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RELATIONSHIP BETWEEN METACOGNITIVE SKILLS AND CRITICAL THINKING IN ELEMENTARY SCIENCE LECTURES THROUGH GUIDED INQUIRY MODEL

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Abstract: Learning science helps one develop understanding and thinking habits and allows students to master many life skills. Science learning emphasizes empowering high-level thinking skills such as metacognitive and critical thinking. This study aimed to determine the relationship between metacognitive skills and critical thinking using a guided inquiry strategy in elementary science education lectures. The study results show a relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures in learning using the guided inquiry strategy. The value of the correlation coefficient (r) of students' metacognitive skills with critical thinking in Elementary Science Education lectures is 0.859 (very high). The direction of the relationship between metacognitive skills and critical thinking is a positive relationship. The coefficient of determination (r2) is 0.737, so it can be explained that the variability of students' critical thinking values is determined by 73.3% of metacognitive skills. The regression significance value proves that the regression line equation can be used for prediction. The equation of the regression line for the relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures using the guided inquiry strategy is $\hat{Y}$=0.960+0.863X.

Keywords: *Correlational Research, Metacognitive Skills, Critical Thinking.*

INTRODUCTION

Science is a branch of science that studies natural phenomena within the scope of human experiences. Science learning helps a person develop understanding and thinking habits and allows students to master many life skills [1]. Science subjects equip students with knowledge, ideas, and concepts about the natural environment, which are obtained from experience through a series of scientific processes, including investigations. In practice, both elementary and tertiary institutions' science learning emphasizes active learning, which is supported by applying scientific inquiry-based learning strategies, models, and techniques. One of the research and investigation-based learning strategies is guided inquiry. This learning strategy can encourage passive learning to become active and train critical thinking skills, metacognitive and other higher thinking skills. Guided inquiry learning strategies significantly affect students' metacognitive skills and critical thinking [2]. Critical thinking and metacognition are closely related and share a high degree of interdependence, so if you want to cultivate metacognition and independent learning behavior, you must also pay attention to critical thinking skills. Students' thinking skills will affect the development of their personalities [3].

Metacognition, on the one hand, refers to "the knowledge one has about the products of one's cognitive processes, or of others related to them" and, on the other hand, "to the active control and consequent regulation and regulation of these processes about cognitive objects or data on whom they act [4-5]. Metacognition and critical thinking are critical to academic success. The relationship between these components and learning at the tertiary level is assessed by examining progress, curriculum development, and efforts to ensure the learning progress of all students. The process of skills in learning will be more meaningful when students' critical thinking and metacognitive skills are optimally developed [6].

Metacognitive skills are considered valuable for students to have [7]. Education in the 21st century requires students to assess their understanding accurately [8]. Metacognition is an important skill for students because it is a high-level thinking process involving active control of students' cognitive processes, such as planning, predicting, testing, perfecting, assessing, and evaluating, so metacognition can reflect students' understanding of what will be learned moderately [9]. Using metacognitive skills makes students aware of their weaknesses and strengths in learning so they can know what to do and monitor the actions taken [10].

Metacognition is the capacity to monitor and control one's cognitive processes introspectively [11]. Metacognitive refers to the capacity to reflect on and assess cognitive abilities [12]. Metacognition is the ability to monitor and regulate our cognitive abilities, such as perception or memory [13]. Metacognition is awareness and thought control for learning. Strong metacognitive skills can influence student learning and performance [14].

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Metacognition, or knowledge of one's cognitive processes, is essential to student academic success. It is one of the cognitive strategies developed by lifelong learners [15]. It is one of the cognitive strategies lifelong learners develop [15]. Metacognition is the ability to reflect, understand, and control learning [16]. Metacognition is part of the self-learning process and includes planning, goal setting, organization, self-monitoring, and self-evaluation at various points during the knowledge acquisition process [17]. Lack of metacognitive abilities causes students to be less successful at the academic level and hinders the independent learning necessary to become lifelong learners who can adapt to any learning situation [18]. Metacognitive skills require students to reflect on what is done and needed to do the assignments given and use and choose learning strategies that support success in learning [19].

Metacognitive skills significantly correlate with critical thinking skills [20-22]. The development of critical thinking as an important skill in 21st-century learning is undeniable in educational and professional settings [23]. The empowerment of the learning process will be more meaningful if critical thinking skills are also optimally developed [6]. Critical thinking skills are developing a mindset and taking the initiative to seek information about something, not only explained by the lecturer in detail [24].

