RESEARCH ARTICLE

# Knowledge of ecological concepts, environmental concern, and ecological behavior: A multiple correlation analysis

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Abstract: Environmental problems are a concern of society. Solving environmental problems requires knowledge of ecological concepts, environmental awareness, and students' ecological behavior. The research aims to determine the relationship between ecological concept knowledge and environmental concern with students' ecological behavior. The research method uses a descriptive method with a cross-sectional survey technique on 180 participants at SMA Negeri 1 Sungailiat, Bangka Regency. Statistical data analysis using regression analysis and multiple correlation. Based on the prerequisite test, it was obtained that the data were normally distributed, the data was homogeneous, there were no symptoms of multicollinearity, heteroscedasticity, or autocorrelation. The results showed a multiple correlation coefficient of r = 0.776 in the strong category. The conclusion of the study is that there is a positive relationship between knowledge of ecological concepts and environmental awareness together with ecological behavior. Achievement of high student ecological behavior requires knowledge of ecological concepts and concern for the good environment of students.

**Keywords**: ecological behavior; ecological concepts; environmental concern

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## Introduction

The environmental damage that has occurred to date has become one of the causes of environmental problems and threatens the survival of humans and other ecosystems. According to Iswari and Utomo (2017), the main factor causing environmental damage is human behavior that does not care about the environment. Various factors are indicated as triggers for environmental problems such as climate change (Blennow et al., 2012; Guo et al., 2015), changes in natural resources (Jacobs & Brown, 2014), changes in technology and development (Voulvoulis & Burgman, 2019), pollution (Wiessner et al., 2014; Dudani et al., 2017) and the most important factor is human activity (Li & Wu, 2019). Activities that humans do every day, such as riding motorbikes and industrial gas exhaust from factories, dominate the emergence of environmental pollution. This situation refers to the human ability to be responsible for efforts to manage and resolve environmental problems (Sadhu et al., 2018).

Apart from that, other environmental damage occurs more frequently from one year to the next (Alam, 2014). This condition is exacerbated by loss of biodiversity (Smeti et al., 2019) and water pollution (Liyanage & Yamada, 2017). This is supported by the statement (Jena &Behera, 2017) that environmental damage can increase natural disasters. Every year pollutant levels in the air are reported to increase (Gunawan et al., 2017). These environmental problems increasingly emphasize that the world needs improved ecological behavior.

Ecological behavior related to action that contributes to environmental preservation (Axelrod & Lehman, 1993). Examples of this behavior include recycling, energy and water conservation, political activism, consumerism, commitment to environmental organizations, and so on. The activities of an individual who

has ecological behavior are generally seen as a way of providing protection and trying to make every effort to pay attention to the environment. An individual's positive outlook in responding to the environment will form a desire to be able to behave positively towards the environment.

Solving environmental problems also requires knowledge and responsible behavior to maintain environmental quality (Martini et al., 2018). One effort that can be implemented to overcome environmental problems is by providing learning from an early age about the environment which can be implemented by teachers to their students. Cultivating positive character and values will influence the way of thinking, the way of acting, and behavior (Ramlino & Niron, 2020).

Efforts to create ecological behavior require conceptual knowledge about ecology that is obtained both independently and through the learning process in class. Knowledge of ecological concepts is related to the understanding of facts, concepts and relationships that are interrelated with the natural environment and ecosystem (Yusof et al., 2013). The impact produced by students who have this knowledge will be on the quality of the environment in the future. The role of students is very important in determining environmental management. The concept of ecology acts as a foundation of knowledge in order to form students who understand environmental sustainability. Research by Septian et al., (2016), several students reported that they did not have the desire to protect the environment from damage, for example students still often throw rubbish carelessly and leave lights on even though they are no longer in use. This shows simply that students' knowledge of ecological concepts is still low.

