



The Correlation Between Critical Thinking Skills and The Learning Outcomes on Musculoskeletal System

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ABSTRACT

Critical thinking skills is a most important aspect that must be owned by students in biology learning, especially in solving the problems that require alternative in-depth solutions and close to the problems that we are often encountered in daily life. This research aims to determine the correlation between student's critical thinking skills and learning outcomes on the topic of human musculoskeletal system. The method for this research was correlational study. The research's populations were all of grade 10 MIPA Senior High School in Tasikmalaya with characteristics discipline and have a lot of achievement in academic and nonacademic. The sample was 48 students from grade 10 of MIPA 4 selected based on cluster random sampling method. The data were gained by giving the essay test consisting of 15 analysis questions with indicators developed by Ennis to measure student's critical thinking, and 35 multiple choice questions to measure student's learning outcomes. Data analyzed by correlation and regression analysis Pearson product moment with significant level (α) 0,05. The normality and linearity test are conducted before performing the hypothesis test as a prerequisite. The result of research, data analysis, and hypothesis testing reveals that there is a positive correlation between student's critical thinking skills and learning outcomes on the topic of human musculoskeletal system with correlation coefficient obtained is 0,667 it's mean have a high correlation category. Contribution of critical thinking skills toward learning outcomes is 44,5% while 55,5% is influenced by other variables that are not researched.

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Keywords: Critical Thinking Skills, Learning Outcomes, Musculoskeletal System

Introduction

Education occupies a central position because it is an important factor in nation building, where the main target is to improve the quality of human resources. In line with that, the problems that arise will be increasingly complex so that it requires the field of education to further improve the quality of education along with the development of science and technology in this era of globalization which is always growing rapidly. Therefore, at this time students are expected to be able to live independently and be useful for themselves and their environment to be globally competitive.

Biology learning is related to how to find out and understand nature systematically. Therefore, biology learning is not only the mastery of knowledge in the form of facts and concepts, but also a process of discovery. In its application, the learning process of biology learning should train students to explore abilities and skills in searching, processing, and critically assessing various information (Sari, 2012). So that in biology learning, critical thinking skills are needed, especially when analyzing a problem to the stage of finding a solution. In addition, in the cognitive or knowledge domain, the 2013 curriculum requires students to have higher order thinking skills which are also called complex thinking which consists of critical thinking, creative thinking, problem solving and decision making (Ramdani and Badriah, 2018).

However, the implementation of the learning process in schools currently does not refer to the application of students' critical thinking skills, but the learning process only directs students to memorize information. Whereas critical thinking skills are one of the most essential cognitive abilities for every student and is a fundamental part of human maturity. Especially with the emergence of a new paradigm in the world of education today, students are required to be actively involved in learning by developing their critical thinking skills in order to understand the knowledge being learned. In accordance with the theory of constructivism, that knowledge is built by itself in the minds of students. So, knowledge cannot be simply transferred from the teacher to the students, but the students themselves must interpret what has been learned by adjusting to their understanding.

Critical thinking is thinking that is always curious about an existing problem so that it will continue to seek information to achieve an appropriate understanding (Ramdani and Badriah, 2018). Thus, students who have this ability will be able to analyze problems, draw conclusions from various aspects and points of view, and determine solutions to solve these problems. In addition, critical thinking is an organized systematic process that allows students to formulate and evaluate the evidence, assumptions, logic, and language that underlies the statement, as well as to find answers to these problems (Antika, et al., 2017).

Critical thinking allows students to find the truth and facts from information or events that occur every day. Driven by the desire to find answers and reach understanding, students who have the ability to think critically will be able to examine their own thinking processes and the thinking processes of others to find out whether these thinking processes make sense. Because the characteristic of someone who has the ability to think critically (critical thinking) is to always question an argument to obtain the ultimate truth (Pujiono, 2012). Students who are able to think critically will be able to properly review all the knowledge learned through thorough understanding, careful analysis, and assessment with accountable criteria. The indicators in critical thinking developed by Ennis (Tawil and Liliyasi, 2013) are: giving simple explanations (elementary clarification), building basic skills (basic support), making inferences (infering), making further explanations (advanced clarification), and set strategies and techniques (strategies and tactics).

