

Mathematics Critical Thinking Reviewed from Self-efficacy and Motivation of Learning in Arias Learning

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Abstract

The ability to think critically and mathematically is the most important goal taught in mathematics learning. The purpose of this study was: analyzing the increase in critical thinking skills, describing the increase in critical thinking skills in terms of self-efficacy, and describing the increase in critical thinking skills in terms of learning motivation. The type of research was mixed methods research, with a sequential explanatory strategy. The sample of this research was the VII-A grade students of Public Junior High School 8 Cirebon City. Data collection was done by test, observation, and interview. Quantitative data were obtained from tests, and qualitative data were obtained from observations and interviews. Quantitative results are then triangulated with qualitative data. The results showed that there was an increase in critical thinking skill through the ARIAS model; students with high self-efficacy had high critical thinking skills; students with medium self-efficacy had medium or low critical thinking skills. Students with low self-efficacy had medium or low critical thinking skill; learning motivation has a strong relationship with critical thinking. Students with high learning motivation have high critical thinking skills. Students with medium learning motivation have medium critical thinking skills. Students with low learning motivation have low critical thinking skills.

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INTRODUCTION

Improving the quality of human resources must always be improved on a sustainable basis through education. Good quality human resources can develop themselves to be able to participate in working together to solve problems in the future. One ability that must be possessed is the ability to think critically — one of the subjects that practices critical thinking skills in mathematics.

Students whose critical abilities are very high with the characteristics that can identify the facts given can mention concepts or prerequisite material, can plan and implement appropriately to have conclusions (Rasiman, 2015). Students who are accustomed to thinking critically and mathematically will be easier to understand the intent and purpose of mathematical problems that influence decisions. The ability to think critically and mathematically in every student is different. This is caused by the habit of learning to solve problems and mathematical solving. The fact that is found in Public Junior High School 8 Kota Cirebon especially in class VII-A and VII-B, there were still students who have difficulties or have obstacles to understand and complete the task of critical thinking questions. It was shown by some students who did not provide complete answers to the questions given and when asked for reasons students gave answers that had difficulty understanding the problem so they could not make plans to solve the problem. The development of critical thinking in mathematics in the classroom can be done through activities such as comparing, making contradictions, induction, generalizing, sorting classifying, proving, linking, analyzing, evaluating, and making patterns, sequenced continuously (Applebaum, 2015).

Mathematical critical thinking ability is the ability to think in solving mathematical problems involving mathematical knowledge, mathematical reasoning, and mathematical verification (Piawa, 2010). Students' critical thinking processes are used in data collection, analysis, and synthesis activities, understanding an issue or fact (Kusumadewi, Mariani, and

Susilo, 2013). Maricic believes that critical thinking as a complex intellectual activity that emphasizes the skills of problem formulation, problem reformulation, evaluation, and problem sensitivity (Maričić, and Špijunović, 2015).

Practicing students' mathematical critical thinking needs to have confidence in the answers made by students. Students who have confidence in their abilities and can do things that have the potential to change circumstances are more likely to act quickly to achieve success compared to students with low confidence. The results of the observations found in class stated that there are still some students who do copy the answers from other students. It is because students do not have the confidence in the results so that they trust the answers of their friends, and eventually, there will be a sense of dependency on the answers. This problem becomes very important, especially in learning mathematics, because mathematics is prioritized for individual critical thinking.

The observation results at VII-A Public Junior High School 8 Cirebon showed that Mathematics is learning using discovery learning models, but in this learning application, it is not yet good fully. This is because the steps of discovery learning have not been fully implemented either by the teacher or students so that the teacher still acts as a center of learning in the classroom. The critical thinking ability of students has not been fully facilitated and has never been measured before; this is supported by daily test questions that still use criteria oriented to low order thinking at the level of remembering and understanding. Also, the results of interviews conducted by a mathematics teacher at VII-A stated that self-efficacy process skills were rarely trained in Mathematics learning, and students tend to be unsure of their answers.

