

Eco-Literacy Awareness of Pre-Service Science Teachers: Assessment of Knowledge, Awareness, Ethics, Emotion, and Behaviour

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Abstract. This study identified the level of eco-literacy awareness of pre-service science teachers through the five components: knowledge, awareness, ethics, emotion, and behaviour. It also identified the relationship of these five components to age and gender. The study's results show that the respondents have high eco-literacy awareness, with an average mean of 4.21. However, despite the high average means between knowledge, awareness, ethics, and emotion, it was observed that ecological behavior was notably lower at a moderate level, with a mean of 3.64. There are indicators in each component that scored low which are (1) living a low-carbon lifestyle, (2) protection of every species that are present in the environment, (3) individual accountability and social responsibility towards environmental protection, (4) role of nature in human development and (5) kind action towards the environment. Also, it was shown from the statistical result of Pearson correlation that there is no significant relationship between age and gender to eco-literacy awareness, with p-values > 0.05. These results suggest that high eco-literacy awareness in terms of knowledge, awareness, ethics, and emotions is not affected by age and gender. Lastly, based on the results, the study suggests researching framework development to enhance education, particularly on the roles and benefits of unpopular and harmful species, to have programs and projects that can help promote personal accountability, and to address anthropocentric views towards nature.

Keywords: Eco-literacy; Ecological awareness; Ecological behaviour; Ecological emotions; Ecological ethics.

1.0 Introduction

Education is crucial in ensuring everyone is eco-literate in this era of widespread environmental challenges. Humans are the most intelligent animals on the planet, and we already know they depend heavily on their environment. People today typically lead materialistic, consumptive lives. Their pursuit of a comfortable existence has led them to adopt a self-centered, greedy, and negligent attitude toward the environment and natural resources. Numerous artificial and natural environmental calamities are thus brought about. The definition of ecological literacy is "the ability to use ecological understanding, thinking, and habits of mind for living in, enjoying, and studying the environment" (Pitman & Daniels, 2016), with an emphasis on the "key ecological knowledge necessary for informed decision-making, acquired through scientific inquiry and systems thinking." Despite variations in definitions and framework designs, the fundamentals of ecological literacy are

universally acknowledged as knowledge and understanding of nature and how ecological systems function. The research studies sought to suggest alternative methods of fostering eco-literacy.

According to the study by Lestari et al. (2023), many projects in environmental courses turned out to be valuable instruments for student participation and good responses about eco-literacy. This realization emphasizes how practical eco-literacy initiatives may spark students' interest in and involvement in environmental education and conservation. In addition to student outputs that encourage engagement, some pedagogies have significant implications for early childhood education and eco-literacy. Ritchie (2017) discusses that educational facilities like libraries and other digital resources like computer labs may also aid this victory for eco-literacy. According to Latif et al. (2023), there is an opportunity for eco-literacy research projects and information awareness to be implemented in both physical and online platforms. Also, behaviour has an impact on the transition to eco-literacy as well. The development of communal values towards the environment shapes the attitudes and concerns of individuals towards the environment (Danish & Naved, 2016c). These can be demonstrated in the research reviewed by McBride et al. (2013), where the variations in ecological literacy, eco-literacy, and environmental literacy were classified through suggested frameworks and thoroughly examined in terms of their behavioral, affective, and cognitive aspects. In the study of Ha et al. (2022), these aspects were also observed, wherein they divided eco-literacy into five parts: ecological knowledge literacy, ecological awareness literacy, ecological ethics literacy, ecological emotional literacy, and ecological behavioral literacy. The value of eco-literacy in fostering environmental stewardship and sustainable development is becoming increasingly apparent. The information, abilities, attitudes, and values required to comprehend and deal with complex ecological concerns are called eco-literacy. Numerous studies have examined students' eco-literacy degrees in various subject areas.

Educating students on their role in ecological preservation and protection is very important aside from the fact that it adheres to the Sustainable Development Goals (SDG) that focuses on SDG 4 Quality Education, SDG 6 Clean Water, SDG 7 Affordable and Clean Energy, SDG 11 Sustainable Cities and Communities, SDG 13 Climate Change, SDG 13 Life Below Water and SDG 15 Life on Land. It is one of the new literacies of the 21st century taught in the classroom. The Nadiroh et al. (2021) study concerning the abilities required of educators to promote eco-literacy shows that knowledge of ecology is aided by their study's six Cs: critical thinking, collaboration, communication, creativity, citizenship/culture, and character education/ connectivity. However, they were able to see that the most challenging part of these abilities is critical thinking. It highlights how crucial it is to develop future educators' capacity to find, evaluate, and synthesize knowledge. Therefore, to teach eco-literacy and incorporate it into the classroom, a teacher must be proficient in implementing the environmental education curricula of the twenty-first century, which will help to preserve the environment.