This critical thinking ability is needed in the learning process carried out by students so that it can affect their learning outcomes. Learning is a series of activities carried out to

obtain changes in behavior as a result of the experience of students in interacting with the environment. Learning is a relatively permanent stage of individual behavior change because of experience and interaction with the environment that involves cognitive processes (Syah, 2011). While learning outcomes are learning achievements achieved by students in learning activities that result in a change and formation of behavior. So that learning outcomes are a very important thing because as an indicator of learning success.

The development of critical thinking skills in the learning process can also be one way to improve student learning outcomes. The importance of critical thinking skills in the learning process is because of the importance of preparing students to become strong problem solvers, mature decision makers, and humans who never stop learning (Malahayati et al., 2015). Through critical thinking, students play an active role in constructing their own knowledge or cognitive and can apply it to find solutions to problems faced so that learning outcomes will also be high. Based on this, critical thinking skills have a very important urgency in improving student learning outcomes.

Previous research related to the relationship between critical thinking skills and cognitive learning outcomes conducted by Resti (2014) showed a correlation coefficient of 0.954, which means, there is a strong relationship between critical thinking skills and students' cognitive learning outcomes. Furthermore, research conducted by Surachman (2010) shows that there is a relationship between critical thinking skills and learning outcomes in project-based learning with a reliability value of 73.4%.

The fact is that after making observations at one of the favorite high schools located in Tasikmalaya, most of the students in their learning activities are classified as being able to ask questions, answer teacher questions, besides that they are also able to analyze and solve problems in questions or question and answer learning methods that are carried out. So in this case their critical thinking skills begin to develop. Student learning outcomes are also quite good, this can be seen from the results of daily tests.

So, to measure how high the correlation between critical thinking skills and student learning outcomes is, researchers use one of the materials that allows to measure both, for example on the musculoskeletal system material. In the competency of the human movement system material, students are required to be able to remember, understand, apply, analyze the relationship between the structure of the organ-composing tissue in the musculoskeletal system in relation to bioprocesses and functional disorders that can occur in the human movement system. So, it will be known how big the correlation between critical thinking skills and student learning outcomes. The purpose of this study was to determine the correlation between critical thinking skills and student learning outcomes on the material of the musculoskeletal system in humans.

Methods

The research method used is a correlational study. The place of research was carried out in one of the Tasikmalaya Public High Schools in November 2019. The population in this study was all 8 classes of grade 11 of MIPA. The sample in this study was grade 11 MIPA 4 totaling 38 students who were taken using cluster random sampling technique.

The research steps taken are: the preparation stage which includes preparing the title, making observations, submitting the title, conducting interviews and asking permission from the teacher concerned, compiling research proposals and instruments, testing research instruments; the implementation phase includes testing of research instruments; and data processing stages such as data analysis on critical thinking ability test results and learning outcomes that have been obtained and then make conclusions.

The data collection technique used in this study is a test technique. In this study there is an independent variable, namely the ability to think critically (X), while the dependent variable is learning outcomes (Y). So that the instruments used in this study were two, namely the critical thinking ability test on the material of the human movement system in the form of description questions totaling 15 valid questions referring to the five indicators developed by Ennis (Tawil, and Liliasari, 2013), namely: giving a simple explanation (elementary clarification), build basic skills (basic support), make inferes (infering), make further explanations (advanced clarification), and set strategies and techniques (strategies and tactics). As well as tests to measure student learning outcomes in the form of multiple choice totaling 35 valid questions referring to indicators from Bloom's Taxonomy with revisions from Anderson and Krathwohl (2015), which include remembering, understanding, applying, analyzing, evaluating, and creating.

