Naturalistic Intelligence and Problem-Solving Skills: Study of Its Connectivity Through Environmental Photovoice Projects

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Abstract

Sensitivity to environmental concepts is closely related to naturalistic intelligence, as well as concern for finding solutions to environmental problems through problem-solving skills. This study aimed to determine the correlation between naturalistic intelligence and problem-solving ability through environmental photovoice project. Correlational research method was used in this study with purposive sampling technique. Population were 10th grade students of senior high school with specific science class as a sample. Naturalistic intelligence was measured by using naturalistic questionnaire. The problem-solving ability indicates in photovoice project and measured by using a photovoice assessment rubric developed based on problem-solving indicators. The results showed that the average of students’ naturalistic intelligence was 75.82 in score, it’s mean that students’ naturalistic intelligence belong to high criteria. The average of students’ problem-solving skills was 66.12 in score belong to high criteria as well. The result of this research shows the value of correlational coefficient was 0.582. This means that there was strong positive relationship between naturalistic intelligence and the problem-solving skills through photovoice project on the environmental topic. These findings indicate that naturalistic intelligence are closely related to problem-solving skills. Finally, we discuss the relationship of naturalistic intelligence and problem-solving skills and provide suggestions for further work.

Keywords: Naturalistic Intelligence, Problem-Solving Skills, Environmental Photovoice Project, Environmental Topic.

INTRODUCTION

Environmental problems occur all the time and are a common challenge for mankind (Heidbreder, et al., 2019; Ali, et al., 2019; Skjæerset and Skodvin, 2018; Martins, et al., 2019). Various efforts must be made in order to respond to this, including through environmental education in developing problem-solving skills to develop alternative solutions to environmental problems (Boas, et al., 2018; Nugroho, et al., 2020; Goldman, et al., 2020). Attention to environmental problems will be related to sensitivity in understanding the environment, so this will relate to naturalistic intelligence.

Naturalistic intelligence has a positive relationship to environmental attitudes (Rahmawati, et al., 2021; Purwono & Jannah, 2020; Anna, 2016). Attitude tendency to solve environmental problems is related to intelligence in determining solutions. Investigations and
observations need to be carried out to see problem aspects directly and clearly before determining the solution. Through investigation or direct observation in the environment, students are expected to get learning experience in solving problems appropriately. In solving environmental problems, data on environmental problems will be more clearly illustrated when visualized in a good photo.

London, et al., 2011 state that a phenomenon will be meaningful when captured in a work of photography because the environment will continue to change and the message from a photo can show other people's thoughts about their environment. Biological object observation activities (first-hand information) can use various ways to obtain data, one of which is visualization results in the form of photos and then the data can be analyzed to obtain answers to problems (Sprague et al., 2021; Petre, 2020). Therefore, learning through photography projects is expected to provide experience to students in determining a problem so as to increase their concern for the environment and inspire them to find alternative solutions to the problem.

Investigations related to environmental photovoice projects have been studied by several studies linking them to environmental awareness (Sprague, et al., 2021); impact on students' community (Coronado, et al., 2020); environmental justice (Evans-Agnew, et al., 2022); Students' views and voices (Kalaitsidaki, et al., 2022); indigenous accounts of environmental change (Mitchell, et al., 2020). But not many studies have tried to find the link between environmental photovoice projects and naturalistic intelligence which are assumed to be closely related to concern in finding alternative solutions to environmental problems. Therefore, researchers consider it necessary to carry out research with an emphasis on the relationship between naturalistic intelligence and problem-solving skills through an environmental photovoice project which is expected to provide knowledge information for teachers and students regarding the relationship between naturalistic intelligence and environmental problem-solving skills.

**METHOD**

Correlational research was used in this research to find the relationship between naturalistic intelligence and problem-solving skills through environmental photovoice projects. The population in this study were all 10th grade senior high school students with specific 10th grade science class as sample by purposive sampling technique.

Students' naturalistic intelligence was measured using a closed naturalistic questionnaire with 20 statement items consisting of positive and negative statements. The naturalistic questionnaire was developed referring to indicators of naturalistic intelligence including
distinguishing members of a species, recognizing the existence of other species, mapping the relationships between several species both formally and informally, and researching, classifying, and identifying natural symptoms. Meanwhile, problem-solving skills are measured using a photovoice assessment sheet for solving environmental problems with an assessment rubric developed based on problem-solving indicators which include identifying problems, formulating problems, providing solutions, assessing solutions, and conducting evaluations.

