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Critical Thinking Skills and Students' Achievement on Biology Lesson Using Genetic Instructional Material Based on Learning Cycle 5E: A Correlation Study

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Abstract: The aim of this research is to uncover correlation between critical thinking skills and student achievement and the contributions of critical thinking skills on student achievement through learning Biology using genetic teaching material that developed based on learning cycle 5E model. This research used correlational design. The population of this research was all of student grade XII-IPA at state senior high school. The sample were student of class XII-IPA3 that consist of 30 students. The result showed that there is correlation between critical thinking skills and student achievement in Biology learning using genetic teaching material that developed based on learning cycle 5E model with the regression equation Y = 0,511X–35,271. Based on the value R square analysis showed that critical thinking skills gives contribution 55,2% on student achievement.

Key Words: critical thinking skills, student achievement, learning cycle 5E, genetic teaching materials

Abstrak: Penelitian ini bertujuan untuk mengetahui hubungan keterampilan berpikir kritis dengan hasil belajar siswa SMA serta sumbangan keterampilan berpikir kritis terhadap hasil belajar dalam pembelajaran Biologi menggunakan bahan ajar genetika berbasis *learning cycle 5E*. Rancangan penelitian yang digunakan adalah penelitian korelasional. Populasi adalah seluruh siswa kelas XII IPA di SMA Negeri. Sampel adalah siswa kelas XII IPA 3 yang terdiri dari 30 siswa. Hasil penelitian menunjukkan bahwa ada hubungan antara keterampilan berpikir kritis dengan hasil belajar siswa pada pembelajaran Biologi menggunakan bahan ajar genetika berbasis *learning cycle 5E* dengan persamaan regresi hubungan kedua variabel adalah Y = 0,511X – 35,271. Berdasarkan nilai R^2 diketahui sumbangan keterampilan berpikir kritis terhadap hasil belajar siswa sebesar 55,2%.

Kata kunci: keterampilan berpikir kritis, hasil belajar, learning cycle 5E, bahan ajar genetika

INTRODUCTION

Critical thinking skill and its relationship to learning success have been interesting research topic in the last few decades (Stewart, 1999). Research results on various subjects and levels of education show a correlation between critical thinking skills and academic success. Jacobs (2012) reports that there is a significant correlation between the level of students' critical thinking skills and the results of academic tests in Mathematics learning using CAIS model (Clarification, Assessment, Inference, and Strategies). Gunawan (2013) reported his research on students taking science courses with results showing the contribution of critical thinking skills to learning achievement of 21.53%. Daud and Hafsari (2015) also reported a relationship between critical thinking skills and learning outcomes in high school students in Makassar.

Research on the relationship between critical thinking and learning outcomes has also been carried out by several researchers relating to the implementation of certain learning models. Wicaksono (2014) reported a significant relationship between critical thinking skills and cognitive learning outcomes in the application of reciprocal learning models with the magnitude of the contribution of critical thinking skills to cognitive learning outcomes of 41.99%. Anafiza

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(2016) also reported a significant relationship between critical thinking skills and learning outcomes using the PBL model.

Critical thinking is one of the thought processes that must be taught in a planned and integrated manner (Corebima, 2009; Lai, 2011; Wallace & Jefferson, 2015). Learning processes that empower thinking skills can be used to improve critical thinking skills (Willingham, 2007; Seniuk & McGrath, 2011; Meeta & Al-Mahrooqi, 2014; Panettieri, 2015). One model of constructivism-related learning that is reported to improve students' critical thinking is the 5E learning cycle. Withers (2016) states that the exploration, explanation and elaboration phases are three phases in the learning cycle that aim at constructing concepts through the design of active student activities to discover concepts by involving critical thinking skills throughout learning. The steps in the 5E learning cycle are consistent with Piaget's cognitive learning theory (Bybee 2006; Marek & Cavallo, 1997; Marek et al, 2003). The phases of the 5E learning cycle lead students to learn through the processes of assimilation, equilibration, and accommodation. Student involvement in constructing knowledge in the learning cycle learning is a form of meaningful learning that increases the understanding of concepts that impact on improving learning outcomes.

The implementation of the 5E learning cycle model in learning has been proven to improve critical thinking skills as well as student learning outcomes. A number of studies reports the successful implementation of the 5E learning cycle model to improve critical thinking skills and student learning outcomes, among others, was reported by Hartono (2013); Cahyarini et al. (2016); Bybee et al. (2006); and Sadi and Çakiroglu (2014). The results of these studies indicate that the 5E learning cycle model can simultaneously improve critical thinking and learning outcomes. Based on these facts, it is possible to have a regression relationship between the two variables. Information about the relationship of critical thinking with learning outcomes in learning using the 5E learning cycle model is very limited, therefore it is urgent to conduct a research to uncover the relationship between the two variables.

This study aims at determining the relationship between critical thinking skills with learning outcomes and the magnitude of critical thinking skills to student learning outcomes in Biology lesson using genetic teaching materials based on the 5E learning cycle. The results of this study are expected to be useful as an alternative learning activity used by teachers to develop critical thinking skills and increase student learning outcomes through the 5E learning cycle model.

METHOD

This research employed descriptive-correlational research design. This research was conducted at SMAN 1 Balen Bojonegoro in the 2016/2017 academic year for ± three months. The population in this study were all students of XII grade, while the sample used was students of XII IPA 3 consisting of 30 students. The determination of the sample in this study was carried out by cluster random sampling technique. The instruments used in this study consisted of (1) Learning Instrument including syllabus, Lesson Plan (RPP), genetic instructional materials based on learning cycle 5E, (2) Instrument for measuring learning outcomes and critical thinking was using cognitive essay test kits, and measurement rubrics critical thinking skills. The data obtained were analyzed using linear regression analysis with computer analyzer program and performed at a significance level of 5%.