It is necessary to make an effort to increase students' knowledge of ecological concepts. Therefore, learning in schools must be designed to optimally empower students' knowledge of ecological concepts. Biology teachers must become essential agents as pioneers of environmentally insightful behavior campaigns by providing the values or norms or criteria contained in the concept of environmental insight (Guerranti et al., 2019; Schill et al., 2019). A biology teacher is considered to be knowledgeable about environmental issues (Li et al., 2019; Shi & Song, 2019; Wang et al., 2019) so that he has the opportunity to carry out environmental behavior campaigns to introduce students to environmental issues.

Apart from ecological behavior and knowledge of ecological concepts, another variable, namely environmental concern, must be an important variable in controlling environmental quality (Machin, 2014). Environmental concern is the main factor influencing environmental behavior (Pagiaslis & Krontalis, 2014). However, based on the environmental problems that have occurred to date, it indicates that people still have low concern for the environment. Environmental awareness is important for every individual because it will keep the environment in good condition so that it can be passed on to the next generation. By increasing their sense of environmental awareness, students will be encouraged to respect their environment and consciously preserve the environment, which in turn will have implications for students' concern for the environment. High knowledge of ecological concepts will ultimately produce students who have environmental awareness and ecological behavior.

Research related to pro-environmental behavior has been reported several times in previous studies (Meyer, 2015; Shafiei & Maleksaeidi, 2020; Sigit et al., 2019; Vicente-Molina et al., 2018). Several other studies also report findings related to student environmental awareness (Bergman, 2016; Cebrián& Junyent. 2015; Situmorang & Tarigan, 2018). On the other hand, studies that attempt to analyze the relationship between ecological knowledge, environmental concerns, and ecological behavior are still difficult to find. Based on the research background above, students' ecological behavior that used as one of determination on solving environmental problems suspected to have a correlation with knowledge of ecological concept and environmental concern. Therefore, the aimed of this study was to determine the correlation between knowledge of ecological concept and environmental concern with students' ecological behavior.

# Method

The research method used correlational descriptive method with cross-sectional survey technique. The cross-sectional survey technique is the research to learning a correlational dynamic between risk factors and the effects, with approach, observation or collecting the data at the period (point time approach). The research used three variables are a knowledge of ecological concepts as an independent variable (X1), an environmental concern as an independent variable (X2), and an ecological behavior as a dependent variable (Y). The research design shows on Figure 1.

## Population and samples

The sample and population selection used multistage random sampling technique with 180 students of SMA Negeri (Public High School) class XI in Bangka Belitung province. The selection of class XI used purposive sampling technique since the class have been learning the of ecological concept knowledge in Biology subject. Then, the sample was calculated using *McClave* formula with the Standard Error (SE) of 0.62 ≤ 2.00 shows that the sample were homogeny and representatively.

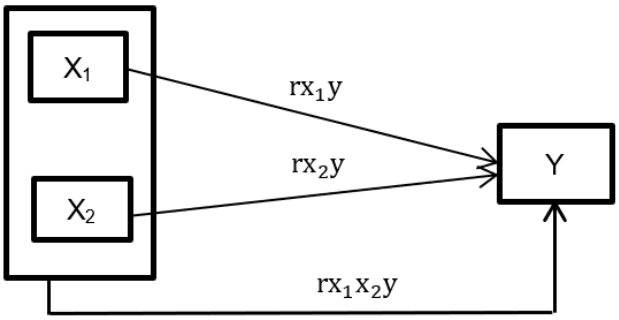


Figure 1. Research design in this study (Note: $X_1$ is a knowledge of ecological concepts, $X_2$ is an environmental concern, and Y is an ecological behavior)

## Instrument

The instrument in the research consists of three instruments such as a knowledge of ecological concepts instrument, environmental concern instrument, and ecological behavior instrument.

## Instrument of knowledge of ecological concepts

This instrument measured through an indicator of cognitive area dimension such as: 1) remembering, 2) understanding, 3) applying, 4) analyzing, 5) evaluating, and 6) creating and the level of knowledge such as: factual, conceptual, and procedural. The research instrument was the question form with multiple choices with a total of 50 items which had 5 answer choices. The assessment of the items was calculated through a dichotomous score. The instrument of knowledge of ecological concept validity in multiple choice type was calculated using *Point Biserial* formula. Based on the result of the instrument validity, it can be concluded that there were 35 from 50 items was valid and 15 from 50 items was not valid. The reliability test used *Kuder Richardson-20 (KR-20)* formula and the score of reliability coefficient was 0.87, the instrument was reliable.