According to the literature study, Critical thinking ability is influenced by factors of self-efficacy level of students (Ng, Liu, and Wang, 2016). Students with high self-efficacy level are usually more diligent in learning and inferior in any situation. Self-efficacy, according to Cai, Liu, Yang, and Liang (2018) describes personal feelings in the form of one's beliefs and expectations regarding actions to resolve

prospective situations and one's ability to achieve learning goals. Self-efficacy in learning mathematics (Taubah, Isnarto, and Rochmad, 2018) is a student's confidence in his ability to organize and carry out mathematics learning to achieve certain goals by predicting the effort needed to achieve the goal. According to Bandura (1994) self-efficacy in each individual will differ from one individual to another based on three dimensions, including level, strength, and generalization. Student self-efficacy develops through the results of interpretations and achievements or previous mastery experiences (Arslan, 2013). The experience experienced by students is very helpful in overcoming obstacles, so it is completing assignments.

It is of mutual concern that each student has a different learning motivation. There are students who have high learning motivation, and others have low learning motivation. Therefore, every teacher must be able to motivate students in learning so that the motivation that exists in each student is optimally stimulated to achieve learning achievement. Strong motivation in students is believed to encourage the student to work hard and never give up in facing all challenges and obstacles in learning so that in the end, it will produce optimal learning achievement. In the concept of learning, motivation as a stimulus for students through learning activities to achieve learning objectives. Indirectly it has an impact on teachers that they have to try to provide motivation externally so that it stimulates students to be more active in learning. There are at least four ways that can be done to increase student motivation, namely: arousal, and it raises the learning spirit; expectancy, it gives something and rises the hope. Incentives, it is an encouragement or giving something; and punishment (Supardi, 2012).

One of the factors that influence the student's low cognitive and affective competence is learning the process. It means the learning quality is a key for student's success. The more qualified learning did, the bigger opportunity (Hardiyanto, and Santoso, 2018). According to Rusman, teachers must use a learning process that can move students to create greater

independence (Zamroni, Sugiharto, and Tadjri, 2014). One learning model to train students' critical thinking skills based on students' self-efficacy is the Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS) models. Rahayu, Waluya, and Sugiman (2014) have conducted research that applies the ARIAS model with the result of an increase in students' mathematical communication skills after the application of the ARIAS model. Self-efficacy can be improved through ARIAS learning with relevant learning and giving rewards to students. By delivering relevant information to students, they are expected to have better self-efficacy.

ARIAS learning model has one of the characteristics of organizing learning where students are more confident about the results of mathematical assignments than relevant questions from the lives of students and teachers give appreciation for the efforts and enthusiasm of students in learning mathematics. The Assurance, Relevance, Interest, Assessment, and Satisfaction (ARIAS) learning model is a learning model that is modified from the ARCS learning model developed by John M. Keller by adding an assessment to the four components of the learning model (Desmawati, and Farida, 2018).

Model ARIAS (Sulistyaningrum, Karyanto, and Sunarno, 2015) model is formed by some learning theories namely Assurance that is related to self-confidence, a relevance that is related to student life, an interest that is related to student learning interest, assessment that is related to student assessment and satisfaction is related to the pride.

METHODS

This study used mixed methods (combination research) with sequential explanatory strategy. Quantitative method was used to analyze the improvement of critical thinking skills before and after being treated with ARIAS model in the experimental class (one group pre-test – post-test design), measure self-efficacy and learning motivation, analyze the relationship between critical thinking skills and self-efficacy, and analyze the correlation critical

thinking skills and learning motivation. A qualitative method was used to describe self-efficacy and learning motivation and describe critical thinking skills in terms of students' self-efficacy and learning motivation. The population of this research was 7th grade students in Public Junior High School 8 Cirebon. The sampling technique used was nonprobability sampling, and it was purposive sampling so that the research sample was obtained from a 7th grade student in Public Junior High School 8 Cirebon. There were 26 students as the sample. Data collection was carried out by tests, observation sheets, questionnaires, and interviews. The instrument of critical thinking skills used tests, self-efficacy, and motivation to learn using a questionnaire. The analysis technique used was quantitative and qualitative analysis techniques. The quantitative analysis consisted of a normality test, homogeneity test, and paired two-sample t-test, N-gain test, product-moment correlation analysis between self-efficacy or learning motivation with critical thinking skills. Analysis of qualitative data collected used interactive model data analysis with three main activities, namely data reduction, data presentation, and conclusion drawing/verification. Data collection results from critical thinking skills, self-efficacy, and learning motivation, were categorized into high, medium, and low. The validity test of qualitative data in this study used data/source triangulation and theory.

