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Biodiversity Literacy Level of Public Administration Students in a Higher Education Institution

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ABSTRACT

A vital tool in the fight against threats to biodiversity is education, particularly increasing knowledge on biodiversity. In this context, it is important to discover the effect of environmental education on the biodiversity literacy levels of the incoming 20th century work force. This study aimed to investigate graduating public administration students' biodiversity literacy levels. The descriptive survey method, one of the quantitative research methods was used in the research. A total of 119 graduating Bachelor of Public Administration students studying at a higher education institution during the 2021-2022 academic year participated in the research. "Biodiversity Literacy Assessment Instrument" was used as a data collection tool in the study. Independent t-test was used to compare gender scores while one-way ANOVA was used to compare student understanding problems related to biodiversity. Tukey HSD test was used to determine the direction of significance in multiple comparisons. The findings revealed that the participants have a high level of understanding and knowledge about biodiversity. Also, there is no dominant gender that has the higher mean scores in all the dimensions. As biodiversity literacy level in biodiversity knowledge increases, the mean score in conservation and importance of species also increases. The study has implications for teaching biodiversity that include activities to help students take responsibility for the protection of biodiversity and the place of biodiversity in the national curriculum.

Keywords: biodiversity literacy, environmental issues, environmental education

INTRODUCTION

Biodiversity is in worldwide decline and it is becoming increasingly important to expand biodiversity awareness and achieve broad-based support for conservation (Michiel et al., 2020). Engaging the public in biodiversity can help build broad-based support for its protection. Support is needed for conservation to be successful, as conservation strategies and practices depend on persistent funding, membership and acceptance (Home et al., 2009). A widely shared willingness of the public to conserve biodiversity could encourage decision makers to implement policies that grant protection, yet when there is a lack of concern about biodiversity, governments or industries will unlikely change course (Novacek and Michael, 2008; Shwartz et al., 2014). Young people are leading the way in calling for transformative change on biodiversity and climate. But they can't carry out this leadership role if they lack knowledge of the planetary emergency and how to solve it. That's why learning – and teaching – are some of the most important things to be done to support biodiversity (Convention on Biological Diversity, UN Environment Programme).

The present generation, especially the children and youth are the two most significant actors that can prevent the total loss of biodiversity and natural resources (Morar and Peterlicean, 2012). Educating them at an early age can help improve their perspective and be fighters for biodiversity through active involvement in conservation and protection of natural resources (Šorytė and Pakalniškienė, 2019). A crucial weapon in the battle against threats to biodiversity is education, particularly biodiversity literacy. Raising awareness of the social and environmental value of biodiversity, providing education on the concept of biodiversity, and promoting the ability to act may lead to active and responsible citizenship (Schneiderhan-Opel and Bogner, 2020).

Education has been recognized as an essential tool for achieving sustainability and protecting biodiversity by transforming human attitudes towards nature (Ehrlich and Pringle, 2008; Dheer and Chauhan, 2023). It further depends on communication, education and awareness strategies to ensure that "everyone understands the value of biodiversity and what steps they can take to protect it, including changes in personal consumption and behaviour" (SCBD, 2010; Coracero et al., 2021). Environmental education, biodiversity should, not be limited to certain scientific aspects. Values of biodiversity, i.e. economic, aesthetic and ethical ones, should be taken into account as well. In other words, not only one, but many biodiversity concepts and corresponding values and meanings

should be treated in environmental education (van Weelie and Wals, 2002).

In the Philippines, environmental education was legalized into Republic Act No. 9512 in 2008 which was known as the "National Environmental Awareness and Education Act of 2008." This law integrated environmental education at all private and public-school levels including day care centers, elementary, high schools, tertiary (technical vocational and professional), and indigenous and out of school learning systems. In the said law environmental education encompass environmental concepts and principles, environmental laws, the state of international and local environment, local environmental best practices, the threats of environmental degradation and its impact on human well-being, the responsibility of the citizenry to the environment and the value of conservation, protection and rehabilitation of natural resources and the environment in the context of sustainable development (Official Gazette, 2008).

