

## Research Article

# PRE-SERVICE TEACHERS' ENVIRONMENTAL LITERACY AND READINESS TOWARDS ENVIRONMENTAL EDUCATION

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### ABSTRACT

Numerous studies have highlighted the pivotal role of environmental education (EE) in addressing environmental problems. As teachers are expected to foster environmental literacy (EL) among their learners, they must be environmentally literate themselves and ready to integrate environmental concepts across disciplines. This study assessed the EL and EE teaching readiness of 622 randomly-selected pre-service teachers (PSTs) in a state university in the Philippines. The study found that the majority of the respondents had average levels of environmental knowledge, have positive environmental attitudes and often practiced actions reflecting pro-environmental behavior. PSTs also had a very high perceived readiness to integrate environmental concepts into their teaching. A significant difference in the environmental knowledge of PSTs was observed using their program ( $p < .01$ ), year level ( $p = 0.038$ ), and their exposure to a stand-alone environmental course ( $p < .01$ ) as grouping factors. The environmental attitude was found to be significantly different between males and females ( $p=.004$ ), across programs ( $p=.004$ ), and exposure to an environmental course ( $p=.003$ ). Environmental behavior significantly differed when PSTs were grouped as to year level ( $p < .01$ ) and program ( $p=.014$ ). PSTs in their senior year and those exposed to at least one environmental course had the highest levels of readiness to integrate EE. Lastly, environmental knowledge, attitudes, and pro-environment behavior were found to be significantly related to PSTs' readiness to teach EE. Consideration of the findings in the crafting of the Environmental Education course syllabus for PSTs was recommended.

**Keywords:** Environmental Education, Education for Sustainable Development, Pre-Service Teachers.

### INTRODUCTION

According to the 2022 Global Risks Report, environmental threats are still on top of the world's most pressing issues with climate action failure constantly making it to the list along with inter-related risks such as extreme weather and biodiversity loss (World Economic Forum [WEF], 2022). The occurrence and the severity of these threats are well-supported by empirical data. Given their strong links to socio-economic issues, the United Nations (UN), has called for a shift towards sustainable development and consider the crucial interplay between society, the economy, and the environment in policy-making. In 2015, member states of the UN approved the 2030 Agenda for Sustainable Development, which serves as a blueprint for lasting peace and prosperity for the people and the planet. At the agenda's core are 17 Sustainable Development Goals (SDGs), which call upon the member nations to act in solidarity regardless of their economic development status. These SDGs stem from the recognition that addressing severe issues such as poverty and various forms of inequality without looking into climate change and environmental preservation is an effort in vain. The Philippines is among the nations which positively responded to the call for sustainable development. This response is evident in its "*AmBisyon Natin 2040*," which reflects the quality of life that Filipinos envision enjoying by the year 2040 (i.e., "a strongly-rooted, comfortable, and secure life"). In light of *AmBisyon*, the National Economic Development Authority's (NEDA) Philippine Development Plan (PDP) 2017-2022 presents a paradigm strategically integrating environmental conservation efforts targeted towards sustaining the functions of biodiversity and ecosystem services, improvement of environmental quality and increasing the adaptive capacities and

resilience of ecosystems. NEDA considers this a key element towards achieving the quality of life mirrored in *AmBisyon* (NEDA, n.d.). Despite all the efforts and resources towards promoting sustainable development in the country, the 2022 Environmental Performance Index (EPI) of the Philippines shows that the country ranks 158<sup>th</sup> out of 180 countries, making it behind most of its neighboring countries in Southeast Asia (Wolf *et al.*, 2022). This ranking suggests the need for the country to improve its performance in terms of protecting human health from environmental hazards and sustaining ecosystem vitality.

As human interactions with the natural environment is strongly influenced by behavior, environmental education plays a crucial role in fostering environmental care and protection among people. Garcia and Cobar-Garcia (2016) believe that improving citizens' environmental literacy (EL) is vital to better understanding environmental or ecological problems and issues. The authors believe this is achievable by providing quality environmental education (EE) and science education. In addition, more environmentally literate citizens can develop proper dispositions, competencies, and behaviors toward addressing these issues (Garcia & Cobar-Garcia, 2016). Literatures highlight two important things: the critical role of teachers as drivers of EE (and, by extension, of EL) in ensuring that future citizens are environmentally-educated; and the need to prepare teachers to achieve the competencies needed by an environmental educator (Álvarez-García *et al.*, 2015). Baroro *et al.*, (2016) add that since teachers face the daunting task of fostering a sense of responsibility towards the environment and society, it must be the case that they carry the same sense of responsibility before passing it on to their learners. In the Philippines, the integration of environmental education in the basic- and higher education levels are anchored on Republic Act 9512, otherwise known as "*Environmental Awareness and Education Act of 2008*." This act expresses the State's mandate to promote national awareness of the importance of the natural environment and its resources towards sustainable development by tasking concerned government agencies to

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collaborate to ensure that the youth will be educated and motivated to take an active stance in environmental conservation. Hence, the same act requires teachers in all subject areas and levels to integrate EE, using various teaching and learning strategies. Environmental education or any related course is not usually taught as a separate subject at the basic education level. Alternatively, EE-learning topics are presented as part of the science subject. They are distributed in different grade levels due to the spiral design of science in the k to 12 curriculum. Concepts taught usually include climate change, waste management, disaster risk reduction, and biodiversity (Perez & Bua, 2019). On the other hand, the Commission on Higher Education implemented three elective General Education (GE) courses at the higher education level that integrate environmental topics. In the current teacher education curriculum of the subject institution, none of these three is being offered. However, mandatory topics on climate change and environmental awareness are included in one of the eight core GE courses called Science, Technology, and Society (STS). Furthermore, Balanay and Halog (2016) assert that the offering of the National Service Training Program (NSTP) in universities also adds significant help towards learning strategies in line with climate change mitigation and adaptation, as well as disaster preparedness and resilience, among students.

Several studies on the environmental literacy of professional teachers and pre-service teachers have focused on at least three key components of EL: Environmental Knowledge (EK), Environmental Attitudes (EA), and Pro-Environmental Behavior (PEB). Given the profound importance placed on the readiness of future educators to integrate EE in teaching and considering the EL dimensions, a sizable number of foreign and local studies reveal alarming findings such as limited environmental knowledge among pre-service teachers (Gwekwerere, 2014; Garcia, Comas, and Negre, 2015; Dada, Eames, and Calder, 2017) and even among practicing professional teachers (Garcia & Cobar-Garcia, 2018). In a separate study by Mwendwa (2017), most respondents pointed out inadequate knowledge of environmental education as a common challenge. The author reported that most of the teachers interviewed in the study felt they lacked knowledge and understanding of contemporary and dynamic environmental issues. Consequently, these teachers lose confidence in teaching environmental topics and sometimes even skip these topics. In the same vein, Mashfufah *et al.*, (2018) examined the level of environmental literacy of biology pre-service teachers. They found that the EK variables of respondent pre-service teachers are low, suggesting that respondents may need more background knowledge on specific environmental topics. A low level of EK may stem from the quality of environmental education pre-service teachers receive. These findings present a potential problem as misconceptions about critical concepts of disciplinary knowledge (as in EE), if not addressed, would continue to be promulgated during the teaching-learning process (Boon, 2011).