One of the tools that is required in directing the process of producing eco-literate learners is teaching materials for the 21st century, and this has been the basis of Pursitasari et al. (2022) in the study titled "Eco-Literacy-Based Interactive Teaching Materials (EITM)". They evaluated whether using interactive instructional resources to improve students' critical thinking abilities was feasible. One of the six Cs of Nadiroh et al. (2021) is critical thinking, which is meant to impart ecological knowledge to students. The encouraging outcomes imply that these resources can successfully encourage critical thinking for the growth of eco-literacy abilities. It was demonstrated via the EITM's validation. In the same year, Rosidah et al. (2022) suggested using comics to teach ecological literacy in another way. Comics are a visual medium for ideas to be expressed through pictures. To illustrate the main points of the situation, it is frequently paired with text. Usually, it takes the shape of a collection of assembled image panels. The study focuses on the framework of comic book design, utilizing comics as teaching tools for elementary and middle school students' eco-literacy. After the implementation, positive results indicate that comics can be valuable for fostering eco-literacy in young students. Some use modules with a series of elementary-level activities to enhance eco-literacy skills, like that of the study by Gustian et al. (2022). During the module's implementation, positive impacts were observed among students, even during the early exposure to the material. Improvements in students' abilities and attitudes are visible; thus, modules can contribute to ecological literacy and problem-solving skills among students.

With all the research conducted to promote eco-literacy among learners, assessing whether there has been a significant change in their behaviour in dealing with the environment is essential; we know that learning occurs when there is a behaviour change. In the Yuniawan et al. (2022) study, 200 students at a university prioritizing conservation had their eco-literacy levels evaluated. As a result, it demonstrates that students are already aware

of eco-literacy and have been practicing it since they belong to a university with a strong move towards the same goal of producing eco-literacy students. It also demonstrates that the highest level of understanding is that of care conservation eco-literacy, which is followed by understanding culture conservation eco-literacy (and knowing about what organic waste conservation eco-literacy is). Additionally, facilities support students' development of ecological literacy. The importance of public sector college libraries in promoting eco-literacy was highlighted in Latif et al.'s (2023) study. According to their research, students believe libraries help promote sustainability by disseminating information. Scholars perceive libraries as viable agents and community centers that can help encourage students to be environmentally conscious.

Additionally, it directs toward potential eco-literacy research projects. Each student must have a strong sense of environmental concern and a positive attitude toward green items to reach this potential research engagement of students in eco-literacy. According to Danish and Naved's (2016c) study, those with a strong sense of collectivism and eco-literacy are more likely to be conscious of and worried about the environment. The study's findings clearly explain how crucial it is to cultivate and direct a mindset toward activities that benefit the environment. This process can begin in the classroom when students are very young. The major component of this goal is the role of teachers in environmental literacy, which is supported by the study of López-Alcarria et al. (2021). Their study discusses the importance of teacher involvement in decision-making regarding environmental aspects. They even pointed out the importance of collaborative action research, possibly enhancing environmental literacy and sustainable management in education.

The idea of ecological literacy is quite abstract, and scholars' interpretations of the idea and framework vary from environmental knowledge. The three tiers make up the pyramid, arranged from bottom to top: ecological literacy, environmental attitudes, and environmental knowledge. Ecological literacy is the highest level because it is formed through individual environmental understanding, principles, and measures implemented to address environmental issues. The term "literacy" describes the process of gaining and sharing ecological knowledge, raising awareness of the need to conserve the environment, and eventually directing the development of ecological conduct to reach more advanced ecological knowledge. Stated differently, the five aspects of ecological literacy are integrated into a single whole, and each one is nearly theoretically equally significant. They have an interactive impact on one another. The most fundamental of these is ecological knowledge literacy, whereas ecological awareness literacy shows the path of action; moral norms are emphasized by ecological ethical literacy, internal motivation comes from ecological emotional literacy, and the goal. Furthermore, those impacted by ecological ethics will never stop assessing their psychological trajectory according to their sentimental perspectives or ecological theory. A certain level of ecological emotional literacy will form ecological consciousness, ecological knowledge, and ecology. People will take ecological emotional literacy and ethics out with them in their practices for ecological preservation and create their knowledge of ecological behaviour (Ha et al., 2022).

