



# Students' Knowledge, Awareness, and Pro-Environmental Behavior in Urban to Design Climate Change Book Serials

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## ABSTRACT

**Background and objective:** Problems currently occurred in the environment are caused by a lack of environmental awareness of the community. Biology students learn the environment in ecological learning. Students must explore environmental knowledge (EK) and are expected to have high environmental awareness (EA) and then apply their knowledge in daily life with pro-environmental behavior (PEB). There is a need for designing climate-change book serials for university students (CCBS-US) towards contextualized learning. This study aimed to determine the relationship between EK and EA and the PEB of biology students as a baseline for designing CCBS-US.

**Methods:** The study used a quantitative descriptive method with a correlational design. Total 136 biology students from a state university in Jakarta, Indonesia served as samples of the study.

**Results:** Research results revealed a positive relationship between EK and PEB of biology students. There was a positive relationship between EA and PEB of biology students and between EK and EA and PEB of Biology students. Moreover, 77% of students reported their EK is very high, 55% of students reported their EA is medium, and 46% of students reported their PEB is medium. Ecological learning has a vital role in shaping the EK, EA, and PEB, thus CCBS-US needs to be developed.

**Conclusion:** The study concluded that there was a relationship between EK, EA, and PEB. The study recommends the development of CCBS-US based on the survey results.

**Keywords:** biology students, climate change, ecological learning

## Introduction

Natural resources in the urban community are very important to support their life. The increase in need is related to the need for clothing, food, shelter, and so forth. The needs are obtained through natural resources exploitation; therefore, the need fulfillment process both directly and indirectly raises environmental pollution problems (Bronfman et al., 2015; Kanchanabhandhu and Woraphong, 2016). One of the efforts to overcome these problems is by properly regulating and managing the envi-

ronment through environmental preservation by the community including students. The community's lack of knowledge about the environment, however, results in environmental damage that threatens sustainable life (Bronfman et al., 2015; Goldman et al., 2017).

Environmental Knowledge (EK) is a basic skill to understand various environmental concepts to be implemented in daily life (Kim and Stepchenkova, 2019). Knowledge is a cognitive domain that is very important in shaping human actions through experiences (Chang et al., 2018). Someone with environmental

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problem knowledge will tend to behave pro-environmental behavior (PEB) because EK can raise concerns and awareness. EK is also able to change one's lifestyle and behavior into a sustainable society (Polonsky et al., 2012). It becomes a basis for analyzing and solving various existing environmental problems in the neighborhood. The EK skill will be developed into another higher skill, which is Higher Order Thinking Skills to solve problems (Ichsan et al., 2020; Purwanto et al., 2020; Rahmayanti et al., 2020).

Problems occurred in the environment also cause by a lack of public awareness of the environment. Therefore, various parties need to have the awareness to prevent worse natural damage together. Environmental Awareness (EA) is the soul's awakened state of something, in this case, the environment, and can be seen in the behavior and actions of each individual (Thorburn, 2018). EA is very important for every individual to continue to be able to preserve the environment. Someone with high EA will be more concerned about the environment so that he/she will consider and analyze his/her behavior towards the environment and will form a harmonious and balanced life between all living things.

Pro-environmental behavior (PEB) is an effort to reduce negative impacts that affect the environment and is operationalized as everyday behavior concerning environmental preservation (Tang et al., 2017). PEB is shown by such activities as using recyclable materials, saving energy, using environmentally-friendly transportation, buying and using environmentally-friendly products, carrying out tree planting actions, and joining environmental organizations, especially for urbanites (Truelove and Gillis, 2018). PEB cannot be observed directly; therefore, respondents must perform self-evaluation regarding PEB carried out at a certain time. In addition, they must be provided with a questionnaire containing their routine in performing those activities. Results from the questionnaire calculation can be used as a basis to identify one's PEB level (Masud et al., 2013). PEB measurement is carried out in both positive tendency behavior and negative tendency behavior; for example, the use of plastic bags despite a policy of banning plastic bag utilization. Students, in this case, have a specific responsibility to maintain the environment, as they are role models for their surrounding communities. Students are also an intellectual group that could encourage various groups in the communities to play roles in

overcoming environmental problems (Amaral and Santos, 2018; Ichsan et al., 2020; Sigit et al., 2020). It particularly prevails for students who study Biology science. This is because they learn about living things with discussion focus on their interaction with their environment (Azrai et al., 2019).