Studies which described the EA of respondents mainly reported acceptable levels of such variable (Krishna Priya & Thenmozhi, 2021; Koc & Kuvac, 2016; Lateh & Muniandy, 2013). Furthermore, Dolenc Orbanic and Kovač (2021) found that positive attitude towards the environment is positively correlated to environmental awareness. Regarding PEB, Krishna Priya and Thenmozhi (2021) found that the PEB of their respondents was above average. Interestingly, Raman (2016) found that students who enrolled in environmental science courses had higher environmental attitude and behavior scores compared to those who did not enroll in such course. A comprehensive collection of studies looked into the influence of demographic variables on environmental literacy levels. Studies that focused on the gender variable and the components of EL show interesting findings. For instance, Sarkawi *et al.*, (2017) and Zhao *et al.*, (2021) reported higher EK among males than females. However,

contrasting findings were noted while reviewing related studies concerning environmental attitudes. Most of these studies reported higher environmental attitude variables in females than males (Köse *et al.*, 2011; Strapko *et al.*, 2016; and Li *et al.*, 2022). On the other hand, Sarıkaya & Saraç (2018) found no significant difference in the environmental attitudes of males and females. Meanwhile, several studies report no significant difference in the environmental behavior of males and females (Vicente-Molina *et al.*, 2018; Krishna Priya & Thenmozhi, 2021; Vicente-Molina, 2018; and Afacan, 2022). Lastly, some studies reported that females were more ready to teach EE (Karami *et al.*, 2018) and more intending to carry out Education for Sustainable Development (Vukelić, 2022).

## RESEARCH OBJECTIVES

As pre-service teachers are duty-bound to deliver EE, it is paramount to ensure that they are equipped with the knowledge, skills, and attitudes to help them foster improved environmental literacy among their learners. An essential first step is to understand the status and needs of pre-service teachers concerning their readiness to integrate EE in their teaching and meet these needs to empower them as environmental educators for sustainable development before they graduate. In light of these, the study endeavored to:

1. Describe the Environmental Literacy (EL) of respondents in terms of Environmental Knowledge (EK), Environmental Attitudes (EA), and Pro-Environment Behavior (PEB);
2. Describe the perceived readiness of respondents to integrate EE in their teaching;
3. Determine if there is a significant difference in the EL of respondents when grouped according to profile; and
4. Determine if there is a significant relationship between respondents' EL and their perceived readiness to integrate EE.

## METHODOLOGY

This study employed the causal-comparative and correlational designs of quantitative research to answer the research questions. In compliance with the existing policies that limit face-to-face interactions with students and employees of the university at the time the study was conducted, data gathering was done remotely using Google Forms. Mindful of the possible issues (e.g., on reliability) that may stem from remote data gathering, the researchers maximized the features of the chosen platform to ensure high validity and reliability. In addition, prior approval from the deans of the different colleges offering the programs under study was sought before the distribution of the electronic survey link.

Respondents of the study were first- to fourth-year PSTs recruited from the university's program offerings under the College of Education across all six of its campuses (see table 1).

**Table 1.** Profile of the Respondents

Variable	F	%
<b>Sex</b>		
Male	150	24.1
Female	472	75.9
<b>No. of Environmental Courses Taken</b>		
1 subject	61	9.8
None	561	90.2
<b>Year Level</b>		
First Year	273	43.9
Second Year	179	28.8
Third Year	90	14.5

Fourth Year	80	12.9
<b>Program</b>		
Bachelor of Secondary Education (BSEd)	290	46.6
Bachelor of Elementary Education (BEEd)	125	20.1
Bachelor of Early Childhood Education (BECEd)	53	8.5
Bachelor of Physical Education (BPEd)	14	2.3
Bachelor of Technical and Vocational Teacher Education (BTVTE)	129	20.7
Bachelor of Technology and Livelihood Education (BTLE)	11	1.8
<b>Total</b>	<b>622</b>	<b>100.00</b>

The data shows that of the 622 PSTs participating in the study, 75.9% are females. This aligns with World Bank (WB) data indicating that in 2020, 87.42% of primary teachers in the Philippines and 70.68% of secondary teachers were females (World Bank [WB], 2020a; World Bank [WB], 2020). Moreover, the majority of the respondents were from the first-year level. In terms of the program, most of the respondents were from the BSEd (46.6%), BTVTE (20.7%), and BEEd (20.1%) programs. Enrollment data obtained from the University Registrar's office indicates the same trend. Furthermore, it is evident from the data that only 9.8% of the respondents have taken at least one stand-alone environmental course at the university as of the time of data collection. This indicates the absence of a separate environmental course in most of the program offerings under the college of education.

The study made use of a survey tool which includes an environmental literacy questionnaire developed by Goulgouti, Plakitsi, and Stylos (2019) from the original works of Yavetz, Goldman, and Pe'er (2009), and Yencken, Fien, and Syke (2000). The instrument was modified to include questions to test respondents' knowledge of local environmental concepts/issues and select environmental policies. The final questionnaire likewise includes items to determine the perceived readiness of pre-service teachers to integrate EE in their future classes. For this purpose, indicators from Environmental Education Ontario [EEON] (2003) which contain outcomes expected of pre-service and in-service primary education teachers in light of environment and sustainability education, were incorporated into the questionnaire. An expert on environmental studies, a biology education professor and the college's dean validated the draft questionnaire. Comments and suggestions were considered for the improvement of the data-gathering tool. The output resulting from the experts' validation was further subjected to pilot testing with non-participant PSTs. Appropriate testing through Statistical Package for the Social Sciences (SPSS) yielded a Cronbach's alpha value of 0.920, suggesting the questionnaire's usability.

The final questionnaire is divided into sections on the demographic profile of the respondents, an Environmental Knowledge test (15 items), an Environmental Attitudes Survey (17 items), a Pro-Environment Behavior Survey (14 items), and a survey to describe the respondents' Readiness to Integrate Environmental Education (17 items). Using the SPSS software, descriptive and inferential statistics were applied to analyze the quantitative data. To address the descriptive questions of the study, frequency, mean, and percentage were used. Furthermore, the inferential questions were addressed by treating data using statistical tools such as independent samples t-test, Analysis of Variance (ANOVA), and Pearson correlation. Results were interpreted at a 0.05 level of significance.