## Instrument of environmental concern

This instrument measured through modification based on Cone and Hayes (1984) such as: 1) responsibility toward the environment, 2) attention toward environmental sanitation, 3) responses toward water savings, 4) responses toward household waste management, 5) attention toward energy convention, 6) respect toward the right of animals and plants life, and 7) utilize natural resource wisely. The instrument was the question statement form that made in *Likert* scale through 50 items which have 5 answer choices. The instrument scoring was 5 – 4 – 3 – 2 – 1 (always – often - sometimes – seldom - never). The validity item was calculated using *Pearson Product Moment* formula because polytomies was used in the scoring. Based on the result of the instrument validity, it can be concluded that there were 34 from 50 items was valid and 16 from 50 items was not valid. The reliability test used *Alpha Cronbach* formula and the score of reliability coefficient was 0.83 then the instrument was reliable.

## Instrument of ecological behavior

This instrument measured through modification based on Kaiser et al., (2003) such as: 1) recycle the material, 2) reduce plastic usage, 3) initiative to protect the environment, 4) saving energy and water usage, 5) using environmental friendly product, 6) social behavior towards conservation, and 7) environmental mobility and transportation friendly. The instrument was the statement form that made in *Likert* scale through 50 items which have 5 answer choices. The instrument scoring was 5 – 4 – 3 – 2 – 1 (always – often - sometimes – seldom - never). The validity item was calculated using *Pearson Product Moment* formula because polytomies was used in the scoring. Based on the result of the instrument validity, it can be concluded that there were 37 from 50 items was valid and 13 from 50 items was not valid. The reliability test used *Alpha Cronbach* formula and the score of reliability coefficient was 0.75 then the instrument was reliable.

## Procedure

The research procedure consisted of two steps, research preparation and research implementation step. The step of the research preparation that consist of drafting the instrument, test of validity, and test of

reliability toward the instrument. The next step was research implementation that consisted of data collecting, data analysis, and publication. The data collecting was conducted in SMA Negeri 1 Sungailiat with a total of 180 students. This research was conducted at class XI students on SMA Negeri 1 Sungailiat, Bangka Regency, Bangka Belitung province at semester II (second semester) in academic year 2022/2023.

### Data analysis techniques

The data analysis technique that used in the research includes the test of descriptive data and the inferential data that consisted of prerequisite data analysis tests and hypothesis testing. The stages were: the test of descriptive data included Mean, Modus, Standard Deviation, Variance, Interval Distance, Maximum and Minimum Score, and Frequency Distribution from each variable. The data tabulation used SPSS 25.0 version and Microsoft Excel 2021.

Data analysis prerequisite test consisted of *Kolmogorov-Smirnov* normality test, test of homogeneity using *Bartlett* test, test of linearity, test of heteroscedasticity, test of multicollinearity, and test of autocorrelation. The test of hypothesis was conducted using regression analysis technique and multiple correlation. The research used a dependent variable and two independent variables. On the test of multiple linear regression model significance uses F test, whereas the test of multiple linear regression coefficient significance uses t test.

The multiple linear regression model equivalence as follow:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + e$$

Note:

| | |
|---|---|
| $\hat{Y}$ | = an ecological behavior |
| a | = constant |
| $b_1$, $b_2$ | = independent variable regression coefficient |
| $X_1$ | = a knowledge of ecological concepts |
| $X_2$ | = an environmental concern |
| e | = standard error |

An analysis of correlation is used to determine whether there is a correlation between variables and the closeness of the correlation. The analysis of multiple linear correlation had three correlation coefficient, multiple determination coefficient ($R^2$), multiple correlation coefficient ($R_{x1x2}$), and partial correlation coefficient. The significance test in multiple correlation test and partial correlation test uses F test. The test of multiple linear regression correlation coefficient uses t test.