Biology students explore the knowledge related to living things and their environment in ecological learning. They are expected to have a high awareness of the environment; with the awareness, a person will be more attentive to the causes of environmental problems and PEB. Creating EA among the people especially students who act as agents of change is the best way because they are future leaders, planners, policymakers, and environmental educators (Raman, 2017; Shamuganathan and Karpudewan, 2015). Therefore, Biology students are expected to be able to apply their knowledge in daily life, which is PEB, and to socialize in the community. Ecological learning has a role to shape students' behaviors. Ecological learning in this case can be developed with various innovations related to climate change as the latest issue. One of them is a climate change book serial for university students (CCBS-US) as a supplement book. This supplementary book can improve student's knowledge about the environment (Ichsan et al., 2020). The CCBS-US book serials are an innovation that can be developed for university level. It is suitable to the needs for book serials containing various climate change-related materials. The CCBS-US can serve as a supplement book used by lecturers to complement a variety of teaching materials related to the environmental topics. In turn, CCBS can play a role in improving students' EK and affects the EA and PEB. Thus, it is necessary to develop CCBS-US. This CCBS-US book will later be adopted for use by students in the Jakarta area. The book series will be used in several courses at the university level, such as ecology, science learning, and environmental education. This book will be registered in copyright and published by the university. The number of books that will be used is 10 books for each semester for the printed series. This book is also available in an e-book version to make it easier for students who do not get the printed version.

Prior to the development of the CCBS-US book, based on several research results it was found that EK greatly influences various aspects of ecological learning (Kinslow et al., 2018). In addition, many studies show that EA and EK are

aspects that are the focus to be deeply studied (Cheung et al., 2015; Thorburn, 2018). Research on PEB indicated a lot of PEB profiles and their influencing factors (Watson et al., 2017). Based on this, the novelty formed in this study is a descriptive profile and relation between EEK, EA, and PEB in biology education students. Therefore, this study aimed to determine the relationship between EK and EA and the PEB of Biology Students for designing CCBS-US.

## Research Methods

This research used a descriptive method with correlational studies. The study used three variables, namely environmental knowledge (X1) and environmental awareness (X2) as independent variables, and pro-environmental behavior as a dependent variable (Y). EK and EA could be a continuous variable since students' EK and EA measurements will not end in this research. They can be re-measured in terms of their improvement or reduction. The study's population included students of the Biology Education program of a state university in Jakarta. Data collection was carried out in December 2020- February 2021 at the Biology Education Study Program, Jakarta State University (*Universitas Negeri Jakarta*). The total respondent were 150 students, included 14 students not suitable to be a sample. The sample was 136 students in the 7th and 5th semesters and was selected by simple random sampling. This sample was chosen from the Jakarta area because students living in the Jakarta area are part of urban communities who need more education related to the environment. The selected sample is biology education students because biology education students will later become teachers and teach at the secondary school level, so they must be provided with good knowledge, attitudes, and environmental behavior. In the study, data collection techniques were obtained through the provision of EK tests and non-test instruments to determine EA and PEB in Biology students. EK test instruments consisted of multiple-choice with five answer choices and open-ended questions. Each correct answer in the multiple-choice item received 1 point while the incorrect answer received 0 points. Each open-ended question had a maximum value of 4, while questions that did not have answers got 0 (zero). EA instrument in this study

was a questionnaire using a measuring instrument developed by Partanen- Hertell et al., (1999). A Likert scale was employed consisting of 5 options with a score of 1 - 5 for positive statements: Strongly Agree, Agree, Hesitate, Disagree, and Strongly Disagree. The reverse scoring was used for the negative statement items. PEB questionnaire used in the study was measured by a Likert scale consisting of 5 options with a score of 1 - 5. For positive statement items, the options were always, often, sometimes, rarely, and never. The reverse scoring was used for negative statement.