## RESULTS AND DISCUSSION

### Part 1. Environmental Literacy of Pre-Service Teachers

**Table 2.** Respondents' Environmental Literacy in terms of Environmental Knowledge

Environmental Knowledge Score	Frequency	Percentage
1-5	59	9.5
6-10	401	64.4
11-15	162	26.1
Total	622	100.0

**Note:** 1-5 = low; 6-10 = average; 11-15 = high

Table 2 shows the distribution of respondents according to the scores they obtained in the EK test component. It could be gleaned that most of the respondents scored between 6 to 10 out of 15, which could be interpreted as "average." The assumed mean of the scores obtained by the respondent PSTs is 8.82, which means that they have roughly answered 58.8% of the EK questions correctly.

Low EK among pre-service teachers has been reported in several studies. In a research by Gheith (2019), findings revealed a low level of environmental knowledge among Jordanian pre-service teachers. This is supported by the findings of a study by Gwekwerere (2014) wherein PSTs were likewise found to have limited knowledge of specific environmental concepts, which the author attributed to a lack of specific environmental education in their school. Moreover, Mashfuhah *et al.*, (2018) found a low level of environmental knowledge among pre-service biology teachers revealing a possible lack of background knowledge on specific environmental topics. Garcia and Cobar-Garcia (2018) assessed the EL of in-service elementary teachers in two areas in the Philippines. The findings showed low levels of EK among these teachers, which the authors believe might be related to the quality of EE that these teachers received during their pre-service education. On the other hand, Ahmad *et al.*, (2015) reported high EK and good EA among college students. Magulod (2018) also studied the environmental literacy of pre-service teachers and found that the PSTs had high EK, EA, perceptions of environmental issues, and environmental concerns. The contrasting findings may be attributed to differences in the instruments used to assess the EL dimensions of the respondents and the different learning experiences gained by the PSTs in their respective teacher training institutions. As noted, there are teacher education curricula without environmental courses. Instead, environmental concepts are integrated into some general and professional education courses, exposing issues such as the lack of focus and subject matter expertise of faculty members handling these courses.

**Table 3.** Respondents' Scores per Concept Covered under Environmental Knowledge

Concept	Frequency of Correct Answers (n = 622)	Percentage
Natural Resources	459	73.79
Sustainable Development	490	78.77
Biodiversity	365	58.68
Humans and the Earth's Changing Climate	339	54.50
Local Environmental Issues	533	85.69
Philippine Environmental Policies	510	81.99

It was observed from the results that more than half of the PSTs have correctly answered at least 50% of the questions per concept. However, it was noted that in two topics, *biodiversity* and *Humans and Earth's Changing Climate*, almost half of the respondents failed to pass. On a closer look at the individual items and the responses obtained, it was found that only 32.48% of the PSTs could relate the importance of tropical rainforests to their high plant and animal diversity. In another item that asks about the implication of the Philippines being a "biodiversity hotspot," only 42.93% of the PSTs were able to answer correctly. Furthermore, only 33.76% of the PSTs could correctly point out the relationship of chlorofluorocarbons

(CFCs) to the destruction of the ozone layer. In a related study by Mwendwa (2017), teachers identified their need for knowledge of environmental education as a challenge. Based on the interviews, teachers felt they needed a solid understanding of contemporary and dynamic environmental issues. As a result, these teachers lose confidence in teaching environmental topics and sometimes even skip topics they are not confident teaching. Hence, ensuring that contemporary environmental issues are discussed in environmental courses taken by PSTs is an important measure that would allow them to develop a firmer grasp of environmental topics, enhancing their confidence in teaching such topics to their future classes.

**Table 4. Respondents' Environmental Literacy in terms of Environmental Attitudes**

Indicators	Mean	SD	Verbal Interpretation
1. It is every teacher's responsibility to include environmental subjects and values in his/her teaching.	4.45	0.81	Strongly Agree
2. Each student in a teacher training institution should be required to study an environmental course during his/her studies.	4.46	0.80	Strongly Agree
3. It is very important to organize school activities on the environment – green days, trips, and exhibitions.	4.63	0.75	Strongly Agree
4. It is important to include environmental topics in the educational system.	4.60	0.76	Strongly Agree
5. Laws reduce damage to the environment.	4.20	0.94	Agree
6. Punishment doesn't prevent damage to the environment.	2.31	1.12	No Opinion
7. Factories should be penalized for environmental damage.	4.28	0.91	Strongly Agree
8. Industry should be forced to reduce pollutant emissions even if this entails higher consumer prices.	4.21	0.89	Strongly Agree
9. I believe I can contribute to the quality of the environment through my personal behavior.	4.52	0.78	Strongly Agree
10. There's no use in trying to influence my family or friends on environmental issues.	3.21	1.52	No Opinion
11. If I had more knowledge, I would integrate environmental considerations into my daily habits.	4.42	0.80	Strongly Agree
12. It is each person's responsibility to take care of the environment.	4.70	0.73	Strongly Agree
13. Even if I save water or energy or purchase environmentally-friendly products, it won't make a difference because the influence caused by other people is too great.	2.64	1.45	No Opinion
14. Concern for the environment is out of proportion.	2.58	1.28	Disagree
15. It is humanity's right to exploit nature's resources according to their needs.	3.38	1.37	No Opinion
16. Action conducted by single citizens are useless because the 'authorities' aren't impressed by the 'little citizen'.	2.65	1.37	No Opinion
17. The value of living creatures in nature is determined solely by their use for humanity.	2.25	1.24	Disagree
<b>Composite Mean</b>	<b>3.73</b>	<b>1.24</b>	<b>Agree</b>

**Note:** 4.21-5.00 Strongly Agree; 3.41-4.20 Agree; 2.61-3.40 No Opinion; 1.81-2.60 Disagree; 1.00-1.80 Strongly Disagree

The strong agreement of the respondents to actions that promote the inclusion of EE in school curricula, imposition of penalties to those who cause harm to the environment, and the importance of modeling environmental care all imply that PSTs have a positive attitude towards environmental care and protection. It can also be noted that PSTs generally disagree with items that denote negative perceptions of the environment such as the belief that the concern for the environment is out of proportion and that the value of living creatures is determined solely by their use for humanity. Overall, it can be said that PSTs have positive attitudes towards the environment. In the same manner, Koc and Kovac (2016) likewise described the EA of their respondent preservice science teachers to be moderately favorable. However, there are certain items in which the PSTs manifest uncertainty as to whether they agree or not, such as the effect of punishment in preventing damage to the environment, the impact of practicing conservation of energy and resources considering the magnitude of other peoples' influence, whether humans have the right to exploit natural resources the way they want to, and the impact of the actions done by "little citizens". The inability of the PSTs to either agree or disagree with these perceptions signals the need to incorporate them in future EE classes. Dolenc Orbanic and Kovač (2021) studied the relationship between environmental awareness and environmental attitudes. They found that PSTs with high levels of awareness also displayed positive attitudes toward nature and its protection