## Results and Discussion

The highest score of a knowledge of ecological concepts was 100 and the lowest score was 46. The mean score was 74.14. The most of frequency distribution found on the fifth interval was 44 students (24%), while the smallest frequency distribution found on the first interval was 4 students (2%). The highest frequency of a knowledge of ecological concepts found on interval 73.5 – 80.5, 44 respondents with percentage 24%. The lowest frequency of a knowledge of ecological concepts found on interval 45.5 – 52.5, 4 respondents with percentage 2%. Range of frequency distribution of knowledge of ecological concepts can be seen in the following histogram graphic on Figure 2.

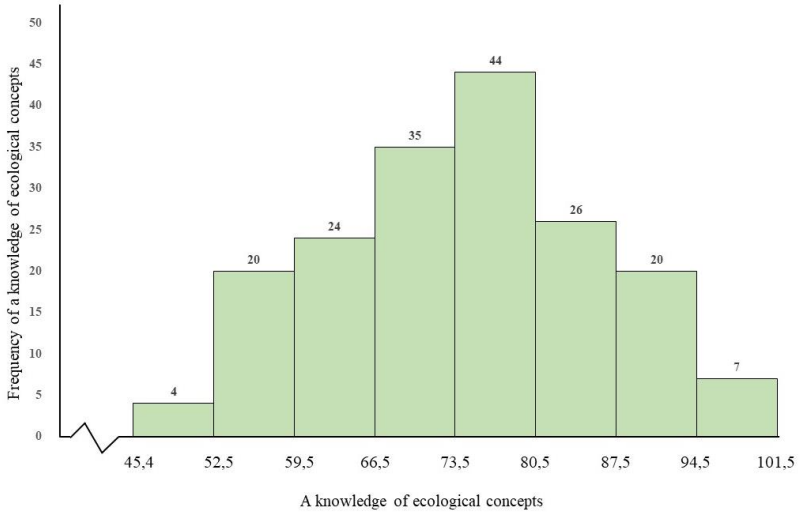


Figure 2. Frequency distribution of knowledge scores of ecological concepts

Then, the converted ecological concept knowledge scores were categorized into 5 interpretation categories, namely very high, high, fair, low and very low. Based on the calculation results, 3 categories of knowledge level of ecological concepts were obtained, namely very high, high and sufficient. This shows that the level of knowledge of ecological concepts is in the high category. Categories for the level of knowledge of ecological concepts are shown in Table 1.

Table 1. Percentage of students' ecological concept knowledge categories

| No. | Category | Sum | Percentage (%) |
|---|---|---|---|
| 1 | Very High | 53 | 29 |
| 2 | High | 97 | 54 |
| 3 | Fair | 30 | 17 |
| | **Total** | 180 | 100 |

In environmental concern variable, the highest score of an environment concern was 93 and the lowest score was 55. The mean score was 74.86. The most of frequency distribution found on the fourth interval was 44 students (24%), while the smallest frequency distribution found on the eighth interval was 2 students (1%). The highest frequency of an environment concern found on interval 72.5 – 77.5, 44 respondents with percentage 24%. The lowest frequency of an environment concern found on interval 92.5 – 97.5, 2 respondents with percentage 1%. Range of frequency distribution of an environment concern can be seen in the following histogram graphic on Figure 3.