Critical thinking is thinking about looking at a subject, assessing content, or understanding a problem skillfully. Critical thinking is also used to choose and analyze right and wrong [25]. Critical thinking is the ability to try to maintain an objective position. Critical thinking means weighing all sides, be it the strengths or weaknesses of an argument. The core of critical thinking is the ability to analyze and creatively adapt to new situations is the core of critical thinking [24].

Research conducted by [26] explains that metacognitive skills are significantly related to students' critical thinking in learning using four different strategies. There is a correlation between metacognitive skills and critical thinking skills of class X and XI high school students in Malang City [27]. More [27] explained that the relationship between metacognitive skills and critical thinking in class X students was very high, with a correlation coefficient of 0.978, and metacognitive skills determined 95.6% of the variability in the value of critical thinking. The relationship between metacognitive skills and critical thinking of class XI students is very high, with a correlation coefficient of 0.944 and 89.2% variability in the value of critical thinking determined by metacognitive skills.

Students with good metacognitive skills will be successful in learning because they will develop themselves to become independent learners and able to control their cognitive processes, including thinking skills]. Based on this explanation, this study aims to determine the relationship between metacognitive skills and critical thinking in elementary science education courses using guided inquiry strategies.

RESEARCH METHODS

Research using correlational research methods. Correlational research is research that is used to describe the relationship that exists between variables [28]; [29]. The variable relationship seen in this study is a real picture of the relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures using guided inquiry. The correlational research design can be seen in Figure 1 below,

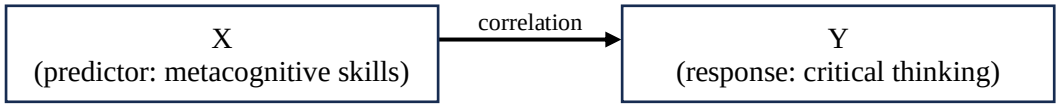

Figure 1. Correlational Research Design

Metacognitive skills are measured using validated essays. The rubric of metacognitive skills is used to determine scores of metacognitive skills [30]. It consists of 7 scales (0-7) and is used as a reference for checking student answers for each test item. Critical thinking skills are measured using tests and assessed using a critical thinking rubric [31]. The data analysis used in this research is Pearson Product Moment [32]. Pearson Product Moment correlation is analysis to determine the closeness of the relationship between metacognitive skill variables and critical thinking with the following formula,

$$r = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2}\sqrt{n\sum y_i^2 - (\sum y_i)^2}}$$

Furthermore, the coefficient of determination analysis is carried out to determine how much influence the independent variables have on the dependent variable. The coefficient of determination is calculated by multiplying the correlation coefficient by 100%. Furthermore, a regression analysis is performed using simple linear regression to determine the value of the regression coefficient and the regression line equation. Regression analysis is a statistical technique for investigating and modeling the relationship between variables [33]. the regression equation used is,

$$\hat{Y} = a + bX$$

Before being analyzed using simple regression analysis, the data were first analyzed with normal distribution and the linearity relationship pattern of the data as a classic assumption test for simple regression analysis. Analysis of the normality distribution test of the data was carried out using the Shapiro-Wilk test analysis. The normality test using the Shapiro-Wilk tests how well the distribution of the research data conforms to the normal curve if the number of samples is less than 50 [34]. A linearity test is carried out to determine the relationship pattern between metacognitive skills and critical thinking.

RESULT AND DISCUSSION

The research results are explained in detail, starting from the results of the classic assumption test of research data, namely normality and linearity data. The results of the data normality test can be seen in Table 1 below.

Based on the conclusions from the normality test results of the research data in Table 1, it can be seen that the metacognitive skill data is normally distributed with a significance value of 0.074 greater than the predetermined significance level of 0.05. Students' critical thinking data is also normally distributed with a significance value of 0.220, greater than the predetermined significance level of 0.05. In addition to the normality test, a linearity test was also carried out on the research data. The results of the linearity test can be seen in Table 2 below.