**Table 5. Respondents' Environmental Literacy in terms of Pro-Environment Behavior**

Indicators	Mean	SD	Verbal Interpretation
1. Conserve energy by turning off lights and electric appliances when not in use. (PC, TV, radio)	4.64	0.68	Always Practiced
2. Conserve water at home (close faucet when brushing teeth, washing dishes etc.).	4.62	0.70	Always Practiced
3. Re-use plastic bags that previously served as shopping bags.	4.50	0.82	Always Practiced
4. Re-use used writing paper as draft paper.	4.47	0.84	Always Practiced
5. Purchase 'environmentally friendly' products (such as: ozone friendly sprays, products with recyclable packaging, economy size products).	4.17	0.94	Often Practiced
6. Bring things (such as: newspapers, plastic bottles) to recycling collection points.	3.99	1.12	Often Practiced
7. Recycle batteries.	3.49	1.34	Often Practiced
8. Comment to people who throw trash in public space or damage the environment in any manner.	3.96	1.04	Often Practiced
9. Collect things that people have thrown in public areas and dispose of them in trash barrels.	4.01	0.97	Often Practiced
10. Participate in campaigns for cleanup and care of public spaces.	3.98	1.01	Often Practiced
11. Report to authorities on environmental problems or send letters to media on environmental problems.	3.44	1.35	Often Practiced
12. Take part in campaigns for prevention of environmental damage (petitions, demonstrations, etc.).	3.66	1.22	Often Practiced
13. I'm active in an environmental organization. (Greenpeace, WWF etc.)	3.63	1.16	Often Practiced
14. Recycle electric or electronic devices.	3.78	1.19	Often Practiced
<b>Composite Mean</b>	<b>4.03</b>	<b>1.03</b>	<b>Often Practiced</b>

**Note:** 4.21-5.00 Always Practiced; 3.41-4.20 Often Practiced; 2.61-3.40 Sometimes Practiced; 1.81-2.60 Seldom Practice; 1.00-1.80 Never Practiced

Described in table 5 is the extent to which PSTs practice activities that constitute pro-environment behavior. The overall mean of 4.03 indicates that PSTs often practice such activities daily. A closer look at the individual means obtained in each item shows that the most often practiced pro-environment activities by the PSTs are turning off lights and electric appliances when not in use, followed by conserving water at home. The results likewise indicate that PSTs are practicing recycling, educating others on proper waste disposal, and participating in campaigns that aim to prevent environmental damage. The present findings are congruent with the study of Krishna Priya and Thenmozhi (2021) who described the PEB of their respondents as above average.

**Table 6. Respondents' Perceived Readiness to Integrate Environmental Education in their Future Classes**

Indicators	Mean	SD	Verbal Interpretation
1. Collaborate with fellow teachers and plan for environmental education integration across disciplines.	4.36	0.77	Very Much Ready
2. Attend workshops, summer institutes, and conferences that provide training for integrating ecological concepts and environmental issues across disciplines.	4.34	0.78	Very Much Ready
3. Apply concepts such as ecological thinking (or systems) thinking, sustainability, stewardship, sense of place, environmental costs and benefits, participatory democracy, and the precautionary principle.	4.33	0.78	Very Much Ready
4. Reflect in my teaching the holistic nature of the environment and its complex relationship to society, technology, and the economy.	4.29	0.82	Very Much Ready
5. Include in my teaching a focus on the relationships between environmental health and human health.	4.38	0.77	Very Much Ready
6. Provide students with opportunities to develop skills of inquiry, communication, problem-solving, decision-making, and informed participation in addressing environmental issues.	4.38	0.76	Very Much Ready
7. Appreciate, understand, and discuss the importance of innovation and ingenuity, in both technological design and business, for advancing sustainable communities.	4.35	0.77	Very Much Ready
8. Provide experiences in outdoor environments that enhance students' knowledge and connection to the "real world" outside the school, which includes the natural world.	4.38	0.75	Very Much Ready
9. Collaborate and share experience and expertise with other educators through workshops, professional organizations, and publications.	4.37	0.75	Very Much Ready
10. Involve students in working towards environmentally-friendly schools.	4.43	0.74	Very Much Ready
11. Use holistic educational approaches to investigate environmental values.	4.32	0.78	Very Much Ready
12. Teach students to assess the ecological and sustainability implications of everyday choices and behaviors	4.37	0.77	Very Much Ready
13. Invite a critical analysis of products and consumption, and their implications for ecological and economic sustainability	4.24	0.80	Very Much Ready
14. Provide opportunities to discuss and build an understanding of the major long-term economic and technological changes required to create a truly sustainable economy	4.31	0.79	Very Much Ready
15. Model and teach the use of environmentally friendly, sustainable practices in the classroom and the school community	4.39	0.74	Very Much Ready
16. Initiate or work with environment clubs and school and community environment projects	4.34	0.75	Very Much Ready
17. Teach students how to become environmentally responsible citizens	4.51	0.71	Very Much Ready
<b>Composite Mean</b>	<b>4.36</b>	<b>0.77</b>	<b>Very Much Ready</b>

**Note:** 4.21-5.00 Very Much Ready; 3.41-4.20 Ready; 2.61-3.40 Neutral; 1.81-2.60 Not So Ready; 1.00-1.80 Not Ready

The respondents' strong agreement with the statements, which include competencies expected of environmental educators, shows their high level of perceived readiness to involve themselves in environmental education, regardless of their fields of specialization. This is supported by the findings of Lateh and Muniandy (2013) that PSTs have a positive attitude toward teaching environmental education concepts.

## Part 2. Difference in the Environmental Literacy Components of Pre-Service Teachers

**Table 7. Probability Value and Significant Difference in the Environmental Knowledge of Pre-Service Teachers when grouped according to Profile**

Indicators	Groups	Mean	SD	F	t	P	Decision on Ho	Interpretation
<b>Sex</b>	Male	8.89	2.72	/	0.242	0.809	Failed to Reject Ho	Not Significant
	Female	8.84	2.41					
<b>Number of Environmental Course Taken</b>	1 course	10.43	2.02	/	5.327	*0.000	Reject Ho	Significant
	None	8.68	2.47					
<b>Year Level</b>	First Year	8.75	2.55	2.816	/	*0.038	Reject Ho	Significant
	Second Year	9.17	2.37					
	Third Year	9.04	2.44					
	Fourth Year	8.26	2.47					
<b>Program</b>	BSEd	9.46	2.36	8.311	/	*0.000	Reject Ho	Significant
	BEEd	8.48	2.66					
	BECEd	8.87	2.13					
	BPEd	7.43	2.93					
	BTVTE	8.12	2.37					
	BTLE	7.45	1.97					