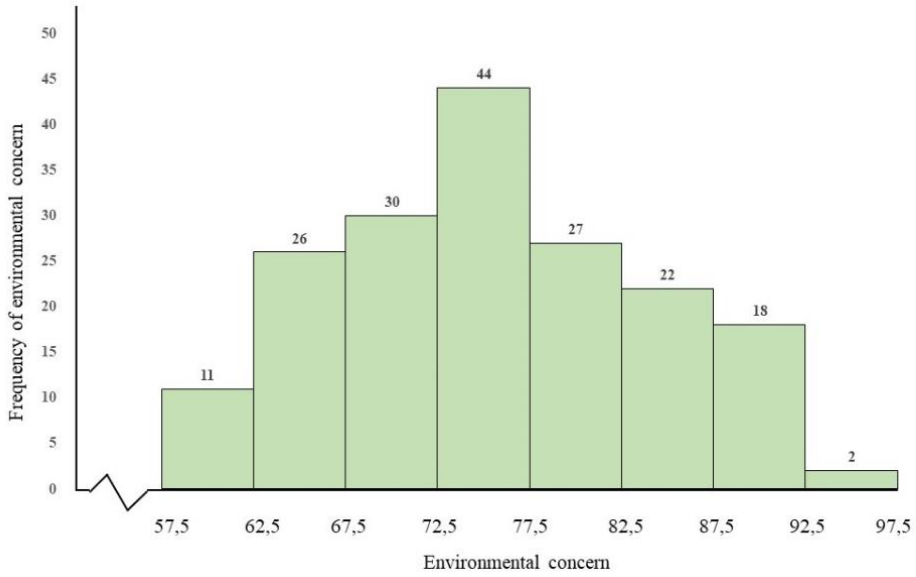


Figure 3. Frequency distribution of an environmental concern

The research data obtained two categories of environmental concern scores. The highest percentage of the environmental concern score category was in the good category, namely 82.8% (149 students). The lowest percentage for the environmental concern score category is in the bad category, namely 17.2% (31 students) (Appendix 8). Based on the calculation results, it was found that the majority of students had environmental awareness scores in the good category as shown in Table 2.

Table 2. Percentage of students' environmental awareness categories

| No. | Category | Sum | Percentage (%) |
|---|---|---|---|
| 1 | Good | 149 | 82.8 |
| 2 | Bad | 31 | 17.2 |
| | **Total** | 180 | 100 |

Furthermore, the highest score of an ecological behavior was 97 and the lowest score was 61. The mean score was 80.00. The most of frequency distribution found on the fifth interval was 39 students (22%), while the smallest frequency distribution found on the first interval was 5 students (3%). The highest frequency of an ecological behavior found on interval 80.5 – 85.5, 39 respondents with percentage 22%. The lowest frequency of an ecological behavior found on interval 60.5 – 65.5, 5 respondents with percentage 3%. Range of frequency distribution of an ecological behavior can be seen in the following

histogram graphic on Figure 4.
The research data obtained two categories of ecological behavior scores. The highest percentage of the ecological behavior score category was in the good category, namely 83.3% (150 students). The lowest percentage of the ecological behavior score category is in the bad category, namely 16.7% (30 students). Based on the calculation results, it was found that the majority of students had ecological behavior scores in the good category as shown in Table 3.

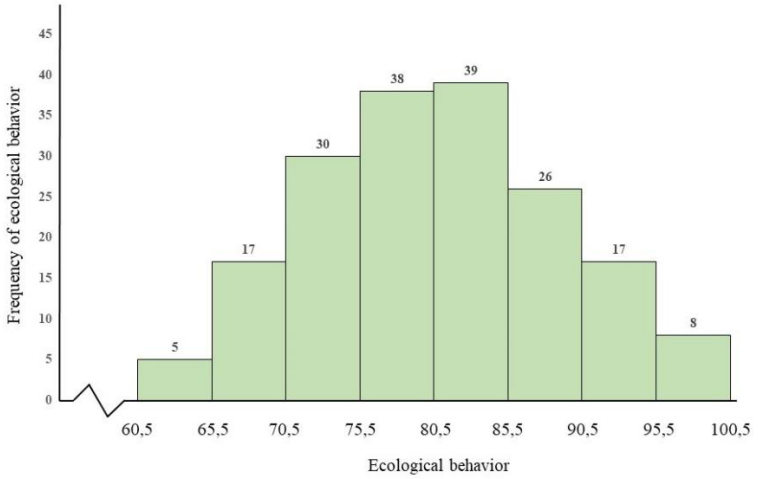


Figure 4. Frequency distribution of an ecological behavior

Table 3. Percentage of students' ecological behavior categories

| No. | Category | Sum | Percentage (%) |
|---|---|---|---|
| 1 | Good | 150 | 83.3 |
| 2 | Bad | 30 | 16.7 |
| **Total** | | 180 | 100 |

