INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 13, No. 1, p. 316-323, 2018
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Environmental knowledge, attitudes and practices of physics teachers

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Article published on July 30, 2018

Key words: Environmental education, Environmental awareness, Environmental attitude, Physics teaching.

Abstract

This study purposively determined the relationship between physics teachers' environmental knowledge and environmental attitude. The study employed a descriptive correlational research design. Questionnaires were administered to the sample respondents of physics high school teachers.The study used descriptive and inferential statistics. Results of the study revealed that the physics teachers have the high level of environmental knowledge implying that they manifest understanding and mastery of articulating environmental concepts in teaching physics. It was also revealed that they have favorable attitude and concern towards environmental issues around them. Their difficulties in integrating environmental education are generally low. Indicating that most of them infused the concept of environmental education in their teaching. The test of difference showed no significant difference between male and female physics teachers in their level of environmental knowledge, environmental attitude, and difficulties encountered in integrating environmental concepts. Further, level of educational attainment showed the significant difference in the level of environmental knowledge of the respondents. Consequently, the highest educational attainment showed no significant difference in terms of the environmental attitude and difficulties encountered by the physics teachers in integrating environmental education. In furtherance, there is a significant relationship between physics teachers' environmental knowledge and level of environmental attitude. The findings imply that the physics teachers need more relevant training to further strengthen their environmental competency.

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Introduction

As obvious for everybody living on Earth, the vital signs of the planet are declining virtually everywhere. Scientists have concluded that the major reasons are population growth, industrial discharges, consumption patterns, solid wastes disposal, domestic wastewater discharges, etc. But these trends may still not become fatal if we are able to call the courage and the moral energy necessary to respond. Environmental education is suggested as one of the most effective ways to respond to environmental threats with the environmental problems experiencing today (Teksoz, Sahin, & Ertepinar, 2010). In this regard, Environmental Education is essential so that people will become responsive and take an active part in guarding the earth‘s environment by making informed decisions and taking environmentally friendly actions. Environmental education refers to organized efforts to teach about how natural environments function and, particularly, how human beings can manage their behavior and ecosystems in order to live sustainably. The goals of environmental education efforts around the world are similar-to maintain and improve environmental quality and to prevent future environmental problems.

Environmental problems arise from the interaction between mankind and nature and therefore they are not always soluble in the sense that a physics problem is soluble. Still, physics may help toanalyze, prevent or mitigate environmental problems (Boeker & Grondelle, 2001). Unsworth (2017) defined environmental physics as the branch of physics concerned with the measurement and analysis of interactions between organism and their environment. Most commonly, the organisms are plants and animals, and the environment is the atmospheric or soil environment in which they are surrounded. The study of environmental physics requires an understanding of classical physics but frequently also draws on knowledge of environmental physiology. That is, how living organisms function and respond to the environment. Consequently, Walker, *et al* (2014) provided good grounding regarding physics teachers need a sound understanding of environmental education since progress in environmental physics is often made through collaboration between the physicist, biologists, atmospheric scientists and soil scientist.

Many studies about knowledge, attitudes, and behavior towards environment among teachers and students were conducted locally and globally (Arba'at 1992; Taylor *et al.* 2007; Ozden 2008; Kaliaperumal & Sharifah Norhaidah 2008; Suriati 2009). There were also studies on the roles of environmental education in promoting sensitivity towards environment among societies (Ozden2008). Findings from these studies revealed the importance of environmental education in promoting sensitivity towards environmental issues but there are limited studies conducted focusing on how physics teachers integrate the concept of environmental education.

As research gap, Appelquist & Shapero (2001) recommends that Physics teaching should review and revised their teaching methods to ensure that they are engaging and effective for a wide range of students and that they make connections to together important areas of environment, science, and technology with the principal goals of contributing scientific literacy of the general public and the training of technical workforce. Therefore, it is essential that physics teachers should be properly trained in environmental concepts and skill to impart training to learners. They should be well-equipped with the knowledge and skills of methods/approaches in teaching environmental concepts, material to inculcate the right understanding of an attitude towards the environment in the learners. Hence, these teachers must be environmentally competent (Kurapka & Viatkus 2003). In fact, Fien *et al.,* (1996) documented different results and findings brought by researches on the role of physics teachers in promoting environmental education. In like manner, Kaplowitz and Levine (2005) concluded from their research about the level of environmental knowledge of students that, increasing the level of environmental knowledge of tomorrow's teachers may be both possible and fruitful. Based on the aforementioned discussion, the researcher as a Physics professor felt

