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Interaction of students motivation and ecological phenomena toward learning outcomes using problem-based ecopedagogy

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Abstract. Knowledge as a cognitive outcome and academic motivation is directly linked to the affective outcome as attitudes and behaviors. Ecopedagogy as a learning model lead students to enhance the interaction on outcomes. This research focused on the interaction of the motivation and ecological phenomenon to the cognitive and affective outcomes. Validated instruments were used to collect data on motivation, cognitive and affective. Data were analyzed using factorial design with two ways ANOVA model. The result showed the interaction between motivation and ecological phenomena to the cognitive outcome is different to the affective outcome. The different showed on high and low motivation and ecological phenomena as the climate change, the deforestation, and the using energy resources. Through an analysis of interaction, the features of such approaches based eco-pedagogy to ecological phenomena subjects are a discussed.

1. Introduction

Education is a continuous process of building and developing the dimension of each human being so that it has to develop continuously. The development of this education should be in line with the development of science and technology to give a significant effect toward the development of self-dimension. Student self-dimension according to the Indonesian National Qualification Framework (KKNI) to encourage the realization of character through learning that includes cognitive, affective, and psychomotor outcomes. These three outcomes based on Bloom dimension [1,2].

The previous study of students Physics Education at one of the universities in Sulawesi Tengah found that affective outcome can be shifted from receiving (the lowest category) to characterization (the highest category) of affective. Based on Blooms’ affective categories, the shifting indicates an inconsistency for ecological phenomena [1,3]. The other research found that metacognitive with motivation and affect have interaction in the MASR as a framework [4]. The other study found that using Problem-based learning and Project-based learning Models, there is no different effect on students’ critical thinking [5]. It is remind that some of learning approach and model can improve the skill of learning.

Nowadays, ecological phenomena arise that caused of some factors as using wasteful the energy sources, deforestation, and the other human activities that contributed to environmental degradation [6]. The increasing of the human population that increase the need of food had impacted to the deforestation. Deforestation has affected various flora and fauna extinguish [7]. Therefore, to address the occurrence
of ecological phenomena, eco-pedagogy is needed because living in the world is one part of 21st century skill that gives attention to cultural awareness and competence. Cultural awareness itself can be built through education that accommodates the formation of character.

The existence of interaction effect of motivation, cognitive with affective outcomes and learning models is the basic for finding the learning model is appropriately used in accordance with the learning subject. This study analyzed motivation, cognitive outcome, and affective outcome interaction using Problem-based Ecopedagogy (PB-EcoP). The result of interaction illustrate the effectiveness of PB-EcoP in three ecological phenomena in this research as climate change, deforestation, and using of energy resources. Few of previous research have found the integration or connection on cognitive and affective domain in science learning, but missing the subject matter of science. The interaction analysis in the study considers with the three subject matter of ecological phenomena to develop model learning.

2. Research method

2.1. Data collection and analysis

This quantitative research was conducted through survey design. A survey has done to find a view of students’ motivation and learning outcome as cognitive and affective domains toward three ecological phenomena as the climate change, the deforestation, and the using energy resources. The survey uses two validated instruments to pre-service physics teachers. The analysis statistical to find the interaction all variable in this research use interaction analysis with ANOVA two ways by software program SPSS version 19.0 for Windows.

2.2. Research and instrument design

The instruments used in the research are the cognitive test and the affective questionnaire is undertaken by validating the content conducted by three expert validators and statistical validation used SPSS 19.0 Version for windows. A sample of research divide to students with high and low motivation that collected data used academic motivation questionnaire consist 40 statements. The result shows that both instruments are valid and reliable with reliability coefficient were 0.87 and 0.85 the cognitive test given to 22 respondent consist 45 questions to assess the understanding concept of ecological phenomena. The questionnaire affects consist 50 statement that formed in the favorable and unfavorable with six the choice answers as “always experience” to “always not experience.”

![Figure 1. Research design using PB-EcoP toward ecological phenomena.](image)

Learning of ecological phenomena follows the research design as figure 1. The subject of climate change, deforestation, and using the resources of energy as ecological phenomena given to the respondent that students’ motivation measured and categorized. The students cognitive and affective found with using the two instruments.
3. Result and discussion
The result of study uses the Anova Two Ways to describe the signification effect the motivation and ecological phenomena to the cognitive as dependent variable shows in table 1.

Table 1. Test of interaction motivation (M) and ecological phenomena (EP) to the cognitive outcome (C).

| Source          | Type III Sum of Squares | df  | Mean Square | F     | Sig. |
|-----------------|-------------------------|-----|-------------|-------|------|
| Corrected Model | 5.067\(^a\)             | 5   | 1.013       | 0.017 | 0.000|
| Intercept       | 19558.533               | 1   | 19558.533   | 325.433| 0.000|
| M               | 0.533                   | 1   | 0.533       | 0.009 | 0.026|
| EP              | 1.267                   | 2   | 0.633       | 0.011 | 0.090|
| M * EP          | 3.267                   | 2   | 1.633       | 0.027 | 0.030|
| Error           | 1442.400                | 24  | 60.100      |       |      |
| Total           | 21006.000               | 30  |             |       |      |
| Corrected Total | 1447.467                | 29  |             |       |      |

a. R Squared = 0.504 (Adjusted R Squared = 0.404)

Table 1 show the interaction effect based on F (interaction) = 0.027 and p-value = 0.030 < 0.05. It concluded that there are significant interaction motivation and ecological phenomena to cognitive outcome. The result of analysis founded the percentage impact of motivation and ecological phenomena variable and its interaction is 50.4. The interaction effect of M and EP toward C shows in figure 2.