In response to the mandate of Republic Act No. 9512, the public administration program in Higher Education Institutions (HEIs) included the subject Environmental Management in its curriculum. Higher education ensures that the next generation of decisionmakers will be able to respond to global societal and environmental needs. Increasing pressure on educational institutions in recent years has led to a broadening of the focus from the traditional model of teaching and research to a broader contribution to society. In this sense, education has excellent opportunities to contribute by helping citizens to become well-informed, critical and competent and consequently able to act in favor of biodiversity (Dunn, Dalgleish, and Lawrence, 2006).

One of the main environmental aspects of services of public administration is biodiversity protection and restoration. The engagement of the public sector in driving our society towards sustainability is absolutely key. On the one hand, public administration taking a leading role show the way, demonstrate what is possible and stimulate others to follow. It also has a very large direct or indirect influence over activities with significant environmental impact. At the local level, municipalities and local authorities are responsible for activities ranging from land use planning to waste water treatment or local transport and mobility (Canfora et al., 2019).

This research was conducted to examine the biodiversity literacy levels of public administration students that will compose the twenty-first century workforce who must be literate in the context of biodiversity literacy in order to help our society effectively respond to novel diseases, improve resiliency and adaptation to climate change and maintain a healthy planet. Therefore, it is important to

disclose the biodiversity literacy levels of the young generations. Examining the public administration students' biodiversity literacy levels constitutes the main starting point of this research.

OBJECTIVES OF THE STUDY

The study aimed to determine the biodiversity literacy mean scores of the student participants from the public administration department. It also sought to; (a) ascertain the statistically significant difference between the student participants' biodiversity literacy levels based on gender variables, according to students' views of the understanding of environmental problems in comparison to their peers; (b) ascertain the significant differences among the student participants' biodiversity literacy levels according to students' views of the understanding of environmental problems in comparison to their peers; and (c) ascertain the statistically significant relationships between the cognitive outcome domain (BK-Biodiversity Knowledge), the affective outcomes domain conservation and importance of biodiversity (CIB), ethics and biodiversity (EB), sustainability and biodiversity (SB), taking action to protect biodiversity (TAPB), biodiversity and utility (BU), and conservation and importance of species (CIS).

MATERIALS AND METHODS

Research Design

The survey, one of the quantitative research designs, was used in this study. The survey method examines individuals, groups, institutions, methods, and materials in order to identify, compare, contrast, classify, analyze and interpret the entities and events that make up the different dimensions of the research (Cohen, Manion, & Morrison, 2018).

Participants of the Study

The sample of the study consisted of 145 graduating students in the Bachelors of Public Administration program who voluntarily agreed to participate in the research. In the study, the participants were determined by using the purposive random sampling from the population.

Instruments

In the research, the "Biodiversity Literacy Assessment Instrument" developed

by the Wisconsin Environmental Education Centre financed by the World Wildlife Fund (WWF) in 1996 was used as the data collection tool. The scale was adapted to the Turkish language by the researchers. The instrument consists of three parts: demographic information, attitude scale items, and a multiple-choice test. The attitude scale is a 4-point Likert type.

The "Biodiversity Literacy Assessment Instrument" used in the study consists of 6 dimensions and 27 items. The scale has 5 items in "conservation and importance of biodiversity (CIB)", 5 items in "ethics and biodiversity (EB)", 3 items in "sustainability and biodiversity (SB)", 4 items in "taking action to protect biodiversity (TAPB)", 4 items in "biodiversity and utility (BU)" and 6 items in "conservation and importance of species (CIS)" dimension.

The Cronbach alpha coefficient of the scale used in the study was calculated as .726 for the CIB dimension, .764 for the EB dimension, .706 for the SB dimension, .704 for the TAPB dimension, .710 for the BU dimension, .852 for the CIS dimension and .892 for the entire scale.