**Note:** \*Significant at  $\alpha = 0.05$

Male and female PSTs' EK levels did not differ significantly. Several studies have reported contrasting findings as far as the influence of gender in EK is concerned. The findings of Li *et al.*, (2022) are congruent with the results of the present study indicating that being male or female does not influence EK. On the other hand, Sarkawi *et al.*, (2017) and Zhao *et al.*, (2021) reported higher EK in males compared to females. The contrasting nature of the findings merits the need for further studies on gender and EK, especially in the context of pre-service teacher education. Interestingly, data analysis showed significant differences ( $p = 0.038$ ) in the EK levels of PSTs when grouped according to year level, with the first-year group having the highest mean score. Also, PSTs who took at least one stand-alone environmental course gained significantly higher scores ( $p < .01$ ) than those without exposure to any such course. Similarly, a significant difference in the EK levels of PSTs was also observed when they are grouped according to their college program ( $p < .01$ ). Post-hoc analysis revealed that the EK of PSTs from the BSEd program significantly differs from those of their counterparts from the BEEd ( $p = 0.050$ ), BPEd ( $p = 0.005$ ), and BTVTE ( $p = 0.001$ ) programs. The influence of PSTs' college program and exposure to an environmental course on their EK may be considered a gray area as it has yet to be deeply explored. However, in a study by Erhabor and Don (2016) involving environmental science majors, it was found that respondents had high levels of EK and manifested positive attitudes toward nature. Garcia and Cobar-Garcia (2018) argue that understanding environmental issues requires understanding the effects of human activities on the Earth's ecological systems and integrating the different scientific disciplines of science. The same authors attribute respondent teachers' low levels of EK partly to their non-science orientation and the non-science context teaching of environmental science in pre-service teacher training institutions. Hence, to build higher levels of EK among PSTs, there is a need to re-focus the teaching of EE in pre-service teacher training to cover the dimensions of sustainable development, namely environment, society, and economy.

**Table 8. Probability Value and Significant Difference in the Environmental Attitudes of Pre-Service Teachers when grouped according to Profile**

Indicators	Groups	Mean	SD	F	t	P	Decision on Ho	Interpretation
<b>Sex</b>	Male	3.65	0.41	/	-2.926	*0.004	Reject Ho	Significant
	Female	3.76	0.41					
<b>Number of Environmental Course Taken</b>	1 course	3.88	0.41	/	2.968	*0.003	Reject Ho	Significant
	None	3.72	0.41					
<b>Year Level</b>	First Year	3.71	0.41	1.867	/	0.134	Failed to Reject Ho	Not Significant
	Second Year	3.74	0.45					
	Third Year	3.82	0.39					
	Fourth Year	3.72	0.38					
<b>Program</b>	BSEd	3.80	0.44	3.498	/	*0.004	Reject Ho	Significant
	BEEd	3.70	0.40					
	BECEd	3.76	0.37					
	BPEd	3.55	0.39					
	BTVTE	3.65	0.39					
	BTLE	3.62	0.39					

**Note:** \*Significant at  $\alpha = 0.05$

The table above shows that environmental attitudes do not vary across year levels. This is in contrast with some studies which found that more senior PSTs tended to have more favorable attitudes towards the environment than their juniors (Koc & Kovac, 2016; Sarıkaya & Saraç, 2018). Moreover, female PSTs exhibit significantly more positive environmental attitudes than their male counterparts ( $p = 0.004$ ). This is consistent with the findings suggesting that females have higher environmental attitudes than males (Köse, *et al.*, 2011; Strapko *et al.*, 2016; Raman, 2016; Koc & Kovac, 2016; and Li *et al.*, 2020). This may imply that the belief that women have to be more caring than men is still existing among PSTs. In contrast, the findings of Magulod (2018) as well as that of Sarıkaya & Saraç (2018) reveal no significant difference between the environmental attitudes of males and females. The contrasting findings justify the need for more in-depth studies on the role of gender differences in the development of environmental attitudes. The same table also shows that PSTs who have taken at least one environmental course have higher environmental attitudes as compared to PSTs who have not taken any such course. This is consistent with the findings of some studies, revealing that college students who have enrolled in environmental science courses display higher levels of environmental attitudes when compared to those who have not enrolled in such courses (Raman, 2016; Sarıkaya & Saraç, 2018).

Using the respondents' college program as a grouping factor, a significant difference was also seen in respondents' environmental attitudes ( $p = 0.004$ ). To determine the source of statistical significance, post-hoc analysis was carried out, revealing that PSTs from the BSEd program had significantly higher levels of EA than PSTs from the BTVTE program ( $p = .009$ ). This could be explained by the fact that specific specializations under the BSEd program require the completion of content courses (e.g., Environmental Science for science majors) that tackle environmental topics. As Ahamad (2021) found, college students' enrollment in science courses is significantly associated with their environmental attitudes. Unfortunately, there are minimal studies involving PSTs that focus on exploring the role of the field of specialization in environmental attitudes. Magulod (2018) looked into the influence of college programs on the environmental attitudes of tertiary students and found that those specializing in science and technology tend to have higher levels of environmental attitudes than their counterparts from other programs. However, as Köse, *et al.*, (2011) noted, the offering of environmental science courses is usually confined to specific programs such as biology, science education, and environmental engineering. This suggests the need to revisit the teacher education curriculum and look for opportunities to include courses that discuss environmental issues, as this is deemed to facilitate a deeper appreciation and understanding of how human behavior impacts the environment thereby developing among prospective educators' positive attitudes towards nature.

**Table 9. Probability Value and Significant Difference in the Pro-Environment Behavior of Pre-Service Teachers when grouped according to Profile**

Indicators	Groups	Mean	SD	F	t	P	Decision on Ho	Interpretation
Sex	Male	4.09	0.69	/	1.204	0.229	Failed to Reject Ho	Not Significant
	Female	4.01	0.73					
Number of Environmental Course Taken	1 course	3.92	0.67	/	1.219	0.223	Failed to Reject Ho	Not Significant
	None	4.04	0.73					
Year Level	First Year	4.05	0.75	8.655	/	*0.000	Reject Ho	Significant
	Second Year	3.87	0.72					
	Third Year	3.97	0.66					
	Fourth Year	4.34	0.55					
Program	BSEd	3.97	0.69	2.874	/	*0.014	Reject Ho	Significant
	BEEd	4.02	0.69					
	BECEd	3.90	0.80					
	BPEd	3.80	0.80					
	BTVTE	4.21	0.77					
	BTLE	4.25	0.41					

**Note:**\*Significant at  $\alpha = 0.05$

No significant difference was observed in the PEB of respondent PSTs when grouped according to sex. This is supported by the findings of Vicente-Molina *et al.*, (2018) and Krishna Priya and Thenmozhi (2021), who also reported no significant difference in the PEB of their male and female respondents. In the same vein, Afacan (2020) also found no significant difference in the behavior of male and female pre-service science teachers in line with sustainable development practices. Interestingly, the PEB of PSTs who took a stand-alone environmental course and those who did not also did not differ significantly. Focusing on the mean scores of each group, it could be said that regardless of sex or exposure to a stand-alone environmental course, respondent PSTs practice behavior that reflects their care for the environment. However, mean PEB scores were significantly different using year level ( $p < 0.01$ ) and program ( $p = 0.014$ ) as grouping factors.

