



STUDENTS' COGNITIVE ACHIEVEMENT, CRITICAL THINKING SKILLS, AND METACOGNITIVE AWARENESS IN PROBLEM BASED LEARNING

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Abstract:

This study aims to determine the correlation between improvement (i) cognitive achievement with critical thinking skills, (ii) cognitive achievement with metacognitive awareness, (iii) critical thinking skills with metacognitive awareness, and (iv) cognitive achievement with critical thinking skills and students' metacognitive awareness. This research is pre-experimental (pre-experimental design) with the design of One Group Pretest-Posttest Design. The study population was all students of class XI at Public Senior High School (SMA Negeri) 1 Binamu consisting of 210 students. Determination of the sample is done by random sampling. The research instrument is a test of critical thinking skills, a Metacognitive Awareness Inventory (MAI) questionnaire, a student's cognitive biology learning outcomes test. Data were analyzed using inferential statistics with a one-way product-moment correlation test and multiple regression. The results showed that there were correlations that were: (i) positive between cognitive achievement and critical thinking skills, (ii) positive between cognitive achievement and metacognitive awareness, (iii) negative between critical thinking skills and metacognitive awareness, and (iv) there correlation between increasing cognitive achievement with critical thinking skills and students' metacognitive awareness.

Keywords: cognitive achievement, critical thinking skills, metacognitive awareness, problem based learning

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1. Introduction

Biology learning in practice is still dominant in implementing conventional learning patterns that are more teacher-oriented and this reality continues to this day. According to Tindangen (2006); Mustami and Safitri (2018) concluded that learning that occurs in biology learning is that teachers have not implemented meaningful learning, so students experience problems thinking. Thinking problems that occur in students are that students do not arrive at high-level thinking skills, namely problem solving that is included in creative thinking. This is reinforced by Dharma (2008) which states that problem-solving and critical thinking skills of Indonesian students are still low.

These symptoms are a common symptom of the results of the educational process. School education is too crowded with children's brain with a variety of teaching materials that must be memorized, education is not directed at developing and building the character and potential of children, in other words, education is not directed at shaping human beings who are intelligent, equip real-life problem solving skills and are not directed at forming human beings. Critical thinking, creative, independent, and innovative. This means that it will have implications for metacognitive skills in students will be low because in metacognitive critical thinking skills are needed. Students' critical thinking skills that are still indirectly low are the impact of the learning process that does not yet empower students' thinking skills (Ekoningtyas, 2013; Bachtiar, 2014).

That fact will also affect the skills of cognitive achievement which tend to be low because untrained students become independent learners in the sense of not knowing their cognitive skills (self-assessment) and being less able to manage and monitor their cognitive development further (self-management), so that in learning lack of self-planning, self-monitoring, and self-evaluation. This means that students' metacognitive awareness is still relatively low and this is reinforced by the results of Rahman and John (2006) research which concluded that metacognitive awareness is positively correlated with academic achievement or student learning outcomes. Dharma (2008) also said that critical and creative thinking skills are one of the demands of 21st-century education which is marked by global competition.

These problems also occur in Public Senior High School 1 Binamu, obtained information that learning at Public Senior High School 1 Binamu as a State High School which is at the superior level in Jeneponto district is still a quite dominant teacher centered orientation with the use of conventional models that are oriented to expository models and have never applied a learning model PBL. Based on the interview, information was obtained that qualitatively critical thinking skills, metacognitive awareness, and cognitive achievement of students were relatively low. It was also acknowledged that in Binamu 1 Public Senior High School had never measured students' critical and metacognitive thinking skills, especially in biology learning at all grade levels (Bachtiar, 2013; Bachtiar, et al, 2015).

PBL is one of the learning model solutions that can be used to overcome these problems. PBL is an innovative method that involves problems in learning (Nurhadi et

al, 2003; Arends, 2008; Keziah, 2010; Bachtiar, et al. 2018). Dehkordi and Heydarbejad (2008) revealed that students who are taught with problem-based learning models can foster critical thinking skills, improve independent learning and cooperative group work when compared to traditional learning. Tessier (2004) also states that in the biology class problem-based learning becomes a popular and effective learning model. Related to this, then in this study, the material to be taught is the material of the excretion system.