The multiple-choice part of the scale consists of 30 questions that measure the level of biodiversity knowledge. The Spearman-Brown test was used to determine the value of multiple-choice questions. The reliability value was calculated as .822 for the whole test.

Data Analysis Techniques

SPSS 28 was used to analyze the data collected for the study. Independent t-test was used to compare gender scores while one-way ANOVA was used to compare students' understanding on problems related to biodiversity. Tukey HSD test was used to determine the direction of significance in multiple comparisons. Pearson Correlation was used to measure the statistical relationship between cognitive outcome and affective outcome domain. Means for the items were calculated. The intervals used to interpret the means for the scale used in the research are given below.

Completely agree	3.25-4.00	very significant
Agree	2.50-3.24	significant
Disagree	1.75-2.49	less significant
Completely disagree	1.00-1.74	not significant

RESULTS AND DISCUSSION

1. To determine the biodiversity literacy mean scores of public administration students.

Table 1

Participant students' mean scores for the scale items

Dimension	Item	Mean
CIB	A plant or animal can be important just because it is interesting to watch.	3.24
CIB	If I wanted to, I could help get a law passed to protect plants and animals.	3.55
CIB	I could convince my classmates to protect plants and animals.	3.55
CIB	If I do things like planting trees and putting up nesting boxes, this can help animals that are in danger of becoming threatened or extinct.	3.52
CIB	The things I do every day show how I protect the environment.	3.34
SB	I think it is my responsibility to let people know how the things they buy can affect the environment.	3.43
SB	It is my responsibility to try to get my school to do things like recycle and use less paper.	3.45
SB	I think that it's my responsibility to help protect species.	3.43
TAPB	We should limit the use of bicycles, boats, and other vehicles if they harm the environment.	3.26
TAPB	I believe that my friends need to make changes in their lives to protect the environment.	3.42
TAPB	I think that people like scientists and engineers can solve most of the world's environmental problems.	2.93
TAPB	Most people I know should change how they live to help solve environmental problems.	3.29
EB	An important reason for studying about the diversity of plants, animals, and ecosystems is because I want to know what I can do to help protect them.	3.51
EB	An important reason for studying about the diversity of plants, animals, and ecosystems is because there are many interesting jobs relating to these things.	3.37
EB	An important reason for studying about the diversity of plants, animals, and ecosystems is because some of the species may be gone by the time I am an adult.	3.29
EB	An important reason for studying about the diversity of plants, animals, and ecosystems is because we use many species for food and medicine.	3.18
EB	An important reason for studying about the diversity of plants, animals, and ecosystems is because my future, as well as future generations, depend on healthy ecosystems.	3.55
BU	How important do you think the protection of biodiversity should be for scientists?	3.60
BU	How important do you think the protection of biodiversity should be for individual my age?	3.53
BU	How important do you think the protection of biodiversity should be for people who live in Africa?	3.42
BU	How important do you think the protection of biodiversity should be for people who live in the country?	3.61
CIS	How important do you think is to protect hummingbirds?	3.65
CIS	How important do you think is to protect frogs?	3.56
CIS	How important do you think is to protect worms?	3.55
CIS	How important do you think is to protect vultures?	3.46
CIS	How important do you think is to protect fungi?	3.14
CIS	How important do you think is to protect bats?	3.31

The participants' mean scores to all of the items in EB and BU were found to be at the very significant level. While on the other dimensions, CIB, EB and CIS there were some items that were on agree level but its overall mean score belongs to completely agree or very significant level. On average, only TAPB has the dimension whose overall mean score belongs to significant level. In CIB, only the first item relating to the importance of plants or animals because it is interesting to watch was at significant level. For TAPB, the participants' view about scientists and engineers as solvers of the world's environmental problems was on significant level. One of the items in EB which is the only one at significant level was on the importance of studying diversity because it is used for food and medicine. This result depicts that the participants have a high level of understanding and knowledge about biodiversity.