The two research instruments before being used as a data collection tool were first tested for feasibility by testing the research instrument, then the instrument was tested for the validity of each item along with reliability testing using Anates 4.0 software with reliability values of 0.79 and 0.73 for each. instruments for critical thinking skills and learning outcomes.

Data processing and analysis techniques in this study include prerequisite tests and hypothesis testing. Prerequisite tests include the Kolmogorov-Smirnov normality test and linearity test. Then proceed with hypothesis testing using the Pearson Product Moment correlation test and simple regression test. Data analysis in this study was carried out using the help of SPSS version 23 for windows at a significance level of 5%.

Results and Discussion

Analysis Prerequisite Test

There are two analytical prerequisite tests in this study, namely the One-Sample Kolmogorov-Smirnov normality test and the linearity test. In the prerequisite test, the significance value must be more than 0.05. Based on the normality test on SPSS, it is known that the probability value (p value) in the asymptotic significance (2-tailed) column is 0.200, the data has a p value > 0.05. So according to the basis for making the decision on the One-Sample Kormogorov-Smirnov normality test, it can be concluded that the research data is normally distributed. Thus, the assumptions or requirements for normality have been met.

Furthermore, a linearity test was conducted to determine whether the two variables had a significant linear relationship or not. Based on the linearity test, the Deviation from Linearity Sig value was obtained. is 0.785 0.05. Furthermore, based on the value of F obtained a value of 0.662 so that $F_{(count)} < F_{(table)}$ (3.26). So according to the basis for making decisions on the linearity test, it can be concluded that there is a significant linear relationship between the Critical Thinking Ability variable (X) and the Learning Outcome variable (Y).

Hypothesis Testing

The correlation between critical thinking skills and learning outcomes is known by testing the hypothesis, namely by testing the bivariate Pearson product moment correlation and simple regression using SPSS 23 for Windows with a significance level of 5%. Correlation analysis was carried out to produce the degree of closeness of the relationship between variables which was expressed by the value of the correlation coefficient. The summary of the calculation results is shown in Table 1.

Table 1. Bivariate Correlation Test Results

		Correlations	
		Critical thinking	Learning outcomes
Critical thinking	Pearson	1	.667**
	Correlation		
	Sig.(2-tailed)		.000
	N	38	38
Learning outcomes	Pearson	.667**	1
	Correlation		
	Sig.(2-tailed)	.000	
	N	38	38

Based on Table 1, it is known that the value of Sig. (2-tailed) is 0.0001 0.05, which means that there is a significant correlation between research variables. Based on the value of $R_{(count)}$ (Pearson Correlations), it is known that the correlation coefficient of Critical Thinking (X) with Learning Outcomes (Y) is 0.667. Because $R_{(count)}$ or Pearson Correlations in this analysis is positive, then the relationship between the two variables is positive, in other words, the increased critical thinking skills will increase student learning outcomes. Furthermore, the strength of the relationship is interpreted based on the correlation coefficient interpretation guidelines in Table 2.

Tabel 2. Correlation Coefficient Interpretation

Score	Interpretation
0 – 0,19	Very Low
0,2 – 0,39	Low
0,4 – 0,59	Middle
0,6 – 0,79	Strong
0,8 - 1	Very Strong

(Source: Sugiyono, 2011)

Based on Table 2, the results obtained by R (correlation coefficient) of 0.667 indicate that the strength of the correlation between the two variables is in the strong category. Furthermore, a simple linear regression test was carried out to predict student learning outcomes based on the critical thinking ability scores obtained. The results of the simple linear regression test are shown in Table 3.