Prior to the distribution of the three measuring instruments to the research subjects, a pilot test was conducted on 35 students of the Biology Education Program, Jakarta State University. The measuring instruments were first tested to acquire valid and reliable instruments. EK instrument that consisted of 22 multiple choices and 4 open-ended questions was valid. EA instrument that consisted of 23 questions was valid. PEB instruments that comprised 28 questions were valid. The valid questions were from the indicators such as understand the relationship between humans and the environment (EK), take action on the use of transportation (EA), and minimize the use of goods that cause waste (PEB). Once the data had been checked and scored, the analysis continued using the SPSS version 24 for the Windows program. The correlation analysis results of the three variables will be taken into consideration for designing CCBS-US. The analyzed data were then entered into several categories started from very high, high, medium, low, and very low as stated by Sigit et al. (2020) in Table 1.

**Table 1.** EK, EA, and PEB score categories according to the score interval

Category	Interval score
Very high	$X > 81.28$
High	$70.64 < X \leq 81.28$
Medium	$49.36 < X \leq 70.64$
Low	$38.72 < X \leq 49.36$
Very low	$X \leq 38.72$

## Results and Discussion

Based on the results of EK, the descriptive data indicated that none of the students (0%) was in the very low and low criteria, medium criteria of three students (2%), high criteria of 28 students (21%), and very high criteria of 105 students (77%). Details of the score are presented in Table 2.

Based on the EA results, it could be seen that students within very low and low criteria were zero (0%), medium criteria were 74 students (55%), high criteria were 59 students (43%), and very high criteria amounted to three students (2%). The detail of the EA score category can be seen in Table 3.

There were four criteria for the value of pro-environmental behavior, 33 students were in a low category (24%), medium criteria with 63 students (46%), high criteria with 39 students (29%), and 1 student at very high criteria (1%). Details of the PEB score can be seen in Table 4.

Descriptive data are also presented in the form of each indicator on EK, EA, and PEB. The results show that the EK score was the highest in the metacognitive thinking indicator. Meanwhile, the highest score for EA was found in the first indicator, which was "have concern for environmental problems". Then at the PEB, the indicator of "efficient use of energy" was the indicator with the highest score. More details can be seen in Table 5. The table contains a detailed description of EK, EA, and PEB average scores derived for each measured indicator. It aimed to facilitate data description for each indicator to identify the highest indicator.

### Relationship between EK and PEB

The results of the first hypothesis indicated that there was a positive and significant relationship between EK and students' PEB. The relationship was illustrated from the correlation coefficient obtained at 0.511 (Table 6). This was due to knowledge possessed by someone is useful for him/her to help solve the life problems he/she faces. Knowledge is a cognitive domain that is very important in shaping human actions through experiences; hence, EK plays a role in shaping PEB. EK plays an important role in strengthening the relationship of environmental behavior by providing support to enhance views and arguments that promote their

beliefs and behavior towards the environment (Asilsoy et al., 2017; Geiger et al., 2014). EK and PEB are highly interrelated, they are mutually reinforcing, especially in the search for information on issues relating to the environment, particularly regarding EK (Choe et al., 2019; Panno et al., 2017). Someone who is cognitively aware but unable to behave because they, themselves, are not trained to do good or continuous actions (Bissinger and Bogner, 2018).