Data analysis was carried out using regression analysis (can be seen in Fig. 1) to see the causal relationship that occurs between one variable and another; Product Moment correlation analysis (can be seen in Fig. 2) to measure the closeness of the linear relationship between two variables that have normal data distribution; and test the coefficient of determination (can be seen in Fig. 3) to find out how much the endogenous variables are simultaneously able to explain exogenous variables.

The Least Squares Regression of $y$ on $x$

$$\hat{y} = a_{yx} + b_{yx}x$$

where

$$b_{yx} = \frac{n \sum xy - (\sum x)(\sum y)}{n \sum x^2 - (\sum x)^2} \quad a_{yx} = \frac{\sum y - b_{yx} \sum x}{n}$$

**Figure 1.** Regression Equation Formula.

The Correlation Coefficient (Pearson’s $r$)

$$r_{yx} = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n \sum x^2 - (\sum x)^2}[n \sum y^2 - (\sum y)^2]}$$

**Figure 2.** The Correlation Coefficient.

$$r^2 = \frac{RSS}{TSS} = \frac{\sum (\hat{Y} - \bar{Y})^2}{\sum (Y - \bar{Y})^2}$$

**Figure 3.** The Determination Coefficient.

RESULTS AND DISCUSSION

This study examines naturalistic intelligence and problem-solving skills through environmental photovoice projects and analyzes their interrelationships. The average of students’ naturalistic intelligence was 75.82 in score, it’s mean that students’ naturalistic intelligence belongs to high criteria. The results showed that 65% of students have naturalistic intelligence with high criteria (can be seen in Fig. 4). The achievement of naturalistic
intelligence shown by students is closely related to hands on activity by environmental photovoice project learning carried out by students, because these learning activities provide opportunities for students to obtain various forms of learning outcomes. In line with several studies stating that hands-on learning activities are closely related to the achievement of students' naturalistic intelligence, fieldtrip learning on students’ naturalistic intelligence and environmental problem-solving skills (Adisendjaja, et al., 2019; Martasari et al., 2022); SETS approach on Students’ cognitive learning achievement and naturalist intelligence (Alifah, et al., 2017); outdoor learning and naturalist intelligence (Supriadi, et al., 2020).

Juniarti (2015); Adisendjaja, et al. (2019); Leksono, et al., (2020); Ekanara, et al., (2021) Martasari et al. (2022) propose that the fieldtrip/hands on activity can increase naturalistic intelligence, this is strongly suspected because these activities provide learning opportunities for students to be able to understand real environmental conditions. In this case. Furthermore, Gardner (2003); Armstrong (2009) explains that naturalistic intelligence is the intelligence to love the beauty of nature through an introduction to the flora and fauna found in the environment, but the environmental photovoice project carried out in this study has limitations related to the specific introduction stage of a species, these limitations are thought to explain that the acquisition of students' naturalistic intelligence is not entirely optimal (Mauladin, 2013; Fatonah and Prasetyo, 2017); learning activities related to multiple intelligences including naturalistic intelligence need to be well prepared (Chaerunnisa, et al. 2017). Students' naturalistic intelligence averages indicator can be seen in Fig. 5.

**Figure 4.** Percentage of Students’ Naturalistic Intelligence Acquisition Category.
Figure 5. Students' Naturalistic Intelligence Averages Indicator.

Fig. 5. shows students' naturalistic intelligence averages indicator, indicator of "Researching, classifying, and identifying natural phenomena" was the highest score achieved by students compared to other indicators with an average score of 83.8. This can be explained that direct observation learning in the environment through the environmental photovoice project provides learning opportunities for students to optimally research, classify, and identify natural phenomena (Trout, et al., 2019; Strack, et al., 2004; Strack, et al., 2022; Berbés-Blázquez, 2012). Through hands-on activity learning, naturalistic intelligence can be stimulated by facilitating students by giving them the freedom to look for alternative information in the environment and other literary sources. This step can provide a stimulus to the brain area in the left parietal lobe (Shearer and Karanian, 2017; Mieles, et al., 2021). By providing an optimal stimulus, students are expected to have the ability to research, classify, and identify phenomena of natural change as a manifestation of naturalistic intelligence (Chatib, 2009).