Then, normality and homogeneity tests were carried out to test the normality of the data distribution and the homogeneity of the data variants in this study. A summary of the results of the normality test using Kolmogorov-Smirnov is presented in Table 4. Based on this table, the data is stated to be normally distributed. The results of the homogeneity test using the Bartlett test also inform that the variances of Y over X1 as well as over X2 were homogeneous. After that, a classic assumption test was carried out where a summary of the overall results of the test is presented in Table 5. Based on this table, this research data meets the assumptions required before regression analysis is carried out.

Table 4. The Result of Kolmogorov-Smirnov Test

| Variable | α | Value of Sig. | Result | Note |
|---|---|---|---|---|
| Y over $X_1$ | 0.05 | 0.200 | $H_0$ accepted | Data Normal |
| Y over $X_2$ | 0.05 | 0.053 | $H_0$ accepted | Data Normal |

Table 5. Test of classical assumption

| No. | Test of Classical Assumption | Note |
|---|---|---|
| 1. | Test of Normality Probability Plot | Data are normally distributed |
| 2. | Test of Multicollinearity Tolerance and VIF | Data are not multicollinearity indication |
| 3. | Test of Heteroscedasticity Scatterplots | Data are not heteroscedasticity indication |
| 4. | Test of Autocorrelation Durbin Watson | Data are not autocorrelation indication |

Then, the results of the regression analysis are carried out. A summary of the results of the regression analysis is presented in Table 6. Based on Table 6, the multiple regression model was significant. In addition, there were a correlation between variable $X_1$ and variable $X_2$ on variable Y that had been verified. The multiple regression analysis calculation result was found a = 30.736; b1 = 0.515; b2 = 0.148. Therefore, variable Y over $X_1$ and $X_2$ found a multiple regression equation $\hat{Y} = 30.736 + 0.515X_1 + 0.148X_2$ means the multiple regression model was significant. Therefore, it means that there was a correlation between $X_1$ and $X_2$ on Y that had been verified.

Table 6. F test on multiple linear regression analysis

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 7526.197 | 2 | 3763.098 | 134.185 | .000 |
| | Residual | 4963.803 | 177 | 28.044 | | |
| | Total | 12490.000 | 179 | | | |

To analyze the correlation in each variable, a multiple correlation test was carried out. A correlation between $X_1$ and $X_2$ on Y strength shown through a correlation coefficient $r_{xy}$ = 0.776 (Table 7). Based on the Sig. value *F change* was 0.000 < 0.05 then variable $X_1$ and $X_2$ had a correlation with variable Y simultaneously. R value (correlation coefficient) was 0.776 then it can be concluded that the correlation between variable $X_1$ and $X_2$ on variable Y had a strong category.

Table 7. Multiple correlation test

| | | | | | Change Statistics | | | |
|---|---|---|---|---|---|---|---|---|
| R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| .776[a] | .603 | .598 | 5.29567 | .603 | 134.185 | 2 | 177 | .000 |

Furthermore, value of *R square* was 0.603 (Table 7). This finding was shows that variable $X_1$ and $X_2$ with Y simultaneously was 60.3%. However, the respite of 100% - 60.2% = 39.7% was influenced through a further variable without the regression equation or the variable that were not examined.
Moreover, the independent variable was controlled for the partial correlation coefficient (Table 8). Value of r-count was found 0.762 > r-table 0.146 then it can be concluded that there was a correlation between variable $X_1$ and variable Y without a variable control $X_2$. In addition, based on the Sig. value 0.000 < 0.05 then it can be concluded that there was a correlation between variable $X_1$ and variable Y without a variable control $X_2$. Value of correlation coefficient was included as a strong category. However, an output table $X_2$ (Table 8) shows that there was a decrease on the correlation coefficient value into 0.752 > r-table 0.146 (however it had a quite positive value and it in a strong correlation category) and a Sig. value 0.000 < 0.05 then $H_0$ rejected and $H_a$ accepted means the correlation between variable $X_1$ and variable Y with a variable control $X_2$ was significant. Therefore, it can be concluded that the appearance of a variable control $X_2$ would affect the correlation between variable $X_1$ and variable Y.