### Relationship between EA and PEB

Based on the results of the second hypothesis it showed that the correlation coefficient obtained was 0.470 indicating the relationship between EA and PEB was in the sufficient criteria (Table 6). This was due to awareness encourages a person to be able to take actions that serve as positive or negative movements towards the achievement of goals. Awareness is a condition where individuals have full control over in-

**Table 2.** Environmental knowledge category and score

No	Category	Percentage	Total student
1	Very high	77%	105
2	High	21%	28
3	Medium	2%	3
4	Low	0%	0
5	Very low	0%	0

**Table 3.** Environmental awareness category and score

No	Category	Percentage	Total student
1	Very high	2%	3
2	High	43%	59
3	Medium	55%	74
4	Low	0%	0
5	Very low	0%	0

**Table 4.** Pro-environmental behavior category and score

No	Category	Percentage	Total student
1	Very high	1%	1
2	High	29%	39
3	Medium	46%	63
4	Low	24%	33
5	Very low	0%	0

**Table 5.** EK, EA, and PEB scores based on each indicator

Environmental knowledge (EK)		
No	Indicators	Average score
1	Understand the relationship between humans and the environment	0.68
2	Analyze existing environmental problems	0.57
3	Understand the conservation of natural resources and ecosystems	0.66
4	Know about alternative environmental management (preservation and utilization)	0.68
5	Metacognitive thinking*	3.07
Environmental awareness (EA)		
No	Indicators	Average Score
1	Have concern for environmental problems	3.89
2	Have an understanding of students contribution to the environment	3.66
3	Understand the responsibility for the actions in the environment	3.07
4	Willingness to act	3.10
5	Have information about the possibility of procurement of environmental activities	3.54
6	Have information about environmental problems	2.98
7	Take action on the use of transportation	2.94
8	Keep environment in the house	3.27
9	Do something for the environment in campus	3.04
Pro-Environmental behavior (PEB)		
No	Indicators	Average Score
1	Efficient use of energy	3.50
2	Pro-environment mobility of used transportation	3.33
3	Minimize the use of goods that cause waste	2.94
4	Pay attention to environmentally friendly products in consumer behavior	2.90
5	Recycle recyclable items	2.86
6	Social behavior that reflects concern for the environment	2.83

Note: EK(score scale 0-1), EA (score scale 1-5), PEB (score scale 1-5)

\*Except metacognitive has scale from 0-4

ternal stimuli and external stimuli. A person's awareness of the environment depends on his ecological knowledge and also it determines his behavior which then causes him to have an obligation to act on the environment (Murzi et al., 2019).

### Relationship between EK, EA, and PEB

The results of the third hypothesis proved that EK and EA together have a relationship with PEB in the sufficient criteria. The result of the correlation coefficient was 0.586 indicating that the correlation relationship with the criteria is sufficient. The result of the coefficient of determination was 34%. This can be interpreted that EK and EA contribute

34% to the PEB of biology students, while 66% relate to other factors (Table 6). This was due to the two elements, namely knowledge and awareness are factors that influence PEB. This suggests that EK and EA have an important role in PEB. PEB is influenced by various factors including external factors such as institutional factors, economic factors, and socio-cultural factors; and internal factors such as motivation, EK, individual judgment, attitudes, EA, emotional

**Table 6.** Correlation coefficient of EK, EA, and PEB

Variable	Correlation coefficient	Category
EK and PEB	0.511	Significant
EA and PEB	0.470	Significant
EK, EA, and PEB	0.586	Significant



involvement, locus, control, care, and priorities (Ting and Cheng, 2017). EK and EA are part of the factors that influence PEB. Previous studies have found a relationship between higher EA and the purchase of environmentally friendly products, which is more likely where individuals have stronger pro-environmental beliefs (Gadenne et al., 2011). EK will encourage someone to be more sensitive to problems that occur in his/her surroundings, such as environmental problems. One of these problems requires knowledge and awareness to create a harmonious and balanced environment.