that ecological crises presently experienced are not just the task of policy-makers, scientists, and environmentalists to find a solution but rather it involves everyone. Theories and applications are mostly learned at school that's why this study aimed to explain the status on the level of integrating environmental education practices of physics teachers to gain more information and understanding which the researcher believes as a supplement for a deeper understanding of its readers. This academic undertaking provides the most reliable information on sustainable development practices and environmental education.

This study generally aims to determine the relationship between physics teachers' integration of environmental knowledge and environmental attitude. It specifically aims to assess the (1) the level of knowledge of integrating environmental education; (2) the level of environmental attitude; (3) level of difficulties in integrating environmental concepts; (4) ascertain the significant differences on the knowledge, attitudes, and difficulties of physics teachers in integrating environmental concepts when grouped according to their selected profile variables; (3) Test the significant relationship between knowledge, attitude and difficulties of integrating environmental education.

Materials and methods

Method of Research

This study employed a descriptive-correlational method of research to describe and determine the relationship among variables. Collection of data was conducted through survey method. The researcher selected the largest high schools in the municipalities of the first congressional district of Cagayan, Philippines. Inform consent was employed as the ethical consideration of the study. Permission was sought from the concerned offices before the conduct of the study.

Instruments

The main instrument used was a two-part survey research tool adopted from Hasaan & Ismail (2011). Part I: Personal Profile; and Part II: knowledge about the environment, teaching practices, teaching planning, teaching emphasizing, teaching and assessment methods, and obstacles in infusing EE. The respondents answered on a five-point Likert scale with 1 as the lowest and 5 as the highest.

The instrument used was subjected to validation by experts such as DENR officer, environment-advocate, and high school subject teachers to test its applicability in the Philippine setting.

Data Collection Procedure

Seeking approval through a formal communication letter from the authorities concerned to float the questionnaire started the data gathering stage. Upon informed consent, the researcher ensured proper consultation for the schedule of the administration of the questionnaire. Distribution and retrieval were personally executed by the researcher. As agreed upon by the concerned authorities and the researcher, the data gathered was properly kept to ensure it's confidentially and were strictly used for research purposes only.

The elicited quantitative data had undergone checking, scoring, analysis, and interpretation. Every item in the questionnaire was analyzed and interpreted. The researcher utilized Weighted Mean in order to analyze and interpret the data that provided an answer to the specific problems posed in this study. Through this procedure, the teachers' integration of environmental awareness, environmental attitude and level of difficulties on Environmental Education Content were obtained.

Data Analysis

Descriptive statistics, mean and rank, were used to describe the gathered data. Inferential statistics such as the independent sample t-test, one way ANOVA, and Pearson's r were used to determine the magnitude of the relationship between variables. Perception of the respondents was measured using a five-point Likert scale with its numerical scale, statistical limits and verbal description: 4.20 – 5.00: very high/ highly positive; 3.60 – 4.19: high/positive; 2.60 – 3.59: moderate/neutral; 1.80-2.59: low/ negative; 1.00-1.79: very low level/highly negative.

Results and discussion

Level of Environmental Knowledge

Table 1 shows the knowledge of the Physics teachers about environmental concepts. The items obtained thehighest mean are knowledge on biodiversity (4.76, SD=0.42), environmental pollution (4.76, SD=0.42), and recycling (4.76, SD=0.42) described that the physics teachers have a very high level of knowledge in these environmental concepts. Meanwhile, knowledge of biodegradable polymers (3.71, SD=1.05) was also rated with a high level of knowledge by the respondents. Consequently, concepts on ozone layer (3.56, SD=0.68), acid rain (3.48, SD=1.02), waste product (3.46, SD= 0.99), sustainable development (3.33, SD=0.83), ecosystem (3.38, SD=1.11), and renewable energy (3.30, SD=0.76) were rated by the physics teachers to have moderate knowledge about these environmental concepts.