In contrast, the lowest naturalistic intelligence indicator obtained by students was "Recognizing the existence of other species" with an average score of 70.8. This finding is thought to be closely related to the background of the research subjects who come from urban areas. Gardner (2003) states that someone who grows up in an urban environment, and has no imagination about the natural world of living things, he will analogize the natural components to the objects found in the city. Most of the research subjects in this study grew up in urban areas, so it is suspected that they have difficulty recognizing other species because they tend to divert their attention to objects in cities, not to plants or animals. Some of the limitations of urban society related to the imagination of the environment are thought to be obstacles in optimizing naturalistic intelligence (Sadiku and Musa, 2021; Naik, 2017; Sahabuddin, et al., 2020).
**Figure 6.** Percentage of Students' Problem-Solving Skills Acquisition Category.

Fig. 6 shows the percentage of students' problem-solving skills acquisition category. The results show that 50% of students have high category problem-solving skills with the average of students' problem-solving skills was 66.12 in score belong to high criteria as well. This finding indicates that students were able to construct alternative solutions to environmental problems through an environmental photovoice project. Students are assumed to be able to identify photos and develop narratives according to the indicators of problem-solving-skills through an environmental photovoice project. High percentage of students' problem-solving skills categories is strongly suspected to be related to hands-on activity through an environmental photovoice project that guides students to build their own knowledge based on field data and see problems that occur in the environment and identify problems by documenting them in a photo, so they can develop problem-solving skills (Lumpe and Oliver, 1991; Machin, 2016; Joseph and Strain, 2010). Wang and Burris (1997) state that photovoice is a technique that can help individuals to identify a phenomenon through photographs or images which are then explained and interpreted.

Fig. 7. shows students' problem-solving skills averages for each indicator. The result indicates that the indicator of “problem identifying" was obtained 77.5 which is the highest score. This finding is thought to be related to good preparation regarding the implementation of the environmental photovoice project carried out by students (Boss and Larmer; 2018; Boss and Krauss, 2022). Students are facilitated with leading questions to be able to identify problem through environmental photovoice project, so students are able to identify environmental problem very well. Moreover, the basic questions in a hands-on activity, in this case the environmental photovoice project, students are given supervisory questions related to understanding and taking topics according to field data through in-depth investigations of predetermined topics (Holmlund, *et al.*, 2018). Thus students are given the opportunity to
build an initial understanding of the object that will be documented in the environmental photovoice project.

**Figure 7.** Students' Problem-Solving Skills Averages Indicator.

In contrast, the lowest students’ problem-solving skills indicator obtained by students was "evaluating" with an average score of 41.6. The ability to evaluate is one of the higher order thinking skills in the cognitive domain (Anderson and Krathwohl, 2001; Brookhart, 2010). In the environmental photovoice project carried out by students, they are required to construct alternative solutions to problems and check the suitability of problem-solving with problems. In carrying out evaluation activities required accuracy and in-depth study of the advantages and disadvantages of alternative solutions to problems that have been made. In this case, it is suspected that students have not been able to optimally analyze errors from the alternative solutions to problems they have made due to the lack of references used (Brundiers, *et al.*, 2021; Ching, *et al.*, 2018).

From the results of the regression analysis using a simple linear regression model between students' naturalistic intelligence with problem-solving skills, it is shown that the regression equation is \( \hat{Y} = 2.81 + 0.89X \). This equation means that when students' naturalistic intelligence is equal to 0, problem-solving skills have a value of 2.81. Furthermore, a positive value on the regression coefficient illustrates that the direction of the relationship between naturalistic intelligence and problem-solving is unidirectional, where every single increase in the variable unit of naturalistic intelligence will cause an increase in problem-solving of 0.89. Furthermore, the results of the statistical correlation test between students’ naturalistic intelligence and problem-solving are presented in Table 1.
Table 1. Relationship Analysis between Students’ Naturalistic Intelligence and Problem-solving Skills through Environmental Photovoice Project.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalitas Test *</td>
<td>0.200</td>
</tr>
<tr>
<td>Correlation Coefficient (r)</td>
<td>0.528</td>
</tr>
<tr>
<td>Significance of Correlation Coefficient</td>
<td>0.000</td>
</tr>
<tr>
<td>Determination Coefficient (r²)</td>
<td>0.279</td>
</tr>
</tbody>
</table>