These statements are reinforced by the results of previous studies that apply problem-based learning (PBL) to show an increase in learning outcomes, concept understanding, learning independence, critical thinking skills, motivation, interest, and learning activities in the subjects of biology, physics, chemistry, mathematics, geography, and economics (Aisyah, 2003). Dwiyoogo (2008) also stated that research on PBL confirms that students develop skills that include: (1) problem solving, (2) critical thinking, (3) research, (4) presentation, and (5) moving vision to action. Therefore, it is necessary to apply PBL learning model as an alternative in biology learning to improve critical thinking skills, metacognitive awareness, and cognitive achievement.

According to Iwamoto, et al, 2016 states that PBL learning models have the potential to increase student involvement in learning activities. Through PBL activities, students can focus on declarative knowledge with an emphasis on learning material directly related to student learning outcomes. PBL has a positive effect towards increasing student learning motivation which will have an impact on improving learning outcomes (Chiang & Lee, 2016). Ravitz (2010) states that PBL is a learning model that can encourage students' motivation so that they can demonstrate and explain what they are learning.

Based on the background of the problem so that research was conducted with the title correlation between critical and metacognitive thinking skills with cognitive achievement in the PBL learning model.

2. Methods

The study was a pre-experimental study (pre-experimental design) with the One Group Pretest-Posttest Design design that only used one class as an experimental class taken through class randomization assuming homogeneous classes, in this study, there was no control group or comparison but was given an initial test and final test (Sukmadinata, 2005). The design of the research experiment is listed in Table 1.

Table 1: One Group Pretest-Posttest Design Experimental Design

Pretest	Treatment	Posttest
O ₁	PBL Learning Model	O ₂

Information:

O₁: Pretest to measure critical thinking skills, metacognitive awareness and cognitive achievement before the application of PBL learning models.

O₂: Posttest to measure critical thinking skills, metacognitive awareness and cognitive achievement after the application of PBL learning models.

Treatment: Application of PBL learning model

The population of this study was all students of class XI in Public Senior High School 1 Binamu consisting of 7 study groups. Each class totaled 30 students, so the total population in this study was 210 students. Determination of the sample is done by random sampling. The research instrument is a test of critical thinking skills, a Metacognitive Awareness Inventory (MAI) questionnaire, a student's cognitive biology learning outcomes test. Data were analyzed using inferential statistics with a one-way product-moment correlation test and multiple regression.

3. Results and Discussion

3.1 Cognitive achievement with Critical Thinking Skills

Based on the results of the research that has been done, it can be seen that there is a positive correlation between cognitive achievement and critical thinking skills, where the correlation value is 0.22 and if consulted in the classification table the size of the relationship, the relationship between the two is at low intervals. To see the correlation value between cognitive achievement and critical thinking skills, it can be seen in Table 2 below.

Table 2: Correlation Values of Cognitive Achievement with Critical Thinking

Correlation Value	Category
0.22	Low

Table 2 above shows that the calculated r-value is 0.22 and after consultation with the categorizer, is at a low interval. The conclusion of the results of this test is that there is a positive correlation between cognitive achievement and students' critical thinking skills. The results of the research and data analysis that have been carried out by researchers show that there is a positive correlation between cognitive achievement and critical thinking skills of students taught by using PBL learning models on the excretory system material in Public Senior High School 1 Binamu. Correlation values obtained are in the medium category which means that students who have cognitive skills will be accompanied by critical thinking skills. In the correlation equation between the two shows that the correlation between students' critical thinking skills with cognitive achievement if constant metacognitive awareness is positive, or each increase in students' critical thinking skills by one unit, then cognitive achievement increase by 0.36 units.

Indicators of critical thinking skills above are closely related to cognitive achievement that involve students' skills in remembering, understanding, applying, analyzing, synthesizing and evaluating so that between cognitive abilities and critical thinking are interconnected, especially in the learning process using appropriate models such as PBL learning models which in the implementation process provides a great opportunity for students to think about solving problems. The results of this study are supported by research conducted by Ismail (2011), stating that there is a positive relationship between cognitive skills with students' critical and creative

thinking skills in describing a material into an explanation that can be better understood and understood by students.