### Ecological learning for EK, EA, and PEB

Ecological learning in the biology education program becomes important for Biology Education Students (Bustami et al., 2018; Istiana and Awaludin, 2018). Biology education students become biology teacher candidates in middle schools and must explain the importance of the environment in their class. This is due to ecological learning that teaches students to understand various environmental concepts starting from the importance of protecting ecosystems, maintaining the environmental balance to preventing pollution. These are parts of ecological learning that can improve EK. After that, students must implement the knowledge. Not all students who are taught about environmental concepts, however, have a high EA and PEB (Sigit et al., 2020). It is related to the difficulty of implementing EA and PEB in the environment they live in. Many students have no choices. For example, they have no choice but to use private vehicles to go to campus since the existing public transportations have not yet reached all regions. This has become one of the obstacles in the formation of students' PEB. The low EK, EA, and PEB cause difficulties to implement various environmental concepts learned by the students. As a consequence, the environment becomes more deteriorate and it affects climate change.

Nevertheless, it does not mean ecological learning is unnecessary. It seems that there must be a change in learning strategies undertaken in ecological learning. An effectively designed education-based strategy can bring positive results in students' PEB. The strategy provides four insightful components in terms of PEB: (a) the trip itself, (b) tour guides and lecturers, (c) connecting theories to practice, and (d)

transformation of behavior to promote PEB (Ting and Cheng, 2017). Changes in strategies are doable, for example by changing strategies into project-based learning. Students can start getting used to bringing their water bottles to campus. Besides, activities to recycle waste can be done to reduce environmental pollution around the campus. The use of project-based learning strategies has an impact on the behavior of students who become more active, so it is expected that they bring the behavior at home as a habit (Jewpanich and Piriyaawong, 2015). Ascertaining aspects that encourage pro-environmental behavior have become a crucial undertaking in anticipating imminent environmental needs and societal trends and in designing projects, educational activities, and regulations that meet society's environmental demands (Vicente-Molina et al., 2018).

### Climate change book serials

The results of the correlation measurement suggested a strong relationship between EK, EA, and PEB. This indicates that increasing student knowledge regarding current environmental issues will be related to their attitudes and behavior. Therefore, the latest environmental issues such as Climate change is urgent to be discussed in environmental learning at the university level (Bissinger and Bogner, 2018; Karpudewan et al., 2015). This is because students must have knowledge related to climate change issues. The goal is that students can become mobilizers and role models for other communities and promote environmental protection.

Efforts that can be made to support this are by designing and developing learning media for the university level. Innovation is needed to improve EK and PEB, one of which is the development of the Climate Change Book Serials for University Students (CCBS-US). This book is a book series that contains a collection of materials related to efforts to prevent the impact of climate change. This book is made in several series according to the needs of students who will be the user. The information presented in the book is also adjusted to the latest developments from various studies carried out related to climate change.

CCBS-US, in this case, can be used as a choice of teaching materials to understand various environmental problems. This type of contextual teaching material has a great impact on

the development of student knowledge related to current issues (Garcia, 2015; Ichsan and Rahmayanti, 2020; Imamura, 2017; Suharini et al., 2020). Contextual learning will facilitate students to implement various environmental concepts studied. This will certainly have an impact on society. In this case, CCBS-US must also be developed by paying attention to inputs from experts and observing the students' responses as the product users. The advantage of the CCBS-US is its form of book serials that specifically discuss climate change topics. Therefore, it will facilitate students in understanding various matters related to climate change. Lecturers must search for appropriate methods and strategies to teach various concepts of climate change through the CCBS-US. The strategies selected must simplify the students to understand its content; thus, it could improve their EK in climate change topics.

## Conclusion

Based on the results of research and discussion, it can be concluded that there is a positive relationship between EK and PEB of Biology students, between EA and PEB of biology students, and between EK and EA, and PEB of Biology students. Suggestion proposed to improve this research is that it is necessary to hold activities in study groups that can improve the ability of students in recycling activities to reduce waste by recycling recyclable items. Recommendations for future research include the development of the CCBS-US as a form of learning innovation in climate change and the measurement of other variables related to EK. The limitation of this research is that the sample used is only biology education students in the Jakarta area, so this research and learning media that will be developed may only be suitable for students with a background in the natural science program.

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