With the growing concern in eco-literacy awareness, it is essential to know if students are eco-literate, especially those pre-service science teachers who will serve as a medium in the future to make future generations eco-literate. With this, the study will identify the level of eco-literacy awareness of Bachelor of Secondary Education major in science and identify whether there is a significant relationship between the demographic profile of the pre-service science teachers and their eco-literacy level in terms of the five components of eco-literacy: knowledge, awareness, ethics, emotions and behaviour. The study would open an avenue for possible interventions and strategies in promoting eco-literacy among students.

2.0 Methodology

2.1 Research Design

The study utilized a descriptive-correlational research design to assess the eco-literacy level of pre-service science teachers. It examines the relationship among five components of eco-literacy: ecological knowledge, ecological awareness, ecological ethics, ecological emotion, and ecological behaviour, and its association with pre-service science teachers' age and gender.

2.2 Research Locale

The study was carried out in one of the universities in Leyte. The participant institution provides a Bachelor of Secondary Education specializing in Science. This research locale is very convenient for the researcher due to its proximity and the courses it offers, since the study's primary respondent should be a BSEd Science program

student.

2.3 Research Participants

The researcher considered the total number of pre-service science teachers in the research locale as participants since there was only one BSEd Science 4th year section in the participating university. The total number of BSEd Science 4th year students who agreed to participate was considered the study's respondents. Out of 22 students, only 18 opted to participate in the survey.

2.4 Research Instrument

The questionnaire used in the study was the adapted questionnaire from the study of Ha et al. (2022) entitled "Assessing ecological literacy and its application based on linguistic ecology: a case study of Guiyang City, China". It was modified by transforming the multiple-choice questionnaire to a Likert Scale without changing the statements and the choices. The reliability and validity were conducted before the implementation to ensure the accuracy and consistency of the modified research instrument. The instrument underwent expert review by assessing whether the statements cover the literacy components and whether the students could understand them in the context of the Philippines. For reliability, a pilot test was conducted to evaluate internal consistency with Cronbach's alpha of 0.78. The questionnaire is a 5-point Likert Scale Questionnaire, and the interpretation of the mean of the student responses is shown in Table 1.

Table 1. *Mean Interpretation of Student Responses*

Range	Interpretation
1.00-1.80	Very Low
1.81-2.60	Low
2.61-3.40	Moderate
3.41-4.20	High
4.21-5.00	Very High

2.5 Data Gathering Procedure

This researcher implemented the study by letting the respondents answer the adapted and modified survey questionnaire. The questionnaire was implemented face-to-face. The result of the survey underwent statistical treatment using the Jamovi 2.3.28, because of its free access and friendly user interface as well as the accuracy of statistical analysis it provide in finding the mean for the level of eco-literacy and Pearson correlation p-value to identify the correlation between the demographic profile and the five components of eco-literacy; knowledge, awareness, ethics, emotion and behaviour. Additionally, the researcher conducted an Independent T-test to identify whether there is a significant difference in gender and the five components.

2.6 Data Analysis

The data were analyzed using both descriptive and inferential statistical techniques. Frequency distribution and percentage were used to describe the demographic profiles of respondents. Mean values were calculated to evaluate the central tendencies in responses to performance appraisal and productivity items. A T-test was conducted to identify significant differences in the perceptions of productivity between employees and supervisors. Additionally, Pearson's Correlation Coefficient was used to determine the strength and direction of the relationship between performance appraisal and employee productivity. All analyses were conducted using a 95% confidence level and a 5% margin of error. The findings were presented in tabular form to enhance clarity and support interpretation.

2.7 Ethical Considerations

This research study followed ethical guidelines by securing proper communication with the participating school and the respondents. Informed consent was also obtained from the study participants, and those who agreed to participate were included in the total enumeration. The participants were informed of the purpose of the study and the benefits of participating in the study. The data was treated with utmost confidentiality and used solely for the study.

3.0 Results and Discussion

This section discusses the survey results conducted by the researcher to answer the research questions. The results presented below are the data taken from the quantitative statistical analyses conducted by the researcher on the

data gathered.