The results of Sungur and Tekkaya research, 2006 showed that PBL students had higher levels of intrinsic goal orientation, task value, use of elaboration of learning strategies, critical thinking, metacognitive self-regulation, business regulation, and peer learning compared to control group students.

The same thing was expressed by Palluvi (2010) which states that between cognitive achievement and critical thinking skills cannot be separated because both rely on the thinking ability of students to solve problems, and according to Palluvi that critical thinking skills are the domains of C5 and C6 in taxonomy bloom.

3.2 Cognitive achievement with Metacognitive Awareness

Based on the results of research that has been done, there is a positive correlation between cognitive achievement and metacognitive awareness, where the correlation value is 0.08 and if consulted on the classification of the size of the relationship, the relationship between the two is very low. To see the correlation value between cognitive achievement and metacognitive awareness, it can be seen in Table 3 below.

Table 3: Correlation Values of Cognitive Achievement with Metacognitive Awareness

Correlation Value	Category
0.08	Very low

Table 3 above shows that the calculated r-value is 0.08 and after consultation with the categorization table, it turns out that the correlation is very low. The conclusion of the results of this test is that the correlation is positive but very low between cognitive achievement with students' metacognitive awareness.

The results of data analysis showed that there was a positive correlation between cognitive achievement and metacognitive awareness of students taught by using PBL learning models on the excretion system material in Public Senior High School 1 Binamu. The correlation between students' metacognitive awareness with cognitive achievement if constant critical thinking skills are positive, or each increase in students' metacognitive awareness by one unit, then cognitive achievement increase by 0.36 units. This means that each increase in students' metacognitive awareness will be accompanied by an increase in students' cognitive achievement.

This research is in line with previous research that proves that the application of PBL learning models in learning is proven to increase metacognitive awareness (Tosun & Senocak, 2013; Husamah, 2015; Ranjanie & Rajeswari, 2016). Tosun & Senocak (2013) which revealed that PBL is an effective learning model in developing a level of metacognitive awareness and positive attitude, towards students with a weak scientific background.

According to Ismail (2011), stating that metacognitive ability with cognitive achievement has a positive relationship because, in metacognitive, students are asked to think in determining attitudes related to the material or material taught or related to the

teacher's teaching model so that in practice students will be more flexible to self-regulating in learning but still controlled by the teacher. The same thing stated by Wulandari (2011) revealed that metacognitive strategies affect student learning outcomes and students' critical thinking skills. In this study, trying to see the correlation between metacognitive awareness and cognitive achievement of students taught using PBL learning models, it turned out that the results obtained showed positive results. This is due to the learning model used to contribute to increasing metacognitive awareness and cognitive achievement. PBL learning model is very well applied in processing student intelligence because it provides opportunities for students to work systematically in solving problems by referring to scientific work procedures, which of course rely on the ability to think systematically and procedurally.

3.3 Critical Thinking Skills with Metacognitive Awareness

Based on the results of the research that has been done, there is a negative correlation between critical thinking skills and metacognitive awareness, where the correlation value is -0.12 and if consulted on the classification of the size of the relationship, the relationship between the two does not indicate a relationship. To see the correlation value between critical thinking skills and metacognitive awareness, it can be seen in Table 4 below.

Table 4: Correlation Values of Critical Thinking with the Metacognitive Awareness

Correlation Value	Category
-0.12	Negative

Table 4 above shows that the calculated r-value is -0.12 and after consultation with the categorization table, it turns out that the correlation between them is negative. The conclusion of the results of this test is that there is no correlation between critical thinking skills and students' metacognitive awareness.

The results of the data analysis showed that there was a negative correlation between critical thinking skills and metacognitive awareness of students taught by using PBL learning models on the excretion system material in Public Senior High School 1 Binamu. The correlation between critical thinking skills with metacognitive awareness is negative, or there is no relationship between critical thinking skills and metacognitive awareness. This means that any increase in students' critical thinking skills will not be accompanied by an increase in students' metacognitive awareness.

Thinking skills are mental activities to formulate or solve problems, make decisions, attempt to understand something, find answers to problems, and look for things (Arends, 2008). Critical thinking skills are obtained through problem analysis. Meanwhile, metacognitive awareness is a student's skill in managing the thinking process and learning process independently, namely knowing his own cognitive skills and then being able to manage his cognitive skills further.