![Figure 2. The interaction motivation and ecological phenomena with cognitive outcome.](image-url)

Figure 2 shows that cognitive outcome interacts with motivation and ecological phenomena as the climate change, the deforestation, and the using energy resources. The figure 2 estimated that low motivation effect on low cognitive and high motivation effect on high cognitive. However, the cognitive improvement is not significant at low motivation, but in high motivation tends to increase. Based on ecological phenomena, the interaction with high motivation occurred on the climate change and the using energy resources phenomenon.
Based on the founding research, the motivation and subject matter contributed 50.4% toward the cognitive outcome. It shows how important to consider the motivation in choosing a model or approach to learning in accordance with the material to be studied. The different subject matter need model learning compatible as figure 2 presented that problem-based learning not supported toward the climate change and the deforestation subjects that shows by no interaction between them.

The signification effect the motivation and ecological phenomena to the affective as dependent variable shows in table 2.

**Table 2. Test of interaction motivation (M) and ecological phenomena (EP) to the affective outcome (A).**

| Source             | Type III Sum of Squares | df | Mean Square | F    | Sig.  |
|--------------------|------------------------|----|-------------|------|-------|
| Corrected Model    | 297.767<sup>a</sup>    | 5  | 59.553      | 1.833| 0.044 |
| Intercept          | 16945.633              | 1  | 16945.633   | 521.672| 0.000 |
| M                  | 288.300                | 1  | 288.300     | 8.875| 0.007 |
| EP                 | 2.067                  | 2  | 1.033       | 0.032| 0.069 |
| M * EP             | 7.400                  | 2  | 3.700       | 1.114| 0.003 |
| Error              | 779.600                | 24 | 32.483      |      |       |
| Total              | 18023.000              | 30 |             |      |       |
| Corrected Total    | 1077.367               | 29 |             |      |       |

<sup>a</sup> R Squared = 0.676 (Adjusted R Squared = 0.526)

Table 2 view the interaction effect based on F (interaction) = 1.114 and p-value = 0.003 < 0.05. It concluded that there are significant interaction motivation and ecological phenomena to the affective outcome. The result of analysis founded the percentage impact of motivation and ecological phenomena variable and its interaction to affective domain is 67.6. The interaction effect of M and EP toward A shows in figure 3.

**Figure 3.** The interaction motivation and ecological phenomena with the affective outcome.

Figure 3 shows that affective outcome interacts with motivation and ecological phenomena as the climate change, the deforestation, and the using energy resources. The figure 3 estimated that high motivation effect on high affective on ecological phenomena such the deforestation and the using of energy resources. The interaction effect different for climate change and deforestation subjects that
develop leads to low motivation. This figure 3 also show that no interaction motivation and the climate change and the using energy resources phenomenon to the affective outcome. However, the affective improvement is not significant at the low motivation for both of ecological phenomenon.

Based on KKNI curriculum, the affective domain that effects to the cognitive domain are acknowledged to be an important aspect of learning [1,2]. A number of previous research concerned to study the relationship between the cognitive and affective domain of learning, few studies has observed an effect of learning model to develop the attitudes and conceptual understanding of science. The ecopedagogy enhanced the understanding concept of global warming, depletion of energy resources, and pollutions [8]. Gender, cycle, and math effect to the attitude toward mathematics in students from 5th grade to 12th grade [9]. Various model and learning methods such inquiry-based learning, problem-based learning, and project-based learning have been improved the students attitudes the ability of critical thinking [10,11]. Therefore, according to the interaction of cognitive and affective toward ecological phenomena, and considering motivation dimension, the study suggests constructivist learning that improves the cognitive and affective domains and develops the motivation. For the environmental science subject, it needs learning model based eco-pedagogy that developed from Littledyke [12] as shown in figure 4.

![Diagram](image.png)

**Figure 4.** The framework of learning-based ecopedagogy.

4. Conclusion
Based on the result and discussion of the study, it can be concluded that there is the significant interaction of students motivation and the ecological phenomena (climate change, deforestation, using energy resources) toward the learning outcomes (the cognitive and the affective outcomes) using Problem-based Ecopedagogy (PB-Ecop). The PB-Ecop impact to improve knowledge for the learning of ecological phenomena and it’s as effect the affective outcome. Otherwise, the interaction is not significant for the low motivation. It is remind that teachers have to assess the students’ motivation before learning and improve it in the process with learning model. It’s not right to use the PB-Ecop as unimodel for the different ecological phenomena subjects in this research. We suggest Multimodel-
Based Ecopedagogy (MM-Ecop) as a useful framework to improve the interaction of students’ motivation and outcomes learning as cognitive, affective, and skill domains.

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