The participant students' mean scores for their responses to majority of the items in the conservation and importance of biodiversity (CIB), sustainability and biodiversity (SB), taking action to protect biodiversity (TAPB) and ethics and biodiversity (EB), dimensions were at the level of "strongly agree" while biodiversity and utility (BU) and conservation and importance of species (CIS) dimensions were at the level of "very important", as shown in Table 2. There are specific items in the four dimensions such as item 1 for CIB, item 3 for TAPB, item 4 for EB wherein the mean scores of their responses were at the level of "agree", and item 5 for CIS the mean scores of their responses were at the level of "important". Items in all the dimensions were very significant except 1 for CIB, item 3 for TAPB, item 4 for EB which are significant, based on the interpretation of the scores for assessment.

The result supports the conclusion of several studies that people have poor recognition and comprehension of the term 'biodiversity' (Fischer and Young, 2007; Lindemann-Matthies and Bose, 2008; Turner-Erfort, 1997). For instance, when over 6000 visitors to zoos and aquariums worldwide were surveyed, it appeared that 30% was not even aware that biodiversity was related to biological issues (Moss et al., 2014).

On ethics and biodiversity, the participants assessment on important reasons for studying about the diversity of plants, animals, and ecosystems because many species are used for food and medicine is significant only. The data shows that comprehension of biodiversity and issues related to it needs support of species literacy. Species knowledge is fundamental to understanding the relationships between species and the environment (Magntorn and Helldén, 2006; Somaweera et al., 2010) it can stimulate people's interest, in biodiversity but also the environment and sustainability (Palmberg et al., 2015).Getting to know species may help foster a connection with the environment (Allison et al., 2013; Cox and Gaston, 2015) and species can

provide people with a 'sense of place and belonging', indicating that species add to the authenticity of localities and can contribute to the attachment of people to their living environment (Horwitz et al., 2001; Standish et al., 2013).

Under conservation and importance of species, the research revealed that the participants find the importance of protecting fungi as important only in the conservation and importance of species, this implies that the students learning on the role of fungi in biodiversity is just significant. There is a need to further enhance their knowledge on fungi as an important part of soil biodiversity (Frąc et al., 2015). They have to be aware that life on the planet wouldn't exist without fungi as espoused by Greg Mueller, a mushroom conservation expert and the chief scientist at the Chicago Botanic Garden. Which is supported by another scientist, Money, which says, conserving fungi "is an urgent concern because of their relationship with forests and trees. You can't have the trees without the fungi. We cannot survive without them. In terms of the health of the planet, they're incredibly important." Not only are fungi crucial partners for trees, as Money says, they affect the climate of the whole planet (Gibbens, 2021).

2. To determine the significant difference between the student participants' biodiversity literacy levels based on gender variables.

Table 2

Comparison of participants biodiversity literacy levels based on gender

Dimension	Variable	N	Mean	SD	df	t	p
CIB	Female	79	3.4532	0.3812	117	0.436	0.664
	Male	40	3.4200	0.4121			
EB	Female	79	3.3696	0.4065	117	-0.315	0.753
	Male	40	3.3950	0.4308			
SB	Female	79	3.443	0.4766	117	0.284	0.777
	Male	40	3.4167	0.4819			
TAPB	Female	79	3.2247	0.4486	117	-0.075	0.941
	Male	40	3.2313	0.4613			
BU	Female	79	3.5538	0.4559	117	0.545	0.587
	Male	40	3.5063	0.4367			
CIS	Female	79	3.4135	0.6542	117	-0.812	0.419
	Male	40	3.5125	0.5741			
BK	Female	79	9.2658	3.2293	117	-1.261	0.21
	Male	40	10.2000	4.7782			

The biodiversity literacy in all the six dimensions did not reveal any statistically significant result between the mean scores of male and female. It could not be

assumed whether whose more concerned with the environmental knowledge level according to participants' gender. But the table shows that the there is no dominant gender that has the higher mean scores in all the dimensions. In CIB, SB and BU the female has the higher mean scores and on EB, TAPB, CIS and BK the male have the higher mean scores.