Indicators of critical thinking skills in this study consisted of basic clarification, the best for a decision, inference, advance clarification, supposition, and integration. This study used seven types of self-efficacy, among others: level (level), strength (strength), and generalization (generality). Indicators of learning motivation used in this study consisted of desire and desire to succeed, encouragement, and needs in learning, hopes, and aspirations for the future, interesting activities when learning, appreciation, a conducive learning environment, prefer to work independently whereas qualitative data were often used as supporting quantitative completeness and confirming student work

through oral explanations so that it is more comprehensive (Archibald, 2016).

RESULTS AND DISCUSSION

Increased Critical Thinking Ability

The final data obtained in this study was the data score of 7th grade students of Public Junior High School 8 Kota Cirebon with pre-test value data and post-test value of critical thinking skills after ARIAS model treatment given. Based on the results of the study, the average pre-test and post-test scores of experimental class students were 33.72 and 81.5. The paired two-sample t-test tested increased critical thinking skills in this study and gain test.

Based on the calculation, it is obtained that the value of the $t_{\text{value}} = 2.059$. Value $dk = 26 - 2 = 24$ and a significance level = 5% obtained value table that was 2.009, so the value of $t_{\text{value}} > t_{\text{table}}$. The ARIAS model has the opportunity to empower critical thinking skills that can ultimately improve student learning outcomes. The calculation of the gain value was obtained from the difference between the pre-test and post-test values with 14 high criteria students, eight medium criteria students, and four low criteria students. The calculation of self-efficacy scores of experimental class students had good criteria with an average score of 83.76, while the calculation of learning motivation scores of the experimental class had good motivation with an average score of 78. The results of normality and homogeneity test on test data critical thinking skills, self-efficacy, and motivation to learn were more than $\alpha = 0.05$. The results of student categorization based on the achievement of critical thinking skills can be seen in table 1.

Table 1. Self-efficacy Level

Score interval	Category	Frequency
$73 \leq x \leq 86$	High	9
$56 \leq x < 72$	Medium	7
$40 \leq x < 55$	Low	10

The level of mathematical critical thinking ability of students can be seen in table 2.

Table 2. Critical Thinking Ability Level

Score interval	Category	Frequency
$85 \leq x \leq 90$	High	7
$56 \leq x < 84$	Medium	14
$70 \leq x < 72$	Low	1

The level of students' learning motivation ability can be seen in table 3.

Table 3. Learning Motivation Level

Score interval	Category	Frequency
$86 \leq x \leq 113$	High	9
$58 \leq x < 85$	Medium	11
$30 \leq x < 57$	Low	6

Correlation Test

Product moment correlation test (r) is used to state the relationship between the self-efficacy variable or the learning motivation variable and the critical thinking ability variable. The value of r between critical thinking and self-efficacy of experimental class students contained a correlation of 0.506, including the strong correlation category. The coefficient of determination seen from the r square value of 0.256. This means that 25.6% of students' critical thinking can be explained by the level of self-efficacy, while other factors may cause the remaining 74.6%.

The value of r between critical thinking and learning motivation of experimental class students correlates 0.856, including the category of very strong correlations. The coefficient of determination seen from the r square value was 0.761. It means that 76.1% of critical thinking possessed by students can be explained by the high and low motivation to learn, while other factors may cause the remaining 24.9%.