3.1 Level of Eco-Literacy Awareness of Pre-Service Science Teachers

The first question the study seeks to answer concerns the level of eco-literacy of the pre-service science teachers. Table 2 presents the level of ecological knowledge of the pre-service science teachers. The mean of the students' responses is presented below.

Table 2. *Level of Ecological Knowledge*

No.	Indicators	Mean	Interpretation
1	I understand that forest, marine, and wetland ecosystems are collectively regarded as the earth's three major ecological environmental systems, which are called "the kidney of the earth," "species treasure house," and "natural storage."	4.11	High
2	I know that we should not eliminate animals or insects that humans do not like (bats, mosquitoes, snakes, etc.), because they help maintain biodiversity, the stability and balance of ecosystems, and the diversity of the food chain.	3.78	High
3	I am knowledgeable about environmental hazards (acid rain, white pollution, ozone layer destruction).	3.94	High
4	I know how a sharp decline in biodiversity, eutrophication of water capacity, and the greenhouse effect affect our planet.	4.11	High
5	Humans are part of the natural world and should live harmoniously.	4.44	Very High
6	I respect, obey, and protect nature while developing and using it.	4.61	Very High
7	I know how garbage should be segregated and practice it daily.	4.44	Very High
8	I live a low-carbon lifestyle.	3.83	High
Average		4.16	High

The data in Table 1 shows that the pre-service science teachers have a high ecological knowledge based on the average of 4.16. However, looking into the mean averages among all the indicators, it is clear that statement 6 gained the highest mean score of 4.61, stating, *"I respect, obey, and protect nature, while developing and using nature"*. This indicates that the respondents firmly commit to caring for the environment while using it. This is also somewhat close to the statement 5 *"I am aware that human beings are part of the natural world, we should live harmony in nature"* which supports the statement 6 and only indicate that the pre-service science teachers understand that living in harmony in nature is like a give and take relationship wherein both benefit from it.

On the other hand, there were also items in the indicators with low scores, but this does not mean that they have low ecological knowledge, because the means are within the range of high ecological knowledge. These items are on the low-carbon lifestyle (3.83) and the concern of eliminating animals and insects (3.78), statements 8 and 2, respectively. According to the monograph published by Pretty (2022) entitled *The Low-Carbon Good Life*, a low-carbon lifestyle involves sustainable consumption of natural resources, connecting to nature, and taking actions to combat climate change and biodiversity loss. Moreover, a score of 3.83 may indicate that the respondents are having difficulty being faithful towards all indicators of a low-carbon lifestyle. In addition, transition to a low-carbon lifestyle needs public engagement and citizen action (Pretty, 2022; Yuanyuan et al., 2022).

For statement 2, eliminating animals and insects may appear to have lower scores than the others because of different factors. Sometimes, these animals and insects are eliminated due to their threat to the community. This also indicates that knowledge of the role of each organism in the environment, whether it poses danger or not, plays an important role in maintaining biodiversity stability and balance, particularly in the food chain, and the absence of one organism could have a fatal effect on the others. This was also the research gap that was observed by Jean-Marie et. al (2013) in the study *"Schoolchildren and one of the most unpopular animals: are they ready to protect snakes"* and Zhbanova et. al (2020) in the study *"Attitude analysis of child-constructed scenes depicting human interactions with unpopular animals"* wherein it was observed that lack of information on conservation strategies of these animals are not discussed much in the classroom. According to Ha et al. (2022), ecological awareness is the second component of eco-literacy. Table 3 projects the level of ecological awareness of the pre-service science teachers.

The data in Table 3 reveal that the pre-service science teachers have a high level of ecological awareness. This indicates that the respondents are concerned and understanding regarding environmental protection and aware of possible environmental threats, with an average mean of 4.03.

Table 3. Level of Ecological Awareness

No.	Indicators	Mean	Interpretation
1	Environmental protection is not only the responsibility of the country and the government; it is also my business.	3.28	Moderate
2	It is to impose state taxes for environmental protection fees on every citizen.	3.83	High
3	The importance of environmental protection is no less than economic development.	4.11	High
4	The Earth will not indefinitely provide human beings with natural resources, so protecting natural resources is significant.	4.17	High
5	Currently, the ecological and environmental protection problems in many cities of our country have not yet reached the point where they need to be deliberately protected.	3.94	High
6	Ecological environmental protection should be given top priority with regard to current population control, technological and educational progress, old-age security, social security, ecological environmental protection, and other social issues we face.	4.50	Very High
7	A large number of hunting wild animals will destroy the ecological balance.	4.39	Very High
Average		4.03	High

Based on the results provided above, Statement 6, which says "*About the current population control, technological and educational progress, old-age security, social security, ecological environmental protection, and other social issues we are facing, the issue of ecological environmental protection should be given top priority,*" gained the highest score of 4.50. This only shows that they recognize the need and the urgency in addressing environmental issues over social issues. Moreover, this was also observed in the study of Muzseros and Zsult (2021) in the study title "Collaboration of Communities and Non-Profit Organization in Addressing Environmental Problems in African Countries," wherein it was observed that pro-environment efforts have been initiated, such as the Kyoto protocol, to address the urgency for environmental protection and preservation.