Table 1. Level of Environmental Knowledge.

Knowledge on	Mean	SD	D.I.
1. Biodiversity	4.76	0.42	Very High
2. Ozone layer	3.56	0.68	Moderate
3. Environmental pollution	4.76	0.42	Very High
4. Recycling	4.76	0.42	Very High
5. Acid rain	3.48	1.02	Moderate
6. Waste product	3.46	0.99	Moderate
7. Sustainable development	3.33	0.83	Moderate
8. Biodegradable polymers	3.71	1.05	High
9. Ecosystem	3.38	1.11	Moderate
10. Renewable energy	3.30	0.76	Moderate
Grand Mean	3.85		High

Legend: 4.20 – 5.00: very high; 3.60 – 4.19: high; 2.60 – 3.59: moderate; 1.80-2.59: low; 1.00-1.79: very low leve.

knowledge as evidenced by the grand mean of 3.85 implying that they manifest understanding and mastery of articulating environmental concepts in teaching physics. This is attributed that environmental issues were always on their mind as teachers of the science-related subject. This finding is supported by Ozden's (2008) study on teachers who are teaching Physics, Chemistry, Biology, Science, and Technology revealed a high level of environmental knowledge and positive attitude towards the environment. Physics teachers knew more about environmental pollution terminologies since the study of physics is also concerned with the measurement and analysis of interactions between organism and their environment. Most commonly, the organisms are plants and animals, and the environment is the atmospheric or soil environment in which they are surrounded

Attitudes towards Environmental Education

Table 2 shows the attitudes of the physics teachers towards environmental education. The item obtained the highest mean of 4.69 (SD= 0.46) described to have a highly positive attitude ishelping students to inculcate sensitivity and practice positive attitudes towards environment, followed with the mean of 4.58 (SD=0.67) helping students the best way of decision making and the item with the mean of 4.48 (SD= 0.68) providing opportunity to students were assessed with highly positive attitude by the respondents. The item with the mean of 4.12 (SD=0.67) Help students the best way of solving problem skills, and the item with the mean of 3.94 (SD=0.68) attending course both were interpreted to have a positive attitude by the physics teachers. The item with the lowest mean of 2.12 (SD=0.61) Taught environmental education as a single subject rated with a negative attitude by the respondents.

Table 2. Attitude towards Integrating Environmental Educationin Physic teaching.

Items	Mean	SD	D.I.
1. Attending course	3.94	0.68	Positive
2. Provide an opportunity to students	4.48	0.68	Highly Positive
3. Taught environmental education as a single subject	2.12	0.61	Negative
4. Help students to inculcate sensitivity and practice positive attitudes towards the environment	4.69	0.46	Highly Positive
5. Help students the best way of solving the problem in environmental	4.12	0.76	Positive
6. Help students the best way of decision-making skills	4.58	0.67	Highly positive
Grand Mean	3.99		Positive

Legend: 4.20 – 5.00: highly positive; 3.60 – 4.19: positive; 2.60 – 3.59: neutral; 1.80-2.59: negative; 1.00-1.79: highly negative.

This study revealed that the physics teachers have the positive attitude towards integrating environmental education as evidenced by the grand mean of 3.99. This implies that they showed a favorable attitude and concern towards environmental issues around them. As teachers, they possess the pedagogical competence

to articulate environmental concern in their teaching practices. Having pure and applied science background they have the capability to solve environmental problems. Xin Ma & Bateson (1999) noted that pure Science and technology (S&T) teachers have the high level of environmental attitude because they were more interrelated to the environment.

Difficulties Encountered in infusing Environmental Education in Physics Teaching

The difficulties experienced by the physics teachers in integrating environmental education concepts are explained in Table 3. The highest mean is 4.15 (SD=0.48) physics teaching gives more focus on examination whereas the lowest is 1.82 (SD=0.75) Lack of support from the school's authorities. A closer look at the table reveals that big class size with the mean of 4.10 (SD=0.71), lack of teaching materials (4.00, SD=0.76), insufficient time in classroom teaching (3.76, SD=0.62) was rated by the respondents with high extent level of difficulty being encountered. Consequently, insufficient time to make preparation (3.33, SD=0.73) was singly assessed to have the moderate extent of difficulty. The items Lack of knowledge about environmental issues (1.84, SD=0,67), Lack of knowledge to teach environmental education (2.07, SD=0.70). Environment education is not related to the topics that I'm supposed to teach (2.41, SD=0.81), Environmental issues are difficult to teach (2.05, SD=0.64), and Lack of interest to teach environmental education (2.38, SD= 0.59) were assessed to have a low level of difficulty being encountered by the physics teachers.