Table 8. Partial Correlation Coefficient

| Control Variables | | | X1 | Y | X2 |
|---|---|---|---|---|---|
| -none-[a] | X1 | Correlation | 1.000 | .762 | .190 |
| | | Significance (2-tailed) | . | .000 | .011 |
| | | df | 0 | 178 | 178 |
| | Y | Correlation | .762 | 1.000 | .292 |
| | | Significance (2-tailed) | .000 | . | .000 |
| | | df | 178 | 0 | 178 |
| | X2 | Correlation | .190 | .292 | 1.000 |
| | | Significance (2-tailed) | .011 | .000 | . |
| | | df | 178 | 178 | 0 |
| X2 | X1 | Correlation | 1.000 | .752 | |
| | | Significance (2-tailed) | . | .000 | |
| | | df | 0 | 177 | |
| | Y | Correlation | .752 | 1.000 | |
| | | Significance (2-tailed) | .000 | . | |
| | | df | 177 | 0 | |

a. Cells contain zero-order (Pearson) correlations.

Based on hypothesis testing, the results of the research verifying that there was a significant correlation between knowledge of ecological concepts ($X_1$) and environmental concern ($X_2$) on ecological behavior (Y) of high school students. The results of the correlation analysis shows that the multiple correlation coefficient was r = 0.776 (contribution = 39.7%), however the regression analysis resulted the equation $\hat{Y}$ = 30,736 + 0,515$X_1$ + 0,148$X_2$. This equation shows that knowledge of ecological concepts ($X_1$) was the biggest contributor to ecological behavior (Y). The variable of ecological concepts ($X_1$) and environmental concern ($X_2$) appeared to be almost dominant in contributing to students' ecological behavior (Y), since there were 39.7% that influenced through further variables that were not examined.
The results of the research show that there is a significant relationship in the strong category between knowledge of ecological concepts (X1) and environmental awareness (X2) and ecological behavior (Y) of high school students. The results of the correlation analysis obtained a multiple correlation coefficient of r = 0.776 (contribution = 60.3%). The regression analysis equation also shows that the variable

knowledge of ecological concepts (X1) is the largest contributor to ecological behavior (Y). The variables knowledge of ecological concepts (X1) and environmental awareness (X2) appear to almost dominantly contribute to students' ecological behavior (Y), because 39.7% of them are still influenced by other variables that were not studied. Thus, the combination of the knowledge of ecological concepts and environmental concern provides a greater contribution than the correlation values separately.

The results of this research indicate that although students' environmental awareness and Biology learning have not been absorbed optimally, they are able to make a significant contribution with knowledge of ecological concepts to students' ecological behavior simultaneously. This illustrates that the ecological behavior of high school students requires attention from various parties, such as schools, society and even the government.

Knowledge of basic ecological concepts has a very important role in efforts to convey knowledge to humans individually and in society. The scope of this knowledge is broader regarding living things, nature and the surrounding environment, as well as the interaction patterns formed between the two, the impacts caused by activities carried out by humans. So, if students have this, the environment will be more organized because they care about the environment. Knowledge not only includes knowledge of ecology and its components, but knowledge can be used as a basis for caring (Suhardin, 2016) and having a sense of love for the surrounding environment. Knowledge and attitudes have a positive relationship, because of the encouragement of individual awareness in preserving the environment. An individual with good knowledge about the environment, ecological awareness and behavior will also be useful in everyday life (Okumus et al., 2019). However, when an individual shows good ecological concern and behavior, this does not necessarily mean they have good knowledge about their environment. Therefore, when applying ecological awareness and behavior in everyday life, this can be familiarized and applied from an early age in the family environment and in the school environment.