(*): Kolmogorov-Smirnov Test (Normal, Sig. > 0.05)
(**): Pearson Product Moment

Based on Table 1, the results of the Pearson Product Moment correlation analysis obtained a correlation coefficient (r) of 0.528 with a significance of 0.00. It can be concluded that there is a positive and significant relationship between students' naturalistic intelligence and problem-solving skills. The interpretation of the correlation coefficient between students' naturalistic intelligence and problem-solving skills through an environmental photovoice project has a relatively strong relationship. This shows that students' naturalistic intelligence has a fairly strong correlation with problem-solving skills through the environmental photovoice project. In other words, the higher the student's naturalistic intelligence, the higher the student's problem-solving skills. Determination coefficient (r²) was 0.279, this means that students’ naturalistic intelligence contributes 27.9% to students’ problem-solving skills through environmental photovoice project, while the remaining 72.1% is explained by other factors.

There is a fairly strong relationship between students' naturalistic intelligence and problem-solving skills through the environmental photovoice project, presumably because naturalistic intelligence can become the basis for improving problem-solving skills through the environmental photovoice project. When viewed from the results of the environmental photovoice project carried out by students, the stage of identifying problems becomes a decisive stage that requires students to analyze environmental problems. From the results obtained, students are able to analyze environmental problems well, especially on the indicator "researching, classifying, and identifying natural phenomena". These findings are in line with several related studies which state that students with high naturalist intelligence are better at solving environmental problems than students with low naturalist intelligence (Suhirman, 2012; Sugandi, 2020); multiple intelligences including naturalistic intelligence have a contribution and connection with problem-solving skills (Ahvan, et al., 2016).

The environmental photovoice project is aimed at producing a product (photo) of an observed environmental problem. The process of determining the object to be photographed requires direct investigation into the environment to be able to see problems that occur in the
environment by involving students’ naturalistic intelligence and problem-solving skills. Thus
direct investigation into the environment can assist students in increasing sensitivity to
changes that occur in the environment. This can be a logical explanation of how students' 
naturalistic intelligence has a fairly strong positive relationship with problem-solving skills.
As in several studies that try to explain that hands-on learning activities have a positive
influence on naturalistic intelligence and problem-solving skills (Adisendjaja, et al., 2019;
Martasari et al., 2022; Supriadi, et al., 2020).

Azzet (2011) states that the behavior of prevention, improvement, and problem-solving
of the natural environment, as well as nature conservation is one of the characteristics of
students who have naturalistic intelligence. In line with what was stated by Prasetya and
Andirani (2009) that someone who has well-developed naturalistic intelligence will have the
capacity to manage the environment with the main activity of maintaining and interacting
with nature. This is reinforced Suahirman’ research (2012) which shows the effect of problem-
based learning and naturalistic intelligence on environmental problem-solving skills. Research
result on relationship between naturalistic intelligence and problem-solving skills through
environmental photovoice project can be used as a basis for developing sensitivity and caring
values for environmental issues.

CONCLUSION

There is a significant positive relationship between students’ naturalistic intelligence
and problem-solving skills through environmental photovoice project. Regression equation is
\( \hat{Y} = 2.81 + 0.89X \). Positive value on the regression coefficient illustrates that the direction of
the relationship between students’ naturalistic intelligence and problem-solving is
unidirectional, where every single increase of students’ naturalistic intelligence will cause an
increase in problem-solving skills of 0.89. Pearson Product Moment correlation analysis
obtained a correlation coefficient \( \rho \) of 0.528 with a significance of 0.00. It can be concluded
that there is a positive and significant relationship between students' naturalistic intelligence
and problem-solving skills. The interpretation of the correlation coefficient between students' 
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means that students’s naturalistic intelligence contributes 27.9% to students’ problem-solving
skills through environmental photovoice project, while the remaining 72.1% is explained by
other factors which requires further research to explain.
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