Table 1. Summary of Normality Test Results

Variable		Shapiro-Wilk		
		Statistic	df	Sig.
Score	Metacognitive Skills	.948	38	.074
	Critical Thinking	.962	38	.220

Table 2. Summary of Linearity Test Results

			Sum of Squares	df	Mean Square	F	Sig.
Critical_Thinking * Metacognitive_Skills	Between Groups	(Combined)	1209.182	15	80.612	5.488	.000
		Linearity	1129.937	1	1129.937	76.930	.000
		Deviation from Linearity	79.246	14	5.660	.385	.965
	Within Groups		323.133	22	14.688		
	Total		1532.316	37			

Based on the results of the linearity test, it is known that the significance value of the Linearity data for critical thinking with metacognitive skills is 0.00 <0.05, so it can be concluded that the relationship pattern of metacognitive skills with critical thinking has a linear relationship. The pattern of linear relationships can also be seen from the significance value of Deviation from Linearity. If the significance value of Deviation from Linearity is greater than the significance level, then the relationship pattern between the two variables is linear. Based on the analysis results, it is known that the significance value of Deviation from Linearity is 0.965 > 0.05, so it can be concluded that the relationship pattern of metacognitive skills with critical thinking has a linear relationship.

The next results explain the value of the regression coefficient, which can be seen in Table 3. Based on the results of the analysis in Table 3, it can be seen that the significance value of the regression is 0.00 <0.05, so H_0 states that there is no relationship between metacognitive skills and critical thinking of students in Elementary Science Education lectures using the model Guided inquiry, was rejected Ha, states that there was a relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures using the guided inquiry model, was accepted.

Table 3. Regression Coefficient Analysis Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1140.823	1	1140.823	101.093	.000[b]
	Residual	406.256	36	11.285		
	Total	1547.079	37			

Table 4. Correlation and Determination Coefficient of Relationship Between Metacognitive Skills with Critical Thinking

	R	R Squared	Eta	Eta Squared
Critical_Thinking * Metacog_Skills	.859	.737	.888	.789

This regression significance value is also used to determine whether the regression line equation can be used for prediction or not. If the regression significance value < the specified significance level, then the regression line equation can be used for prediction. Based on the analysis results, the regression significance value is 0.00 <0.05, so it can also be concluded that the regression line equation can be used for prediction. The value of the correlation coefficient (r), which explains the close relationship between metacognitive skill variables and critical thinking, and the coefficient of determination (r^2), which explains the influence of the predictor variable on the response variable, can be seen in Table 4.

Based on Table 4, it can be seen that the value of the correlation coefficient (r) of metacognitive skills with critical thinking of students in Elementary Science Education lectures using the Guided-inquiry strategy is 0.859 (very high). The direction of the relationship between metacognitive skills and critical thinking is a positive relationship. The coefficient of determination (r2) is 0.737, so it can be explained that the variability of students' critical thinking values is determined by 73.3% of metacognitive skills. The relationship pattern of metacognitive skills with students' critical thinking based on scatterplot analysis can be seen in Figure 2 below.

Based on Figure 1, the relationship between metacognitive skills and students' critical thinking forms a linear positive relationship. An overview of the regression line equation for the relationship between metacognitive skills and students' critical thinking can be seen in Table 5 below.

Based on Table 5, it can be seen that the intercept of the regression line equation is 0.960. The slope value (slope of the line) is 0.863. This slope value means that for every 1-point increase in the metacognitive ability variable, the value of the critical thinking ability variable will increase by 0.960. The equation of the regression line of the relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures using the guided inquiry strategy is $\hat{Y} = 0.960 + 0.863X$.

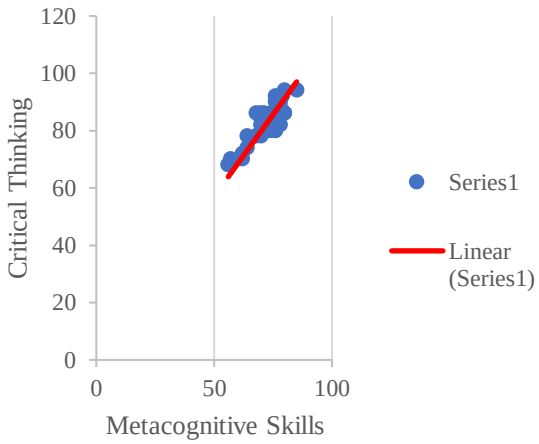

Figure 2. Scatterplot Relationship Between Metacognitive Skills and Critical Thinking

Based on the results of data analysis, it is known that there is a significant relationship between metacognitive skills and critical thinking of students in elementary science education courses with a correlation coefficient of 0.859, which means that the relationship between metacognitive skills and critical thinking is very close or very high [35-36].