Also, the statement 7 "*A large number of hunting wild animals will destroy the ecological balance*" scored 4.39, which means the average indicates that they are aware of the effect of hunting animals on the ecological balance. Moreover, Benitez-Lopez et.al (2017) in their study "The Impact of Hunting in Tropical Mammal and Bird Populations" showed that hunting animals leads to a significant decline in mammal and bird populations. The areas with higher pressure are those with access to major towns. However, in the study of Kareem et. al (2020), they observed that hunters show awareness and a positive attitude towards conservation. However, they recommend that more enlightenment programs should be given to hunters by the government.

On the other hand, the lowest score among all indicators under Table 3 is statement 1 stating that "*Environmental protection not only the responsibility of the country and the government, it is also my business*" with a mean of 3.28 which suggest that some of the respondents think that the government should be more accountable and responsible on environmental protection. This result shows the lack of awareness of the fourth indicator, which is that individual actions and efforts are needed towards a successful government action for environmental protection. Although many are aware of each individual's responsibility towards this action, many researchers suggest that they still lack awareness of the reasons behind environmental degradation and that the level of environmental protection awareness among students is not sufficient (Pavlovic, 2022; Ahmed et al., 202; & Massimo, 2021). Lestari et al. (2023) even pointed out that individuals may feel responsible when exposed to activities promoting environmental awareness, preservation, and protection initiatives. According to Ha et al. (2022), ecological ethics is the third component of eco-literacy. Ecological ethics is a part of environmental philosophy that focuses on protecting natural entities and the sustainable use of natural resources. It is anchored on human beings' ethical decisions regarding the environment. Table 4 shows the results of the pre-service teachers' responses.

The data in Table 4 shows very high ecological ethics, with an average of 4.21. The statement with the highest mean among all indicators is statement 6, "*Nature's power is beyond our imagination,*" with a mean score of 4.50. This statement highlights that the respondents acknowledge and respect nature and its unpredictable forces of destruction and even healing and restoration. It is followed by statement 7, "*The existence of all plants and animals has its meaning and value,*" and statement 8, "*We should not harm plants and animals casually for our own needs,*" with a mean score of 4.44. These two statements have high means, indicating that the respondents consider the importance of the existence of plants and animals and that the lives of these organisms are also valuable.

Conversely, statements 1 and 4, which state "*In the relationship between humans and nature, nature is the most important, and humans serve nature*" and "*All natural and social activities of humankind should follow the laws of nature,*" received a mean score of 4.00. Statement 1 suggests that most of the respondents do not have

anthropocentric views, a human-centered belief, which is usually the cause of ecological crises. According to the study of Guryanova (2020), anthropocentric and biocentric views are usually the moral systems that ecological ethics integrates. It sometimes calls for debate as to the importance of human versus nature.

Table 4. *Level of Ecological Ethics*

No.	Indicators	Mean	Interpretation
1	In the relationship between humans and nature, nature is the most important, and humans serve nature.	4.00	High
2	Nature is our typical home for humankind.	4.33	Very High
3	Human beings should not be the masters of nature.	4.22	Very High
4	All natural and social activities of humankind should follow the laws of nature.	4.00	High
5	Nature is the premise and foundation of human existence and development.	3.78	High
6	Nature's power is beyond our imagination.	4.50	Very High
7	The existence of all plants and animals has its meaning and value.	4.44	Very High
8	We should not harm plants and animals casually for our own needs.	4.44	Very High
Average		4.21	Very High

On the other hand, the lowest mean score is 3.78, which is the statement 5, "Nature is the premise and foundation of human existence and development," which indicates that there is no strong emphasis on the fundamental role of nature in human development. This idea is supported by the study of Chalise (2024b), wherein it highlighted that nature serves as a foundation element in human existence, and there is interconnectedness in the pursuit of environmental protection and responsibility. Moreover, those existential values are aligned with the idea of environmental stewardship. According to Ha et al. (2022), ecological emotion is the fourth component of eco-literacy, which addresses the psychological impact of the environment on an individual. Table 5 presents the responses of pre-service science teachers on ecological emotion.