Concerning year level, a comparison of the mean scores obtained by the groups reveals that fourth-year PSTs tend to perform environmentally-sound practices to a greater extent than their counterparts, followed only by first-years. This could be explained by the fact that fourth-year PSTs are already deployed in various schools for their field study and teaching internship, thereby giving them more hands-on experience- and exposure to environmentally-leaning programs in their cooperating schools. However, in contrast with what this study found, Afacan (2020) reported no significant difference in the behavior of respondents as to year level. The high mean score obtained by the first-year group could be due to their mandatory enrollment in NSTP, where topics and activities aimed at developing a caring attitude toward the environment are provided. According to Balanay and Halog (2016), the NSTP course provides learning opportunities in line with climate change mitigation and adaptation, as well as disaster preparedness and resilience. In terms of the college program, post hoc analysis revealed that the PEB of PSTs from the BSEd program significantly differed from the PEB of the PSTs from the BTVTE program ( $p = 0.021$ ).

### Part 3. Difference in the Perceived Readiness of Pre-Service Teachers to Integrate Environmental Education

Table 10. Probability Value and Significant Difference in the Readiness of Pre-Service Teachers to Integrate Environmental Education when grouped according to Profile

Indicators	Groups	Mean	SD	F	t	P	Decision on Ho	Interpretation
Sex	Male	4.33	0.71		-0.692	0.489	Failed to Reject Ho	Not Significant
	Female	4.37	0.65	/				
Number of Environmental Course Taken	1 course	4.54	0.50		2.897	*0.005	Reject Ho	Significant
	None	4.34	0.68	/				
Year Level	First Year	4.31	0.71		5.661	*0.001	Reject Ho	Significant
	Second Year	4.27	0.71	/				
	Third Year	4.51	0.48					
	Fourth Year	4.56	0.50					
Program	BSEd	4.34	0.68		0.540	0.746	Failed to Reject Ho	Not Significant
	BEEd	4.41	0.60					
	BECEd	4.31	0.72	/				
	BPEd	4.19	0.75					
	BTVTE	4.37	0.68					
	BTLE	4.51	0.46					

Note: \*Significant at  $\alpha = 0.05$

The table above shows that the perceived readiness of PSTs to integrate EE in teaching did not vary as to sex ( $p = 0.489$ ) and program ( $p = 0.746$ ). Hence, male and female PSTs believe they are ready to integrate EE into their classes. This is in contrast with the findings of Karami *et al.*, (2018) wherein female teachers' readiness to teach EE was found to be significantly higher than that of their male counterparts. Comparing the mean scores obtained by the male and female groups, it could be seen that female PSTs' mean score is slightly higher than that of males. In a broader context, Vukelic (2022) studied the factors that influence the intention of PSTs to implement Education for Sustainable Development (ESD) in their classes. It was found that female PSTs exhibited higher levels of intention to implement ESD, although the difference was not statistically significant. Moreover, it could also be construed that PSTs across different programs believe in their readiness to integrate EE concepts across their different fields of specialization. There are very few studies looking into the influence of a college program or field of specialization on a PST's readiness to integrate EE. Karami *et al.*, (2018) found no significant difference in the attitudes of primary and elementary school teachers.

Furthermore, there is a significant difference in the perceived readiness of PSTs to integrate EE when they are grouped according to year level ( $p = 0.001$ ). Post-hoc analysis conducted to determine the source of statistical significance revealed that the perceived readiness of first-year PSTs significantly differed from that of fourth years ( $p = 0.017$ ). In contrast, the perceived readiness of second years varied significantly with that of third years ( $p = 0.023$ ) and fourth years ( $p = 0.006$ ). That the highest level of readiness based on the mean scores is observed among fourth-year PSTs could be attributed to the fact that in the current teacher education curriculum of the study locale, by the time a PST has reached the fourth year level, they are expected to have finished all their general education, professional education, and specialization courses, including the ones that tackle environmental concepts, leading to their field study and student teaching phases. Lastly, a significant difference is also noted in the readiness of PSTs to integrate EE when they are grouped according to exposure to an environmental course. PSTs who took at least one environmental course were more ready to integrate EE than those who did not. In line with this, Vukelic (2022) found that PSTs who attended ESD courses during their schooling showed higher levels of intention to implement SD content. They showed a higher intention to implement ESD teaching methods and approaches.

### Part 4. Relationship between the Components of Environmental Literacy and Pre-Service Teachers' Perceived Readiness to Integrate Environmental Education

Table 11. Probability Value and Decision on the Significant Relationship between the Environmental Knowledge and Readiness of Pre-Service Teachers to Integrate Environmental Education

Variables	r	p-value	Decision on Ho	Interpretation
EK and Readiness to Integrate EE	0.084	*0.035	Reject Ho	Significant
EA and Readiness to Integrate EE	0.394	*0.000	Reject Ho	Significant
PEB and Readiness to Integrate EE	0.458	*0.000	Reject Ho	Significant

Note: \*Significant at  $\alpha = 0.05$

As can be seen in the table above, all three components of EL are significantly related to PSTs' readiness to integrate EE in their classes. Hence, PSTs who are more environmentally knowledgeable, those who manifest more positive behavior towards the environment, and those who practice environmentally-sound behavior to a greater extent, are the ones who have higher levels of readiness to integrate EE when they teach. Correlational studies focusing on the same variables under study are scarce. With respect to this part of the study, the closest work is that of Vukelic (2022), who reported that PSTs who attended ESD courses showed higher levels of intention to implement content related to sustainable development, implement ESD teaching methods and approaches, and achieve ESD goals.



Taken as a whole, Environmental literacy, according to Coyle (2005), is the highest level (above environmental awareness and personal conduct knowledge). People with true environmental literacy can combine knowledge and skills to promote environmental care and protection. Environmental literacy further entails the ability to impart a subject's underlying principles, the skills needed to study the subject, and an understanding of how such principles could be applied in authentic contexts. Hence, PSTs with good levels of EL will be ready to deliver content and model environmentally-sound attitudes and behaviors.

## CONCLUSION

This study describes the EL of PSTs in terms of EL's three components. In addition, it also looked into the perceived readiness of the PSTs to integrate EE in their future classes. It was found that PSTs have an "average" level of Environmental Knowledge. PSTs were found to have positive attitudes towards environmental care and protection and often manifest behaviors that reflect their deep concern for the environment. Furthermore, they see themselves as "very much ready" to integrate EE in their respective classes. In terms of EK, PSTs from the BSEd program and those who took at least one environmental course scored significantly higher than those without exposure to any such course. A gender difference was noted in the EA component, as more positive attitudes were seen among females than males. PSTs who took at least one environmental course also had more positive attitudes towards the environment than those who did not take such a course. In terms of program, PSTs from the EA level of PSTs from the BSEd program significantly differed from the rest of the programs included in the study. With respect to PEB, significant differences were found using year level and program as grouping factors. PSTs in their senior year had higher levels of PEB than their juniors. Those from the BTLE and BTVTE programs were likewise found to have higher levels of PEB when compared with PSTs from the other programs. This study likewise found that PSTs in their senior year had significantly higher levels of perceived readiness to integrate EE in their classes when compared with PSTs from the lower year levels. Interestingly, PSTs who took at least one environmental course reported higher levels of readiness to integrate EE in their future classes. Finally, the study reports a statistically significant and positive relationship between each of the three components of EL, and the PSTs' readiness to integrate EE. The findings support the argument that building the EL of prospective educators through EE plays a crucial role in developing their readiness to teach environmental concepts in their future classes, regardless of their field of specialization.