Table 5. Regression line equation of the relationship between metacognitive skills and critical thinking.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.960	7.126		.135	.894
	Critical_Thinking	.863	.086	.859	10.055	.000

Metacognition plays an important role in developing critical thinking and consists of a person being aware of their thinking processes to improve them to gain better knowledge [5]. Critical thinking depends on this metacognitive mechanism functioning properly, being aware of the processes, actions, and emotions at play, and thus having the opportunity to understand what has not been done well and improve it [5].

The very high relationship between metacognitive skills and critical thinking suggests that students who self-regulate and develop effective strategies such as planning, information management, monitoring, debugging, and evaluation require a sophisticated understanding of their own cognitive processes. The basic skills of critical thinking are metacognitive skills. Both critical thinking and metacognition are associated with higher-order thinking [37]. Students with a high level of metacognitive skills will have cognitive learning outcomes, which is indicated by a higher understanding of concepts compared to students with lower metacognitive skills [10].

Critical and metacognitive thinking can be assessed, linked, and explored by the interactions between thoughts, behaviors, and the learner's environment [38,15]. This theoretical perspective provides a framework that students learn better when they are more aware of their thinking and cognition [15]. Metacognitive practices increase students' ability to transfer or adapt their learning to new contexts and tasks [39].

A successful pedagogy that can serve as a basis for increased thinking must incorporate ideas about how learners organize knowledge and internally represent it and how these representations change and resist change. When new information is discovered, in his explanation, increasing knowledge is referred to as critical thinking, and organizing knowledge can be a factor of metacognition [39].

Metacognition is the ability to use knowledge to direct and improve thinking skills. When engaging in critical thinking, students need to undergo specific metacognitive skills such as engaging their thought processes, assessing progress towards appropriate goals, ensuring accuracy, and making decisions about using time and mental effort [40].

If a person does not have the skills to know the correct answer, they are also judged unable to know when their answer, or that of others, is right or wrong. It suggests that increasing metacognitive abilities to learn specific skills (e.g., knowing right and wrong), how to recognize them, and how to pay for them is needed in many contexts [41].

Metacognitive practice helps students recognize their strengths and weaknesses as learners, writers, readers, test takers, group members, etc. The key element is recognizing the limits of one's knowledge or abilities and looking for ways to extend or extend that ability knowledge. Those who know their strengths and weaknesses in these areas are likelier to "actively monitor their learning strategies and resources and assess their readiness for specific tasks and performance [39].

With metacognition, critical thinking is possible [42]. Critical thinking is a metacognitive process that, through purposeful reflective judgment, increases the likelihood of coming up with a logical conclusion to an argument or a solution to a problem. Instruction in critical thinking is very important because it allows individuals to gain a more complex understanding of the information they encounter and promotes good decision-making and solving problems in real-world applications [21].

Empowerment of metacognitive skills in the learning process must be carried out optimally and continuously at every level of education. It will have an impact on students' critical thinking skills and independence. Students must be equipped with these skills to be competitive and motivated to face the challenges of the fast-paced and digital development era [26].

Metacognitive skills are important in increasing critical thinking capacity and active control of students' cognitive processes in learning [26]. Critical thinking contributes to students' real-life skills [43-44]. When students develop their critical thinking skills, they can make more accurate daily life decisions [45].

One of the three second-level cognitive levels directly related to critical thinking processes is metacognition. The concept of metacognition includes the ability of individuals to understand, control, and reflect on their learning processes [16].

Critical thinking skills are related to metacognition. Someone with good critical thinking skills has better metacognitive activity, especially in strategic planning and evaluation [46]; [47]. Watson & Glaser states that there are four skills in creative thinking, namely: 1) the ability to formulate problems, 2) the ability to choose the right information to solve problems, 3) the ability to develop & choose hypotheses, and 4) the ability to legitimize conclusions & evaluation [48].