Based on the data presented in Table 5, the respondents' level of ecological emotion is very high, with a mean score of 4.42. Among all indicators, it was statement 1,3, and 5 gained the highest mean of 4.56 which states that "I often praise the wonders and greatness of nature," "I can discover the beauty of nature and learn to appreciate its beauty," and "Always to pay close attention to the development of environmental problems." All three statements show that the respondents are amazed by and admire the beauty of nature. The respondents are conscious of the threats and issues concerning environmental protection and preservation. Moreover, this was also observed in Allen's (2011) study entitled "Aesthetic Appreciation of Nature and Environmentalism," which highlighted the idea that aesthetic appreciation of nature influences environmental attitudes and actions towards environmental conservation. He concluded that beauty plays a significant role in preserving the environment.

Table 5. *Level of Ecological Emotion*

No.	Indicators	Mean	Interpretation
1	I often praise the wonders and greatness of nature.	4.56	Very High
2	Humans must revere nature with gratitude to survive and develop better on Earth.	4.39	Very High
3	I can discover the beauty of nature and learn to appreciate it.	4.56	Very High
4	In the face of nature, I will feel very kind.	4.17	High
5	Always pay close attention to the development of environmental problems.	4.56	Very High
6	If we hold ecological environment protection activities, you will have the enthusiasm to participate.	4.38	Very High
7	I am very disgusted with the destruction of the ecological environment.	4.33	Very High
Average		4.42	Very High

While the statement with the lowest mean score of 4.17 is statement 4, "In the face of nature, I will feel very kind," which may indicate that though the respondents admire the beauty of nature, some of them are not kind enough to it. This may be attributed to careless actions like throwing garbage anywhere, which affects the environment. Moreover, Shlomit (2022) pointed out from his study titled "Group Consumption and Ecological Footprint: The Effect of Habits and Lifestyle" that small habits like choosing unhealthy food and the disposal of utensils can impact the environment and increase ecological footprints that affect society as a whole.

The data presented in Table 6 shows that the pre-service science teachers have a moderate level of ecological engagement, with a mean of 3.64. The highest mean is 4.61, which involves refusing to eat wildlife, which is aligned with the global trends towards reducing wildlife consumption to prevent biodiversity loss and zoonotic diseases (Wasser et al., 2015). While the items that cover proper garbage disposal and participation in public

welfare activities both gain a score of 3.67. These show that the respondents adhere to widespread but not universal adherence to waste management and community involvement initiatives, similar to the findings that public participation is crucial for successful environmental policies (Dietz & Stern, 2008).

Table 6. *Level of Ecological Behaviour*

No.	Indicators	Mean	Interpretation
1	I throw my garbage in the correct bins and avoid littering.	3.67	High
2	I refuse to eat wildlife.	4.61	Very High
3	I often participate in ecological environmental protection and public welfare activities.	3.67	High
4	I often consult and pay attention to materials or news reports related to the environment.	3.44	High
5	I participate in activities such as complaints and petitions for environmental protection.	3.11	Moderate
6	I participate in persuading others to stop practices that destroy the environment.	3.22	Moderate
7	I promote ecological concepts and protection awareness to others.	3.72	High
Average		3.64	High

According to McKenzie-Mohr's (2000) study, personal advocacy and staying informed are key components of environmental stewardship. This ecological behavior of the student based on the result only shows moderate level of attention to environmental news (3.44) and efforts to persuade others against harmful practices (3.22) On the other hand, the one with the lowest mean is on the actions towards participating in complaints and petitions towards environmental protection which clearly shows that there is a gap in proactive environmental activism that is an important driver of change (Boudet, 2011).

Table 7 showcases the average mean of the five components and presents the respondent's overall eco-literacy level. Table 7 shows that the level of eco-literacy of pre-service science teachers is very high. However, despite this, as discussed in the previously presented tables, things still need to be considered and focused on. Also, among the five components, ecological behavior scores the lowest, wherein the indicators are primarily focused on actions and efforts towards environmental protection. It is also the most demanding because it seeks individual and collective actions.