## RECOMMENDATIONS

In light of the findings of this study, it is highly recommended that an Environmental Education course be included in the current teacher education curriculum of the host institution across all of its programs to address the existing knowledge gap, especially in critical topics such as biodiversity and climate change. It is also recommended that in the process of designing the course syllabus, the unpacking of the key learning competencies, the identification of topics, materials, primary course outputs, and assessment strategies be framed from the key principles of Education for Sustainable Development (ESD) to develop among PSTs the appreciation that environmental issues are strongly linked to social and economic issues. It is also recommended that a particular topic on "*Gender and the Environment*" be included in the syllabus as gender differences, specifically in environmental attitudes, were noted. The inclusion of activities that could foster a more profound sense of environmental care is likewise

recommended. Lastly, the inclusion of topics and activities that could help PSTs to integrate EE concepts in their respective fields of specialization effectively may help them sustain, if not further enhance, their readiness to involve themselves in the promotion of EE as they practice their profession upon completion of their program. An evaluative study may be conducted in the future in the same study locale for the purpose of assessing the impact of the implementation of the Environmental Education course for PSTs to their EL and to their readiness to integrate EE.

## REFERENCES

- Afacan, Ö. (2020). Investigation of Pre-Service Science Teachers' Behavior towards Sustainable Environmental Education. *International Electronic Journal of Environmental Education*, 10(1), 110–121. <https://dergipark.org.tr/en/download/article-file/863626>
- Ahamad, M. G., & Tanin, F. (2021). Relationships among college-level science course enrollment, environmental perception, and pro-environmental attitude: Evidence from the US General Social Survey. *Environmental Challenges*, 5, 100389. <https://doi.org/10.1016/j.envc.2021.100389>
- Ahmad, J., Md. Noor, S., & Ismail, N. (2015). Investigating Students' Environmental Knowledge, Attitude, Practice and Communication. *Asian Social Science*, 11(16). <https://doi.org/10.5539/ass.v11n16p284>
- Álvarez-García, O., Sureda-Negre, J., & Comas-Forgas, R. (2015). Environmental Education in Pre-Service Teacher Training: A Literature Review of Existing Evidence. *Journal of Teacher Education for Sustainability*, 17(1), 72–85. <https://doi.org/10.1515/jtes-2015-0006>
- Balanay, R. M., & Halog, A. (2016). Teaching Education for Sustainable Development at University Level: A Case Study from the Philippines. *World Sustainability Series*. [https://doi.org/10.1007/978-3-319-32928-4\\_11](https://doi.org/10.1007/978-3-319-32928-4_11)
- Baroro, M. L., Gorospe, J., Relox, R., & Vedra, S. (2016). Environmental Education Embedded in K-12 Program in Urban and Rural Secondary Schools in Iligan City, Lanao Del Norte, Philippines. *World Journal of Educational Research*, 17(1), 72–85. [http://www.wjer.org/WJER\\_Vol.%203,%20No.%204,%20May%202016/Environmental.pdf](http://www.wjer.org/WJER_Vol.%203,%20No.%204,%20May%202016/Environmental.pdf)
- Boon, H. J. (2011). Beliefs and Education for Sustainability in Rural and Regional Australia. *Education in Rural Australia*, 21(2), 37–54. <http://eprints.jcu.edu.au/19339/>
- Congress of the Philippines. (2008). Republic Act No. 9512. [senate.gov.ph](https://www.senate.gov.ph/republic_acts/ra%209512.pdf). Retrieved May 10, 2022, from [https://www.senate.gov.ph/republic\\_acts/ra%209512.pdf](https://www.senate.gov.ph/republic_acts/ra%209512.pdf)
- Coyle, K. (2005). Environmental Literacy in America: What Ten Years of NEETF/Roper Research and Related Studies Say about Environmental Literacy in the U.S. National Environmental Education & Training Foundation.
- Dada, D. O., Eames, C., & Calder, N. (2017). Impact of Environmental Education on Beginning Preservice Teachers' Environmental Literacy. *Australian Journal of Environmental Education*, 33(3), 201–222. <https://doi.org/10.1017/aee.2017.27>
- Dolenc Orbanic, N., & Kovač, N. (2021). Environmental Awareness, Attitudes, and Behavior of Preservice Preschool and Primary School Teachers. *Journal of Baltic Science Education*, 20(3), 373–388. <https://doi.org/10.33225/jbse/21.20.373>
- Environmental Education Ontario [EEON]. (2003). Greening the Way Ontario Learns: A Public Strategic Plan for Environmental and Sustainability Education. [https://www.eeon.org/\\_files/ugd/7b779b\\_2850c3ca51784a2ebac6fb34db6a173a.pdf](https://www.eeon.org/_files/ugd/7b779b_2850c3ca51784a2ebac6fb34db6a173a.pdf)