Metacognitive skills refer to the use of strategies the learner requires to control cognition, also called metacognitive strategies [49]. The strategy focuses on executive control processes, including “fraud attention, conflict resolution, fault detection, and inhibition control” [50]. Metacognitive skills include orientation, planning, cognitive development, coaching, and evaluation approaches [51]. However, [52] suggest that metacognitive skills are part of the self-regulation process.

Planning refers to the efforts of learners to identify the appropriate strategies and resources needed to complete the relevant tasks. Monitoring represents the awareness of students in tracking their assignments. Evaluate captures learners' ability to assess the setting process and their learning outcomes. [16] add debugging and information management strategies as

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two important components of metacognitive regulation. The debugging strategy refers to students' efforts to correct errors related to understanding and performance. Information management strategy refers to the ability of students to process, organize, describe, and summarize information.

Students who have good developmental metacognition will be better able to solve problems, make decisions and think critically, be more motivated to learn, be better able to regulate emotions and be better able to overcome difficulties [53]. In principle, critical thinking and metacognitive skills are closely related. In contrast, critical thinking involves metacognitive skills, whereas having metacognitive skills will make a thinker more successful. As long as students do metacognitive learning, thinking is involved in it. Metacognition is contained in the elements of critical thinking. Critical thinking is a cognitive process at the level of analysis, synthesis, and evaluation, so if a student has high enough metacognitive skills, then he will be able to choose the learning strategy he uses to understand a subject matter well and to solve the problems encountered to obtain high cognitive learning outcomes [54].

Critical thinking involves secreting, analyzing, summarizing, and evaluating information. In critical thinking, of course, you can't see only a problem from one side. In critical thinking, a person must have the skills to listen and read carefully, seek, obtain, and process hidden assumptions, and explore the consequences of a statement [55]. Critical thinking is a cognitive skill or strategy that aims to increase the likelihood of a desired outcome. Describes thinking that is full of goals and directs goals and can also be called thinking, which involves the ability to solve problems, conclude, remember the opportunities that exist, and make decisions [56].

Paul and Elder explained that the characteristics of a person's critical thinking abilities include 1) being able to solve questions & answer a problem clearly and accurately; 2) collecting relevant information & using thinking effectively; 3) Summing up & getting good solutions according to relevant criteria and standards, 4) expressing openly in understanding problems, 5) communicating effectively to find solutions to a problem [57]. The ability to think critically is the ability to identify and formulate a problem, which includes determining the essence, finding differences and differences, and digging up relevant information and data [58].

Metacognition is not only about "thoughts about thoughts" but also includes how a person knows knowledge, information processing, and cognitive and affective states [59]. Indirectly, metacognitive skills will affect students' cognitive abilities and especially how they process existing information.

Metacognition skills are defined as a form of cognition or thought process that includes control of cognitive activity [60]. Metacognition skills refer to two skills, namely (Self-Regulation) students' skills in managing their learning activities, and (Self-Evaluation) students' skills in managing their knowledge and abilities in learning [61]. Metacognition skills are very important to be empowered because they can help students become independent, think critically, and improve learning outcomes [62-63].

Students supported by their metacognitive skills can learn about thinking processes and apply specific learning strategies to think independently through difficult tasks [64]. Metacognitive skills need to be empowered in learning because, with metacognitive skills, students can manage information and behavior and complete learning activities more easily [6].

Metacognition refers to higher-order thinking skills that involve active control of the cognition process in learning [65]. Metacognition is Related to developing critical thinking and is an important aspect of improving cognitive abilities. Students also need metacognitive skills to improve thinking and problem-solving. Therefore, metacognition is related to students' critical thinking and cognitive development, especially in understanding concepts. The good application of metacognitive and critical thinking is to use higher-order thinking skills and deal with cognitive abilities in understanding the material being studied [10].

CONCLUSION

The study results show a relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures in learning using the guided inquiry strategy. The value of the correlation (r) of students' metacognitive skills with critical thinking in Elementary Science Education lectures is 0.859 (very high). The direction of the relationship between metacognitive skills and critical thinking is a positive relationship. The coefficient of determination (r2) is 0.737, so it can be explained that the variability of students' critical thinking values is determined by 73.3% of metacognitive skills. The regression significance value proves that the regression line equation can be used for prediction. the regression line equation of the relationship between metacognitive skills and students' critical thinking in Elementary Science Education lectures using the guided inquiry strategy is $\hat{Y}=0.960+0.863X$.

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