RESULTS

The results of data analysis of the relationship between critical thinking skills with learning outcomes in biology learning using genetic instructional materials based on the 5E learning cycle is presented in Table 1–3.

Table 1. Anova Summary for The Regression Correlation between Critical Thinking Skills and Learning Outcomes

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	1882,775	1	1882,775	36,764	,000[b]
	Residual	1433,959	28	51,213		
	Total	3316,734	29			

a. Predictor: (constant), Corrected critical thinking skills
b. Dependent variable: Corrected learning outcomes

Table 2. Summary of Correlation Analysis between Critical Thinking Skills and Learning Outcomes

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	,753[a]	,568	,552	7,15631

a. Predictor: (constant), Corrected critical thinking skills

Table 3. Regression Coefficient of Correlation between Critical Thinking Skills and Learning Outcomes

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	35,271	5,318		6,633	,000
	Corrected critical thinking skills	,511	,084	,753	6,063	,000

a. Dependent variable: Corrected learning outcomes

The results of the analysis obtained a value of F = 36.764 and a significance value of 0.000<0.05, which means there is a relationship between critical thinking skills with student learning outcomes in Biology lesson using genetic instructional materials based on the 5E learning cycle. Critical thinking skills contribute to the learning outcomes of 55.2%. The equation of the linear regression line relationship is Y = 0.511X–35.272.

DISCUSSION

The results of this study indicate that students' critical thinking skills have a correlation to student learning outcomes with a value of R = 0.753. The contribution of critical thinking skills to student learning outcomes is 55.2%. It further means that the increase of critical thinking skills result in the increase of student learning outcomes. The results of this study are in line with numerous studies which state that critical thinking skills are a reliable predictor of student academic outcomes (Stewart, 1999; William et al., 2003; Shirell, 2008). The correlation between critical thinking skills and student learning outcomes is in accordance with the opinion of Carbalaei (2012) which states that academic achievement in the form of learning outcomes is a product of the learning process that involves thinking skills. An effective learning process is one element which provides opportunities for students to practice thinking skills. Thinking skills that are mastered by students become learning capital and at the same time become the goal that is expected from the learning process.

The significane of critical thinking skills on learning outcomes indicates that critical thinking skills should be a teacher's attention. Critical thinking plays as one of the important thinking skills in learning. Ennis (2013) defines critical thinking as a process of reasoning and reflective thinking to make decisions. Students who are trained in terms of critical thinking will be beneficial when understanding new concepts. Ideally, critical thinker are (1) focusing on questions or events to decide on an answer or response; (2) has reasons to support or reject decisions based on relevant situations and facts; (3) able to make conclusions with convincing reasons; (4) able to think in the context of the problem to clarify questions, understand the meaning of key terms and identify relevant parts as supporters; (5) understanding and comprehending the terms used and (6) able to review and thoroughly examine the conclusions of the decision made (Ennis, 1996). The six types of ideal abilities in critical thinking allow students to learn in remembering, understanding, applying, analyzing and evaluating knowledge.

One way to practice critical thinking skills is through explicit modeling by the teacher in the learning process (Zirkovic, 2016). The teacher is able to directly include critical thinking by utilizing the learning content which enforces asking questions, delivering responses and criticisms of problems, brainstorming or other thinking simulations explicitly. In addition, critical thinking could be implicitly aroused through the design of learning activities using learning models that practice critical thinking skills.

Lesson content on Genetic requires abstract thinking in accordance with the characteristics of the

5E learning cycle learning model that exercises higher-order thinking skills. This is in accordance with the opinion of Ennis (2013) which states that critical thinking cannot be separated from the learning process, therefore it must be consistently integrated.

The 5E learning cycle learning phase to improve critical thinking skills encourages students to perform higher-order thinking. The 5E learning cycle learning model was developed based on Piaget's theory of cognitive development, namely assimilation and accommodation (Bybee, 2006). The initial phase of the learning cycle, engagement, aims at exploring and directing students' initial knowledge as learning objectives to be achieved (Withers, 2016). The results of exploring the students' initial concepts are used for the next phase which is exploring new knowledge. In the exploration phase, students are given the opportunity to discover new concepts independently by having the initial concepts they have. In the process of concept discovery, students' abilities in determining the focus of a problem or phenomenon, reasoning, deducing, and concluding are actively involved. In this phase, assimilation of old and new concepts that are possible to occur disequilibrium. The next phase, explanation, is the stage of equilibration of the new concept which then becomes a new knowledge. Then, elaboration allows student to use the newly acquired knowledge to be applied to different conditions. It arouses students' critical thinking skills to think based on different contexts. The results of the elaboration phase may enable students to re-evaluate previously acquired knowledge and be replaced with new knowledge or the results of the elaboration strengthen students' understanding of prior knowledge. The three phases, exploration, explanation and elaboration, have prominent characteristics in practicing critical thinking skills (Budprom et al., 2010).

CONCLUSION

The results of this study indicate that there is a relationship between critical thinking skills with student learning outcomes in learning to use genetic teaching materials based on the 5E learning cycle. The relationship formed the regression line equation Y = 0.511X–35.271 with the contribution of critical thinking skills to learning outcomes of 55.2%.

Based on these results the teachers and students are advised to use Genetic instructional materials based on the 5E learning cycle model to encourage students' critical thinking skills which in turn will have an impact on improving learning outcomes.

The learning process should not only focus on student learning outcomes but also practice other skills, one of which is critical thinking skills that will have a positive impact on student learning outcomes.

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