Table 3. Difficulties Encountered in integrating concepts of environmental education in Physics Teaching.

Items	Mean	SD	D.I.
1. Insufficient time to make preparation	3.33	0.73	Moderate
2. Insufficient time in the classroom teaching	3.76	0.62	High
3. Lack of teaching materials	4.00	0.76	High
4. Lack of support from the school's authorities	1.82	0.75	Low
5. Lack of knowledge about environmental issues	1.84	0.67	Low
6. Lack of knowledge to teach environmental education	2.07	0.70	Low
7. Big class size	4.10	0.71	High
8. The physics teaching gives more focus on examination	4.15	0.48	High
9. Environment education is not related to the topics that I'm supposed to teach	2.41	0.81	Low
10. Environmental issues are difficult to teach	2.05	0.64	Low
11. Lack of interestto teach environmental education	2.38	0.59	Low
Grand Mean	2.90		Low

Legend: 4.20–5.00: very high; 3.60 – 4.19: high; 2.60 – 3.59: moderate; 1.80-2.59: low; 1.00-1.79: very low level.

The high level of difficulty encountered by the physics teachers on giving focus on examination than experience-based learning shows that the teachers are more pre-occupied on testing component of learning. Hence, the emphasis on students' engagement in solving environmental issues which were very important in teaching environmental education is already neglected. Hudson (2001) noted that students must be involved in “learning-by-doing”philosophy to produce excellent learning outcomes. The paradigm of environmental education in the 21st century should be shifted from awareness to action. Physics teachers should practice outdoor learning which is the most suitablemethod for teaching environmental education. In the recommendation of Tekzos *et al.* (2010), chemistry should give more focus on the field work in infusing environmental education. Through fieldwork activities, students gained direct experience from the environment and at the same time, their awareness improved. Teachers should use authentic assessment by asking them to come out with a portfolio about the environment. According to Feuer and Fulton (1993), the portfolio is students' learning outcome carried out systematically in the certain period of time. Some teachers disagreed about making environmental education as a single subject. This finding supported by Hanunah (2004) who agreed that making environmental education as a single subject might interfere with the existing curriculum that was already overloaded. On the other hand, Puk & Behm (2003) disagreed as their study to Science and Geography teachers showed the failure of

infusion model because teachers only gave less time to teach ecology concept. Findings of obstacles to infusing environmental education showed most teachers agreed that teaching focused on examination was the main obstacle, hence, teachers got less time to infuse environmental education. This result supported Puk & Behm (2003) who found that teachers only spent a little time to infuse environmental education due to lack of content in existing physics syllabus.

The difference in the level of environmental knowledge, attitude, and difficulties when grouped according to the Physics teachers' selected personal variables

Tables 4 explains results on inferential statistics involving independent sample t-test and one-way ANOVA. The level of significance was set at p=0.005. The table shows the test of difference in the level of environmental knowledge, attitude, and difficulties when grouped according to selected profile variables. The test of difference showed no significant difference between male and female physics teachers in their level of environmental knowledge (p=0.695), environmental attitude (p=0.732) and difficulties encountered (p= 0.621) in integrating environmental education. ANOVA also revealed that highest level of educational attainment showed a significant difference in the level of environmental knowledge of the respondents with the computed p-value of 0.006 which is significant at 0.01 level (2-tailed). Consequently, the highest educational attainment showed no significant difference in terms of the environmental attitude and difficulties encountered by the physics teachers in integrating environmental education.

Table 4. The difference in the level of environmental knowledge, attitude and difficulties when grouped according to selected profile variables.