There is no relationship between critical thinking skills with metacognitive awareness because in theory it is said that critical thinking skills are measuring aspects

of students' knowledge at the level of analysis using reason, whereas metacognitive awareness emphasizes student responses by relying on the psychological side so that it is very difficult to find a relationship between thinking skills critical with metacognitive awareness.

3.4 Cognitive achievement with Critical Thinking Skills and Metacognitive Awareness

Based on the results of the research that has been done, it is obtained the relationship equation between the three measured variables, namely critical thinking skills, metacognitive awareness, and cognitive achievement with the following form of an equation:

$$Y = 31.69 + 0.36X_1 + 0.18X_2$$

With interpretations are: (i) a value = 31.69: with the students 'critical thinking skills and metacognitive awareness, the magnitude of students' cognitive achievement is 31.69 units, (ii) Value of $b_1 = +0.36$: the relationship between skills critical thinking of students with cognitive achievement if constant metacognitive awareness is positive, or each increase in students' critical thinking skills by one unit, then cognitive achievement increased by 0.36 units, and (iii) Value of $b_2 = +0.18$: the relationship between consciousness metacognitive students with cognitive achievement if constant critical thinking skills are positive, or each student increases in metacognitive awareness by one unit, then cognitive achievement increase by 0.18 units.

The results of the study related to the correlation of the three variables studied were cognitive achievement with critical thinking skills and metacognitive awareness of students who were taught by using PBL learning models at Public Senior High School 1 Binamu, showing positive results namely an increase in cognitive achievement always followed by an increase in critical thinking skills and student metacognitive awareness. It has been stated earlier that cognitive achievement have a positive correlation with critical thinking skills, as well as cognitive achievement positively correlated with students' metacognitive awareness, and after contact with the three, they still show a positive correlation of the three.

The correlation obtained between the three is inseparable from the learning model used is the PBL learning model which is a learning model that involves students to solve problems through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have the skills to solve problems (Kamdi, 2007) PBL or problem-based learning as a learning approach that uses real-world problems as a context for students to learn about critical thinking and problem solving skills, and to acquire essential knowledge and material from the subject matter.

Learning with PBL learning models begins with problems that can be raised by students or teachers, then students deepen their knowledge of what they already know and what they need to know to solve the problem. Students can choose problems that

are considered interesting to solve so they are encouraged to play an active role in learning.

Researchers draw the conclusion that PBL learning models should be used in learning because with PBL there will be meaningful learning. Students who learn to solve a problem will make them apply the knowledge they have or try to know the knowledge they need. This means that learning is in the context of material applications. Learning can be more meaningful and can be expanded when students are faced with situations where the material is applied. In addition, through this PBL learning model students can integrate knowledge and skills continuously and apply them in relevant contexts. That is, what they do is in accordance with the application of a material or theory that they find during learning. PBL can also improve critical thinking skills, foster student initiative in work, internal motivation to learn, and can develop interpersonal relationships in group work.

Specific steps in the PBL + NHT integration learning model theoretically support the development of students' critical thinking skills. PBL requires long-term exposure to encourage students' critical thinking skills. NHT learning models make students think critically with the questions given to each student. The findings of this study revealed with the results of Masek and Yamin (2011) study which revealed that students who were taught with PBL learning models had better skills in making conclusions and assumptions than students taught with conventional models. PBL has great potential so students have higher thinking skills. PBL learning models must be carefully designed with attention to critical thinking skills. Teachers contribute to the elements of PBL's effectiveness, including the role of facilitators in mediating students to learn especially in triggering students' metacognitive thinking.

4. Conclusion

The conclusion of this study: (1) there is a positive correlation between cognitive achievement with critical thinking skills, where the correlation value is 0.22, (2) there is a positive correlation between cognitive achievement and metacognitive awareness, where the correlation value is 0.08, (3) there is a negative correlation between critical thinking skills with metacognitive awareness, where the correlation values are -0.12, and there is a correlation between the improvement of cognitive achievement with critical thinking skills and metacognitive awareness in class XI students in Public Senior High School.

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