This research question investigating whether gender was an affective variable in students' approaches to biodiversity revealed that there is no significant difference on the participants biodiversity literacy level between male and female. This is in line with the findings of Turan and Common, (2014) and Özbaş (2016) that reported there is no significant difference between students' biodiversity knowledge levels according to the gender variable. Further, Uç and Gül (2021), in their study in which they examined the level of attitude towards biodiversity of undergraduate students, point out that attitudes towards reducing biodiversity and preventing biodiversity do not differ significantly according to the gender variable. In the same vain, Akkaya and Benzer (2019) examined the biodiversity literacy levels of pre-service teachers and concluded that the biodiversity literacy levels of female and male students were similar. In similar situation, the study of Chandrasekar, Sundavadivelan, and Selvan (2012) revealed that the biodiversity awareness of female and male students studying at the high school level is similar in the Vilathikulam region. Nunes and Clorez (2017), in their study examining the environmental literacy of high school students, found that the environmental knowledge levels of female students were higher than that of male students, although it was not significant.

It is reported that females consider environmental aspects to be more important (Wallhagen, Eriksson, & Sörqvist, 2018). Zhang et al. (2014) discovered that females are more connected to nature and appreciate the beauty of nature more. Females are more concerned about environmental problems and report to take voluntary behavior to address these problems more often (Bord and O'Connor, 1997). In addition, females are more engaged in environmental issues and have a more environmental stance (Stern, Dietz, & Kalof, 1999). A number of studies showed that females usually have stronger environmental attitudes than males (Oerke and Bogner, 2010; Fremerey and Bogner, 2015) and a cross-national examination of 22 countries found that in 14 countries females showed significantly higher environmental behavior than males (Hunter et al., 2004). Therefore, gender is a strong predictor for environmental behavior and attitude and females report stronger environmental attitudes and behavior (Zelesny et al., 2000). Vicente-Molina et al. (2013) go one-step further and declare that being a male is a factor that decreases the probability of high environmental behavior.

3. To ascertain the significant differences among the student participants' biodiversity literacy levels according to students' views of the understanding of environmental problems in comparison to their peers.

Table 3

Comparison of participant biodiversity literacy levels based on the understanding of environmental problems in comparison to their peers

		N	Mean	SD	F	Sig.
CIB	above average	35	3.6000	0.3911	6.921	0.001*
	average	82	3.3902	0.3650		
	below average	2	2.8000	0.2828		
	Total	119	3.4420	0.3905		
EB	above average	35	3.5200	0.3856	6.596	0.002*
	average	82	3.3366	0.4011		
	below average	2	2.6000	0.0000		
	Total	119	3.3782	0.4132		
SB	above average	35	3.5714	0.4684	4.598	0.012*
	average	82	3.3943	0.4600		
	below average	2	2.6667	0.4714		
	Total	119	3.4342	0.4765		
TAPB	above average	35	3.3429	0.5324	2.144	0.122
	average	82	3.1860	0.4079		
	below average	2	2.8750	0.1768		
	Total	119	3.2269	0.4510		
BU	above average	35	3.6714	0.3965	5.296	0.006*
	average	82	3.5000	0.4479		
	below average	2	2.7500	0.3536		
	Total	119	3.5378	0.4482		
CIS	above average	35	3.5952	0.5890	2.812	0.064
	average	82	3.4024	0.6318		
	below average	2	2.6667	0.4714		
	Total	119	3.4468	0.6277		
BK	above average	35	9.5429	3.0326	0.669	0.514
	average	82	9.6707	4.1308		
	below average	2	6.5000	3.5355		
	Total	119	9.5798	3.8256		

This research question investigated the participants' biodiversity literacy scores based on their understanding of environmental issues. The results show that there is a statistically significant difference in the participants' responses in CIB, EB, SB and BU according to students' views of the understanding of environmental problems in comparison to their peers. The students belonging to "average" and "above average" has significantly higher mean scores than those of "below average" students. It could be concluded that understanding the depth of environmental problems relates to the knowledge about how biodiversity can be protected given its importance and how destruction can be exterminated.