Table 7. *Level of Eco-Literacy*

Variables	Mean	Interpretation
Ecological Knowledge	4.16	High
Ecological Awareness	4.03	High
Ecological Ethics	4.21	Very High
Ecological Emotions	4.42	Very High
Ecological Emotion	3.64	High
Average	4.09	High

3.2 Relationship of the Five Components of Eco-Literacy to Age and Gender

This section seeks to answer the second question of this study, which is to identify the relationship of the five components of eco-literacy to the respondents' age and gender. Table 8 shows the statistical results using Jamovi 2.3.28. Table 7 shows the relationship of age and gender to ecological knowledge, awareness, Ethics, and emotions. The Pearson correlation matrix shows that the p-values for age are >0.05 , 0.382 for ecological knowledge, 0.536 for ecological awareness, 0.981 for ecological ethics, 0.627 for ecological emotion, and 0.129 for ecological behaviour. There is a significant relationship between age and the five components of eco-literacy. However, it is also observable in the data presented that as age increases, ecological knowledge and awareness also increase. Moreover, this idea is supported by many studies that environmental awareness increases as age increases, as the person gets older, their awareness of environmental issues as well as environmental protection goes with it (Libelo & Sean, 2022; Garay et al., 2022; Vestena et al., 2017; and Wiernik et al., 2013). However, though the correlation is positive, it is also weak, with values of 0.219 and 0.156, respectively. Moreover, according to a longitudinal study, Villanueva et al. (2018) also support the idea that age may not directly correlate with environmental concern.

Meanwhile, for gender, the p-values are also > 0.05 , which are 0.527 for ecological knowledge, 0.972 for ecological awareness, 0.671 for ecological ethics, 0.926 for ecological emotion, and 0.129 for ecological behaviour. The results suggest that there is no significant relationship between gender and the five components of eco-literacy, and it was also observed in the study of Patel (2023) that gender does not significantly affect environmental education awareness.

Table 8. Correlation Matrix

Variables		Ecological Knowledge	Ecological Awareness	Ecological Ethics	Ecological Emotion	Ecological Behaviour
Ecological Knowledge	Pearson's r	—				
	df	—				
	p-value	—				
Ecological Awareness	Pearson's r	0.426	—			
	df	16	—			
	p-value	0.078	—			
Ecological Ethics	Pearson's r	0.292	0.789	—		
	df	16	16	—		
	p-value	0.24	< .001	—		
Ecological Emotion	Pearson's r	0.396	-0.07	-0.057	—	
	df	16	16	16	—	
	p-value	0.104	0.782	0.822	—	
Ecological Behaviour	Pearson's r	-0.033	0.25	0.058	-0.102	—
	df	16	16	16	16	—
	p-value	0.896	0.318	0.818	0.688	—
Age	Pearson's r	0.219	0.156	-0.006	-0.123	-0.372
	df	16	16	16	16	16
	p-value	0.382	0.536	0.981	0.627	0.129
Gender	Pearson's r	0.16	0.009	0.107	0.024	0.178
	df	16	16	16	16	16
	p-value	0.527	0.972	0.671	0.926	0.129

The researcher also identified significant gender differences regarding ecological knowledge, awareness, ethics, and emotion through an independent t-test. The data are presented in Tables 9 and 10. Based on the data presented in Table 9, no significant difference exists between the level of ecological knowledge, awareness, ethics, emotion, and behaviour by gender. It has a p-value > 0.05. These are 0.646, 0.613, 0.821, 0.759, 0.480 respectively. However, looking into Table 10, the difference between the means of the two groups may not be significant. However, for ecological knowledge, awareness, and ethics of females, coded 1, is greater than that of males, coded 0, with means of 4.23, 4.12, and 4.13. Regarding ecological emotion and behaviour, males have a higher mean of 4.44. This data is supported by the study of Mandaric & Hunjet (2023), wherein, based on their study, women in Croatia have higher eco-awareness than men. Women are more concerned about environmental issues and support environmental initiatives like recycling. However, this is opposite to the study of Garay et al. (2022), which found that women have a higher level of unacceptable eco-awareness than men by 42%.