The process of implementing environmental awareness for students is not only the task of the school principal and teachers but also requires support from school residents and the surrounding community (Tam & Chan, 2018). This support can be implemented through Biology learning activities. Implementing this Biology lesson will help students better understand the importance of activities in protecting the environment. Apart from that, in this case students are also trained to be skilled in good environmental management so that it becomes a good habit in their lives.

The success of students in caring for the environment also includes the role of teachers at school. Teachers must provide good direction and guidance to their students regarding various positive things in protecting, caring for and preserving the environment. Teachers must also be able to provide positive examples for students in maintaining and managing the environment optimally at school. The combination of subject matter and environmental insight should be supported in practical implementation, so that the learning process is also better.

Increasing students' ecological behavior can apply behavioristic learning theory and constructivist learning theory. These two theories were chosen because they at least fulfill the comparability requirements, namely in terms of their object, these theories have the same object, namely studying individual behavior in learning (Lenjani, 2015). The behaviorist view which considers learning to be changes in behavior that are visible, and can always be measured, stimulus-response relationships, is always contrasted with the constructivist view where students build their knowledge through experience, so that the learning process is very dynamic and student-centered. These positive habits foster good knowledge and awareness to prevent and control current environmental damage. In learning, these two theories can work together, where constructivism plays a role in conditioning learning, while the process and results can use behaviorism. The teacher's role is to condition learning by using various strategies that are student-centered (Aljohani, 2017).

One activity that can improve ecological behavior is that teachers can hold ecological practicums. Ecology practicum has potential and a strategic role in facing the era of globalization and industrialization. This potential is realized if practicum activities can equip students with creative thinking skills, logical thinking, problem solving, critical thinking, technological adeptness and adaptability to changes and developments over time (Suhendar & Solihat, 2023). This shows that ecological practicum activities can be supporting activities to increase students' knowledge of ecological concepts, environmental awareness and ecological behavior. The existence of a variety of ecological practicum activities can also increase the depth of study and use it to solve problems in everyday life.

Research conducted by Hamilton-Ekeke (2007) compared classes that taught ecology indoors with classes that were taught partly in the field. The results of the study show that fieldwork is an important aspect when studying ecology in secondary schools. Students who had hands-on experience in the field scored higher on multiple-choice tests in ecology. Additionally, another study by Prokop et al. (2007) compared the ecological understanding of elementary school students where one group was taught traditionally indoors and one group studied ecology during field trips at a field center. The group that attended the field trip demonstrated a better understanding in ecology based on multiple choice tests and open-ended questions. Other results showed that these students also scored higher on positive attitudes towards biology.

In this way, teachers can utilize biology learning both in class and outside of class to increase ecological

knowledge and environmental awareness (Rarasandy et al., 2013; Rotari & Komalasari, 2017). Students must be able to understand the ecological complexity that can be realized at various levels of life organization from the molecular level to the ecosystem. In a qualitative study of reflections on outdoor learning by Magntorn and Helldén (2005), field trips were considered an important part of ecological learning. During field trips, students have the possibility to explore, discuss and connect theory with practice. So that a comprehensive practicum program that is implemented well will be able to train thinking skills, such as systems thinking which leads to the ability to solve environmental problems in an integrated manner.

## Conclusion

Based on the results and discussion of the research, it can be concluded that there is a correlation between knowledge of ecological concepts, environmental concern, and ecological behavior. Suggestions for further research is in schools including the teachers should develop the quality of Biology learning such as the selection of methods, a practicum, and a learning media therefore it will have an impact on increasing knowledge of ecological concepts, environmental concern, and ecological behavior on students. In addition, for further researchers who wish to developing and continuing this research able to use a wider population in order to obtain more representative result.

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## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

## Author Contributions

**D. Angelita**: methodology, analysis, writing – original draft preparation, review, and editing. **M. Miarsyah**: writing-original draft preparation, evaluation, review, and editing. **R. Komala**: writing-original draft preparation, evaluation, review, and editing.

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