Tabel 3. Summary of Regression Test Results

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.667 _a	.445	.430	7.249

a. Predictors: (Constant), Critical Thinking Skills
b. Dependent Variable: Learning outcomes

Based on Table 3, it is known that the R Square value (determinant coefficient) of 0.445 means that the influence or contribution of Critical Thinking Ability (X) to Learning Outcomes (Y) is 44.5% while the remaining 55.5% is another variable not examined in the study. this. The magnitude of the contribution given by critical thinking skills to learning

outcomes shows that it is important to have critical thinking skills in students because it will have an impact on learning outcomes.

The regression equation in this study is $Y = a + bx$. The coefficients of the regression equation are shown in Table 4.

Tabel 4. Correlation Regression Equation

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
	1 (Constant)	20.675	6.282		
Critical Thinking Skills	.555	.103	.667	5.378	.000

a. Dependent Variable: Learning outcomes

Based on Table 4, it is known that the value of a (constant) is 20,675, this number is a constant number, which means that if there is no Critical Thinking Ability (X), the consistent value of Learning Outcomes (Y) can be estimated at 20,675. The value of b (regression coefficient number) of critical thinking = 0.555 means that if there is a change in critical thinking ability (X) of one unit, the learning outcomes of Biology can be estimated at 0.555 at a constant unit of 20,675.

The formula for the simple linear regression equation is $Y = a + bX$ so that from the results of the linear regression test, a simple linear regression equation is obtained, namely $Y = 20,675 + 0.555x$. From these equations, the relationship curve between thinking ability and learning outcomes can be drawn in Figure 1.

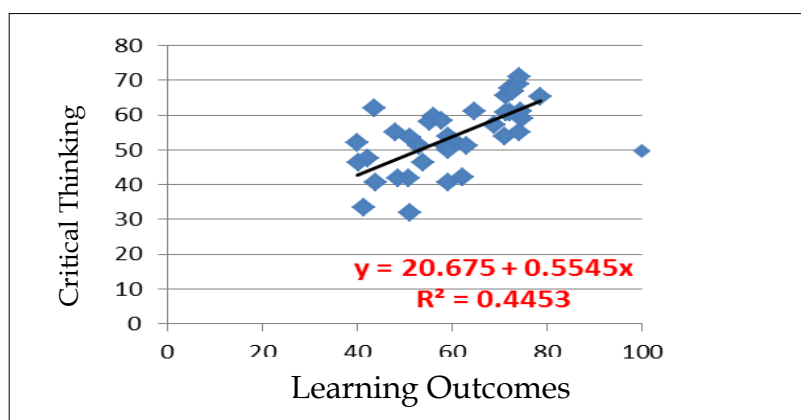


Figure 1. Linear Regression Graph

Based on Figure 1, based on the regression equation $Y = 20,675 + 0.555x$, the critical thinking ability of students increases in direct proportion to the increase in learning outcomes. This means that if students' critical thinking skills are high, their learning outcomes will also be high.

Discussion

There is a relationship between critical thinking skills and learning outcomes because critical thinking skills are one of the developments of skills in the cognitive domain that are

important in the learning process. Critical thinking ability is closely related to students' cognitive abilities so that this ability can affect learning outcomes.

Research conducted by Sunaryo (2014) states that the higher the critical thinking ability possessed by students, the higher the learning outcomes obtained. On the other hand, the lower the critical thinking ability, the lower the learning outcomes obtained. Furthermore, research conducted by Kuswana (2012) found that student learning outcomes based on students' high critical thinking skills showed that their learning outcomes were better than students who had low critical thinking skills. This is because critical thinking skills lead students to be able to identify and examine their own assumptions and the assumptions of others to be free from assumptions that are not verified so that students can determine what to believe or do and can avoid making inappropriate decisions. without going through careful consideration.

Critical thinking skills are related to learning outcomes because this ability can support student performance in learning so that it will improve learning outcomes. Through this ability, students are trained to make the right decisions by reviewing from various points of view carefully, thoroughly, and logically. In line with that, critical thinking is a cognitive ability in determining a decision or conclusion based on logical reasons and accompanied by strong empirical evidence (Yaumi, 2012).