Table 9. Independent T-test Result (Gender)

Variables		Statistic	df	P-value
Ecological Knowledge	Student's t	-0.468	16	0.646
Ecological Awareness	Student's t	-0.516	16	0.613
Ecological Ethics	Student's t	-0.230	16	0.821
Ecological Emotion	Student's t	0.313	16	0.759
Ecological Behaviour	Student's t	-0.723	16	0.480

Table 10. Group Descriptives of Independent T-test (Gender)

Variables	Group	N	Mean	Median	SD	SE
Ecological Knowledge	0	12	4.13	4.13	0.349	0.101
	1	6	4.23	4.31	0.588	0.240
Ecological Awareness	0	12	3.99	3.93	0.514	0.148
	1	6	4.12	4.08	0.492	0.201
Ecological Ethics	0	12	4.08	4.14	0.424	0.122
	1	6	4.13	4.08	0.502	0.205
Ecological Emotions	0	12	4.44	4.43	0.341	0.098
	1	6	4.38	4.36	0.421	0.172
Ecological Behaviour	0	12	3.37	3.43	0.239	0.069
	1	6	3.29	3.29	0.202	0.083

In Table 11, it was observed that there is no significant difference in terms of age for the five components. However, in Table 12, the older groups have higher mean scores regarding knowledge, awareness, ethics, emotion, and behavior. However, in the study of Asha et al. (2023), gender showed no significant difference in environmental behaviour. With that, we can say that these claims may be affected by different factors that should be investigated for future studies. Tables should be referenced in the text using the term "Table." The tables incorporated must

adhere to the following specifications: they should be formatted with a font size of 8, centered, and created using the Microsoft Word table editor. Tables presented in the text must not be included as images; instead, they should be generated using the designated word processing software. The table title should be placed above the actual table. See the sample below for the table presentation.

Table 11. Independent T-test Result (Age)

Variables		Statistic	df	P-value
Ecological Knowledge	Student's t	-0.029	16	0.977
Ecological Awareness	Student's t	-0.589	16	0.564
Ecological Ethics	Student's t	-0.430	16	0.673
Ecological Emotion	Student's t	-1.328	16	0.203
Ecological Behaviour	Student's t	-1.602	16	0.129

Table 12. Group Descriptives of Independent T-test (Age)

Variables	Group	N	Mean	Median	SD	SE
Ecological Knowledge	1	15	4.16	4.13	0.421	0.109
	2	3	4.17	4.13	0.561	0.324
Ecological Awareness	1	15	4.00	4.00	0.471	0.122
	2	3	4.19	3.86	0.705	0.407
Ecological Ethics	1	15	4.20	4.25	0.319	0.082
	2	3	4.29	4.25	0.437	0.252
Ecological Emotions	1	15	4.37	4.29	0.365	0.094
	2	3	4.67	4.71	0.218	0.126
Ecological Behaviour	1	15	3.31	3.43	0.222	0.057
	2	3	3.52	3.43	0.162	0.093

4.0 Conclusion

The study results concluded a high eco-literacy awareness among Eastern Visayas State University- Burauen Campus pre-service science teachers, with an average mean of 4.09. It was observed that the respondents have very high ecological ethics and emotion, with a mean of 4.21 and 4.42; a high level of ecological knowledge and awareness, with a mean of 4.16 and 4.03; and a moderate level of ecological behaviour of 3.64, which is also the lowest mean among the five components. Despite the high average means between knowledge, awareness, ethics and emotion, it was observed by the researcher that there are indicators in each component that scored low such as on the idea of living a low-carbon lifestyle, protection of every species that are present in the environment, individual accountability and social responsibility towards environmental protection, role of nature in human development and kind action towards the environment. On the other hand, it was also observed that the pre-service science teachers have ecological knowledge, awareness, ethics, and emotion, but their actions do not equate to it. There should also be a focus on being attentive to environmental news and actively participating in environmental activities. Another observation based on the result of the study is that there is no significant relationship between age and gender and the five components of eco-literacy awareness.

With the conclusions, the study recommends that there should be a study on how to enhance education on the roles and benefits of other species, even if it is unpopular, may cause harm, or pose health problems, such as bats, mosquitoes, snakes, etc. The focus should be on how they help maintain biodiversity stability and ecological balance. To have programs and projects that can help promote personal accountability and responsibility among every individual and address anthropocentric views that humans are superior to other species, fostering human-nature interactions. Also, studies on how to improve ecological behavior in pre-service science teachers should be considered. Lastly, this study may also be enhanced and expanded by allowing other programs to participate in the survey, since environmental accountability is not only centered on students enrolled in science-related courses.

5.0 Contribution of Authors

The sole author conducted the entirety of the study.

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7.0 Conflict of Interest

There is no conflict of interest.

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9.0 References

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