Variables	Knowledge	Attitude	Difficulties
Sex	0.695 ns	0.732 ns	0.621 ns
Highest Educational Attainment	0.006 **	0.522 ns	0.878 ns

**= significant at 0.05 level (2-tailed)*

ns= not significant at 0.05 level

Note: all other variables are not significant

The non-significant difference found on the environmental knowledge, attitude and difficulties encountered by the physics teachers when grouped according to their gender are supported by Jekayinfa & Yusuf (2005) study on teachers who found no significant difference on the attitudes between teachers of the different gender. Ozden (2008), on the other hand, found opposite findings where female teachers found to have more positive attitude and higher knowledge in environmental education compared to males because of their compassion and motherly nature.

Further, this study also found out the significant difference in the environmental knowledge of the physics teachers when grouped according to their level of education. The result of the Post Hoc Tukey test showed that physics teachers with the higher level of educational attainment manifested a higher level of environmental knowledge. This finding is supported by Kahriman- Ozturk *et al.* (2012) grounding that level of schooling plays a significant role in the development of environmental awareness. Likewise, in the study of Magulod (2018) on environmental literacy found out that the more educated an individual they higher level of environmental concern is manifested. Moreover, regardless of the level of educational attainment of the physics teachers, their environmental attitude and difficulties encountered in integrating environmental education do not spell the significant difference.

The relationship between environmental knowledge and attitude of Physics teachers

Table 5 shows that there is a significant relationship between the environmental knowledge and environmental attitude of the physics teachers (r= 0.5334 and p value= 0.001). The positive relationship showed that the higher environmental knowledge the physics teachers possess the favorable attitude they exhibit towards integrating the concepts of environmental education. The main findings of the study showed a significant relationship between the environmental knowledge and environmental attitude of the physic teachers.

The finding describes that with the high knowledge of the teachers in integrating environmental awareness it affects directly their environmental attitude.

Table 5. Test of Relationship between environmental knowledge and attitude of Physics teachers.

		Environmental attitude
Environmental knowledge	r value	0.5334
	P value	.001**

*= significant at 0.01 level (2-tailed).

Generally, there is a significant relationship between physics teachers' environmental knowledge and level of environmental attitude. This finding of the study confirms Hasaan, Rahman, &Abdullaha (2010) that there was a significant relationship between knowledge, awareness, attitudes, and practices to the environment. Hence, the integration of knowledge, awareness, and attitudes was considered important elements in the environmental practices.

Conclusion and recommendation

This study purposively determined the relationship between teachers' integration of environmental awareness, environmental attitude, and level of difficulties. Based on the findings of the study, the physics teachers a high level of environmental knowledge implying that they manifest understanding and mastery of articulating environmental concepts in teaching physics. It was also revealed that they have a positive attitude towards integrating environmental education. Physics teachers' difficulties in integrating environmental education are generally low. Indicating that most of them infused the concept of environmental education in their teaching. The test of difference showed no significant difference between male and female physics teachers in their level of environmental knowledge, environmental attitude, and difficulties encountered in integrating environmental education. Further, the highest level of educational attainment showed a significant difference in the level of environmental knowledge of the respondents. Consequently, the highest educational attainment showed no significant difference in terms of the environmental attitude and difficulties encountered by the physics teachers in integrating environmental education. Generally, there is a significant relationship between physics teachers' environmental knowledge and level of environmental attitude.

The findings imply that the physics teachers need more relevant training to further strengthen their environmental competency. Hence, these quantitative data may be the framework for their design, plan, and development of environmental education provisions for public school teachers. In consonance with the above-cited results and implications to the intended community, adding environment-related seminars and training may be considered to better instil environmental awareness to their students. Physics teachers are encouraged to reflect on their practices and methods/approaches in incorporating environmental concepts in teaching to further strengthen environmental competencies of their students. Physics teachers will further develop strong environmental knowledge, awareness, and capacity for positive environmental change when it contextualized or taught using real examples, problem-solving, bringing nature inside the classroom, field-trip, find impromptu teachable moments and with active student participation. The developed training module based on the findings of this study may be utilized by science teachers to strengthen environmental education instruction. It is hoped that the findings will motivate them to become more environment-minded and critical thinkers through attending seminars/ training relevant to environmental concepts, volunteerism to be exposed to environmental issues, and conducting personal researches relevant to environmental issues and concerns.

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