- Garcia, M. N., & Cobar-Garcia, M. R. V. (2016, October 2). Need for environmental literacy. INQUIRER.net. <https://opinion.inquirer.net/97833/need-for-environmental-literacy>
- Garcia, M. N., & Cobar-Garcia, M. R. V. (2018). The Environmental Literacy of Elementary School Teachers Based in The City of Manila and Nueva Ecija Province. *Journal of Nature Studies*, 17(2), 10–29. [https://www.researchgate.net/publication/327221647\\_THE\\_ENVIRONMENTAL\\_LITERACY\\_OF\\_ELEMENTARY\\_SCHOOL\\_TEACHERS\\_BASED\\_IN\\_THE\\_CITY\\_OF\\_MANILA\\_AND\\_NUEVA\\_ECIJA\\_PROVINCE/link/5b81099da6fdcc5f8b65d57f/download](https://www.researchgate.net/publication/327221647_THE_ENVIRONMENTAL_LITERACY_OF_ELEMENTARY_SCHOOL_TEACHERS_BASED_IN_THE_CITY_OF_MANILA_AND_NUEVA_ECIJA_PROVINCE/link/5b81099da6fdcc5f8b65d57f/download)
- Gheith, E. (2019). Environmental Literacy among Prospective Classroom Teachers in Jordan. *International Journal of Learning, Teaching and Educational Research*. <https://doi.org/10.26803/ijlter.18.12.15>
- Gökmen, A. (2021). The effect of gender on environmental attitude: A meta-analysis study. *Journal of Pedagogical Research*, 5(1), 243–257. <https://doi.org/10.33902/jpr.2021167799>
- Gwekwerere, Y. (2014). Pre-Service Teachers' Knowledge, Participation and Perceptions About Environmental Education in Schools. *Australian Journal of Environmental Education*, 30(2), 198–214. <https://doi.org/10.1017/ae.2015.15>
- Hoffmann, R., & Muttarak, R. (2020). Greening through schooling: understanding the link between education and pro-environmental behavior in the Philippines. *Environmental Research Letters*, 15(1), 014009. <https://doi.org/10.1088/1748-9326/ab5ea0>
- I. Erhabor, N., & U. Don, J. (2018). Impact of Environmental Education On the Knowledge and Attitude of Students Towards the Environment. *Tap Chí Nghiên Cứu Dân Tộc*, 24. <https://doi.org/10.25073/0866-773x/68>
- Karami, S., Bidhendi, M. E., & Naderi, M. (2018). Assessment of teachers' attitude toward environmental education and its relevance to their readiness to educating students (Case study: Teachers of primary school in Tehran city. *Quarterly Journal of Environmental Education and Sustainable Development*, 6(4), 9–18. [http://ee.journals.pnu.ac.ir/article\\_4960\\_a00c25914fbd5258503db3a56b79d72.pdf](http://ee.journals.pnu.ac.ir/article_4960_a00c25914fbd5258503db3a56b79d72.pdf)
- Koc, I., & Kuvac, M. (2016). Preservice Science Teachers' Attitudes toward Environment. *International Journal of Environmental and Science Education*, 11(13), 5925–5941. <http://files.eric.ed.gov/fulltext/EJ1115547.pdf>
- Köse, S., Gencer, A. S., Gezer, K., Erol, G. H., & Bilen, K. (2011). Investigation of Undergraduate Students' Environmental Attitudes. *Istanbul University - DergiPark*. <https://dergipark.org.tr/tr/download/article-file/88981>
- Krishna Priya, B., & Thenmozhi, S. (2021). Study on Self-efficacy and Pro-Environmental Behavior among School Students. *The International Journal of Indian Psychology*, 9(2), 1852–1858. <https://doi.org/10.25215/0902.184>
- Lateh, H., & Muniandy, P. (2013). Pre-Service Teachers Attitude towards Teaching Environmental Education (EE) during Practicum in Malaysian Primary Schools. *Journal of Environmental Protection*, 04(02), 201–204. <https://doi.org/10.4236/jep.2013.42024>
- Li, Y., Wang, B., & Saechang, O. (2022). Is Female a More Pro-Environmental Gender? Evidence from China. *International Journal of Environmental Research and Public Health*, 19(13), 8002. <https://doi.org/10.3390/ijerph19138002>
- Magulod, G. (2018). Climate change awareness and environmental attitude of College students in one campus of a State University in the Philippines. *Journal of Biodiversity and Environmental Sciences (JBES)*, 12(2), 211–220. <https://hal.science/hal-03544223/document>
- Mashfufah, A., Nurkamto, J., Sajidan, & Wiranto. (2018). Environmental literacy among biology pre-service teachers: A pilot study. *AIP Conference Proceedings*. <https://doi.org/10.1063/1.5054444>
- Mwendwa, B. A. (2018). Learning for Sustainable Development: Integrating Environmental Education in the Curriculum of Ordinary Secondary Schools in Tanzania. *Tap Chí Nghiên Cứu Dân Tộc*, 24. <https://doi.org/10.25073/0866-773x/65>
- National Economic and Development Authority [NEDA]. (n.d.). Philippine Development Plan 2017 - 2022 (updated). Philippine Competition Commission. Retrieved June 8, 2022, from <https://www.phcc.gov.ph/wp-content/uploads/2021/02/Updated-PDP-2017-2022.pdf>
- National STEM Learning Center. (2022, January). Vygotsky's concept of the "Zone of Proximal Development." *FutureLearn*. Retrieved August 9, 2022, from <https://www.futurelearn.com/info/courses/differentiating-for-learning-stem/0/steps/15505>
- Perez, R., & Bua, V. Jr. (2019). Greening the Curriculum for Sustainable Development. *ERIC*. <https://files.eric.ed.gov/fulltext/ED600473.pdf>
- Raman, R. A. (2016). Attitudes and Behavior of Ajman University of Science and Technology Students Towards the Environment. *IAFOR Journal of Education*, 4(1). <https://doi.org/10.22492/ije.4.1.04>
- Sarıkaya, R., & Saraç, E. (2018). An Analysis of Pre-service Teachers' Attitudes towards Environmental Issues in Terms of Various Variables. *Universal Journal of Educational Research*, 6(1), 99–109. <https://doi.org/10.13189/ujer.2018.060109>
- Sarkawi, D., Priadi, A., & Oktaviani, A. (2017). Environmental Knowledge and Environmental Friendly Behavior Based on Gender and Education Level. *International Journal of Advanced Research*, 5(6), 2106–2113. <https://doi.org/10.21474/ijar01/4649>
- Strapko, N., Hempel, L., MacIroy, K., & Smith, K. (2016). Gender Differences in Environmental Concern: Reevaluating Gender Socialization. *Society & Natural Resources*, 29(9), 1015–1031. <https://doi.org/10.1080/08941920.2016.1138563>
- Stylos, G., Goulgouti, A., & Plakitsi, A. (2019). Environmental Literacy: Evaluating Knowledge, Affect, and Behavior of Pre-service Teachers in Greece. *Interdisciplinary Journal of Environmental and Science Education*, 15(1). <https://doi.org/10.29333/ijese/6287>
- Vicente-Molina, M., Fernández-Sainz, A., & Izagirre-Olaizola, J. (2018b). Does gender make a difference in pro-environmental behavior? The case of the Basque Country University students. *Journal of Cleaner Production*, 176, 89–98. <https://doi.org/10.1016/j.jclepro.2017.12.079>
- Vukelić, N. (2022). Student Teachers' Readiness to Implement Education for Sustainable Development. *Education Sciences*, 12(8), 505. <https://doi.org/10.3390/educsci12080505>
- Wolf, M. J., Emerson, J. W., Esty, D. C., De Sherbinin, A., & Wendling, Z. A. (2022). 2022 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. <https://epi.yale.edu>
- World Bank [WB]. (2020a). Primary education, teachers (% female) - Philippines | Data.data.worldbank.org. Retrieved August 5, 2022, from <https://data.worldbank.org/indicator/SE.PRM.TCHR.FE.ZS?locations=PH>
- World Bank [WB]. (2020b). Secondary education, teachers (% female) - Philippines | Data.data.worldbank.org. Retrieved August 5, 2022, from <https://data.worldbank.org/indicator/SE.SEC.TCHR.FE.ZS?locations=PH>

World Economic Forum [WEF]. (2022). The Global Risks Report 2022 (17th ed.) [E-book]. World Economic Forum. [https://www3.weforum.org/docs/WEF\\_The\\_Global\\_Risks\\_Report\\_2022.pdf](https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf)

Zhao, Z., Gong, Y., Li, Y., Zhang, L., & Sun, Y. (2021). Gender-Related Beliefs, Norms, and the Link With Green Consumption. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.710239>

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