Curriculums in the Public Administration program includes environmental management of which topics on biodiversity are being made part of the discussion. The average result is affected by the literacy of the participants. According to Wardani et al. (2018), the student's environmental literacy (EL) is a vital component to improve the students' awareness on environmental issues in comparison to their peers.

TAPB and CIS dimensions results showed no significant difference on the participants understanding of environmental issues in comparison to their peers. The participants literacy on taking action to protect biodiversity and on conservation and importance of species did not differ. It is not surprising to see the average mean score because education played an important role in addressing the complexity of environmental issues (Orlins and Guan, 2016; Jickling and Wals, 2008). Further, environmental education is considered an effort to manage the environment through a formal approach by providing insight knowledge to students (Carleton-hug and Hug, 2010). Also, environmental education is a commitment of the international government and community and implemented through the school curriculum, it attempts to involve learners in imparting knowledge to change beliefs, attitudes and behaviors towards the environment (Frantz and Mayer, 2014).

The implementation of environmental education integrates EL on it, so that the students understand the environmental and natural relationships with human being (Locke and Russo, 2013). EL is the ability to care for the environment and ability to solve environmental problems (Pe'er, Goldman & Yavetz, 2007; 2009). One of the ultimate goals of environmental education is to increase students' Environmental Literacy (Srbinovski, Erdogan, & Ismaili, 2010).

4. To ascertain the significant relationships between the cognitive outcome domain (BK-Biodiversity Knowledge) and the affective outcomes domain (CIB, EB, SB, TAPB, BU, CIS).

Table 4

Significant relationships between the cognitive outcome domain (BK-Biodiversity Knowledge) and the affective outcomes domain (CIB, EB, SB, TAPB, BU, CIS)

Dimension	N	r	Relationship	p
BK and CIB	119	-0.03	Very weak negative	0.700
BK and EB	119	0.04	Very weak positive	0.655
BK and SB	119	0.01	Very weak positive	0.892
BK and TAPB	119	-0.09	Very weak negative	0.342
BK and BU	119	0.18	Very weak positive	0.054
BK and CIS	119	0.20	Weak positive	0.031*

Based on the results, it depicts that only BK and CIS have a statistically significant relationship. The association between these two dimensions was linearly positive which means that as biodiversity literacy level in BK increases the mean score in CIS also increases. Other dimensions do not possess a dominant direction about its relationship but these were not considered as statistically significant. Some of these dimensions have positive relationship but pairing BK to CIB and BK to TAPB revealed negative relationship. This is supported by the study of Hartel et al. (2023), which posits that species knowledge is a possible starting point when it comes to creating deeper knowledge and awareness of nature, the environment, and biodiversity.

CONCLUSIONS

The results show that the participants have a high level of understanding and knowledge about biodiversity which established the relevance of teaching species knowledge in environmental education for sustainable development, in order not to promote decreasing biodiversity through dwindling species knowledge. Further, it could not be assumed whether whose more concerned with the environmental knowledge level according to participants' gender. There is no dominant gender that has the higher mean scores in all the dimensions. It could also be concluded that understanding the depth of environmental

problems relates to the knowledge about how biodiversity can be protected given its importance and how destruction can be exterminated.

RECOMMENDATIONS

Based on the findings, the following are recommended for the Higher Education Institution:

1. Provide environmental education on the concept of biodiversity, and promote the ability to act for active and responsible citizenship to raise consciousness of the social and environmental cost of biodiversity;

2. Develop biodiversity literacy initiatives at the university level to generate a better appreciation, involvement, and the optimistic ideas necessary to contribute to the quality of our environment; and

3. Introduce biodiversity education in higher education institutions that would guide learners into understanding and analyzing biodiversity's different meanings and dimensions that would enable the students to develop critical thinking skills about biodiversity and its protection.

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