Profile of Critical Thinking Ability Viewed from High Self-efficacy

Students who have high self-efficacy tend to have high critical thinking skills. Relatively deep ways of thinking characterize students attitudes toward mathematical problems and using their conceptual knowledge to solve problems. The characteristic of students who think critically is to find concepts that are relevant to solving the mathematical problems encountered. In line with the results of research

by (Chang, 2015) that self-efficacy has a positive impact on student achievement in learning mathematics.

Students with high critical thinking skills will answer the math questions by reviewing the information in the problem based on understanding and looking for steps to solve the math problem. Based on the results of the interview, it was found that students with high self-efficacy and critical thinking skills could re-explain mathematical problems and concluded the results of the work done.

Profile of Critical Thinking Ability Viewed from Medium Self-efficacy

Students with medium self-efficacy tend to have medium mathematical critical thinking skills, and few have high critical thinking skills based on research that has been done. The attitude of students with self-efficacy is showing the results of working on mathematical critical thinking problems that can identify problems and errors that are still found in determining the resolution process so that it will affect in concluding.

Students with medium self-efficacy sometimes still asked other students who were considered to be better at working on math problems. In other words, there is still a lack of confidence in the results that have been done. Based on the results of the interviews found that the students with self-efficacy were still asking formulas to other friends and did not give the right reason about the conclusion of the process of solving the questions.

Profile of Critical Thinking Ability Viewed from Low Self-efficacy

Students who have low self-efficacy showed low mathematical critical thinking skills as well. Low self-efficacy tends to copy the answers from their friends so that it is not the result of his efforts. Students felt unsure about understanding mathematical problems so that they doubted their answer.

Based on interviews of students who have low self-efficacy, it showed that students did not provide an answer the math questions because

they did not understand the problem in the problem so that students' critical mathematical thinking ability was also low. Also, students' answers were sometimes not systematic because of cheating on other students' answers.

Profile of Critical Thinking Ability Viewed from High Learning Motivation

Students with high motivation tend to have high critical thinking skills as well. Loes, Salisbury, and Pascarella (2015) explain that motivation provides accurate support to foster critical thinking skills. Students with high learning motivation and high critical thinking ability have an interest in critical thinking questions, like the obstacles contained in the problems, and have the petitions or conditions from parents to obtain praise from achieving learning outcomes. This is following the results of Jayanti, and Widayat (2014) that parents make demands on their children to obtain learning achievements that affect perfectionism. Students with high critical thinking ability can analyze problems stably and continue thinking so that they can be classified as advanced thinking. Paul, and Elder (1997) characterize advanced thinking as an active mental activity in the form of analytical actions using the knowledge possessed to look for relationships between concepts.

Profile of Critical Thinking Ability of Students with Medium Motivation

Students with medium motivation tend to have the ability to think critically, as well. The ability to think critically is signed by the achievement of indicators that are not all felt or are said to be imperfect. Students with medium learning motivation and critical thinking skills are having enough or even less interest in critical thinking skills, dislike mathematical obstacles, and lack of the demands or attention from the teacher about the learning outcomes achieved. Beginning thinking is usually signed by the ability of students with critical thinking while students cannot meet all indicators of critical thinking skills. As a result, their answers were incomplete. Paul, and Elder (1997) explain the beginning

thinking has a sign of limited insight that affects the attitude of critical thinking deeply.

Profile of Critical Thinking Ability of Students with Low Motivation

Students with low motivation tend to have low critical thinking skills. Students with low learning motivation and low critical thinking skills have less interest in critical thinking questions, do not like non-routine problems, and do not have the pressure from parents about the results of learning mathematics. This low critical thinking is characterized by unreflective thinking, namely the condition of students who are unable to understand the problems that affect the process of finding answers and using mathematical concepts that support because of limited insight so that sometimes students do not write answers on the answer sheet.

CONCLUSION

Based on the results of the research and discussion concluded, the following conclusions: Critical thinking skills are significantly influenced by self-efficacy and learning motivation. Students with high category critical thinking skills are less able to explain the results of the answers when interviewed. This is due to the lack of self-efficacy of students, so an effort to improve self-efficacy through learning needs to be done.

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