. However, they hold more lack of perceptions on both the effects and mitigations of climate change.

The students have poor extent knowledge and comprehension on climate change. It indi-

cates that the students need deeper understanding about the different concepts in each aspect of climate change. They must evaluate the climate change basic concepts, causes, effects, mitigations and adaptations. They need more activities to explore and investigate climate change phenomena.

The difference in the perceptions of first and second year students on the basic concepts and causes of climate change provide insights on providing them activities to increase their awareness, involvements, and perceptions. In mitigating the impacts of climate change, male and female are given equal chances but women should be empowered to increase their perceptions and participations. Because the sources of information are not related to the correct perceptions but are related to the lack of perceptions and alternative perceptions of the students, identification of students' pre-conceptions and selection of correct materials are necessary in climate change education.

Educators should also involve students in identifying adaptation strategies to cope with the impacts of climate change. They should provide opportunities for the students to evaluate impacts of climate change and create models on how to adapt to the change. Educators should not limit their presentations, instructions and teachings on daily temperature or daily weather conditions but on global data. In addition, there is a need to uncover the lack of perception and incomplete understanding or alternative perceptions of the students to be able to create teaching strategies and techniques. The poor level of knowledge and pre-perceptions of student are best bases for the design of educational strategies to teach climate change. Knowledge gap and lack of perceptions are identified for the selection of information and activities for students.

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