Critical thinking skills can improve the performance of students in the classroom which include: understanding the arguments and beliefs of others, conveying and defending arguments based on various evidences, taking preventive action on a conclusion and helping them evaluate what is learned in class (Wulandari, 2011). The performance of students in learning activities can increase if students have good critical thinking skills. By analyzing the arguments carefully and reviewing assumptions from various points of view, students can find facts from the information obtained or the knowledge they have learned so that it has an impact on increasing understanding of the subject matter, as a result, student learning outcomes will also be maximized.

Critical thinking ability as a directed and clear process used in mental activities, such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research (Johnson, 2011). Critical thinking skills can help students to solve problems in the learning process. This is because students who think critically mean having an attitude of wanting to think deeply about a problem or phenomena described in learning (Fisher, 2012).

The habit of critical thinking of students will have a potential effect on student learning outcomes at school, where the habit of solving problems critically will familiarize students with solving problems accurately and quickly (Caroselli, 2009). In addition, critical thinking skills are abilities or cognitive strategies that are able to increase the opportunities for things to be obtained, including solving problems, formulating influencing factors, calculating various possibilities, and making decisions (Halpern, 2013).

One's ability to think critically is needed in the process of one's understanding of the material. In learning, students are required to solve various problems based on their understanding, activities in the process can stimulate students to be able to think critically. This is because critical thinking skills can develop students' understanding and curiosity (Sochibin, 2009). Critical thinking ability is very influential on learning outcomes because by having this ability, students can solve problems and easily understand the subject matter well. So that if critical thinking skills are developed, it will help students achieve maximum learning outcomes.

The importance of critical thinking skills in the learning process is due to the need to prepare students to become strong problem solvers, mature decision makers, and people who never stop learning William (2010). Through critical thinking, students are honed to

play an active and effective role in analyzing problems so that they will be able to determine the right conclusions based on empirical evidence of problems that arise. The ability to think critically involves the process of cognition so that it can be one way to improve student learning outcomes.

The ability to think critically can also provide the right direction in thinking and understanding concepts, because it can help in determining the relationship between concepts with one another more accurately so that learning is more meaningful. Students can construct their own knowledge or cognitive and use this knowledge to explain phenomena in life related to concepts and facts that have been memorized and apply this knowledge in solving problems at hand. Furthermore, the ability to think critically is a tool used in the concept mastery process because conceptual knowledge is the result of a constructive process (Munfahroyin, 2009).

The relationship between critical thinking skills and student learning outcomes occurs because critical thinking is related to self-reflection awareness, and abilities (basic skills) and willingness to ask questions in order to clarify and improve understanding which helps in drawing appropriate conclusions and making decisions. the best decision (Weissinger, 2004). Then students with high critical thinking skills will have an awareness of thinking so that they are better able to organize and evaluate the needs needed to understand the material, and conclude the information obtained during learning. Students with high critical thinking skills affect their ability to digest learning material so that they can obtain a higher level of understanding.

Critical thinking ability is a parameter that must be achieved by students in the hope of being able to improve their thinking skills so that they will encourage problem solving abilities and the development of higher thinking skills. Based on the explanation above, thus, students who have good critical thinking skills will be trained to optimize their higher-order thinking skills so that it has an impact on increasing the achievement of learning outcomes, especially in the achievement of cognitive aspects.

In general, the success of learning is supported by internal factors and external factors. Metacognition ability is one of the internal factors in learning that is possible to influence the science process skills of students. Learning outcomes are influenced by several factors, including, a) internal factors, namely factors that exist within the individual who is studying. Internal factors include physical factors, such as health; and psychological factors such as talent, interest, motivation, intelligence, thinking ability and others and b) external factors are factors that exist outside the individual. External factors include family factors, school factors, and community factors. Critical thinking ability is an internal factor that must be developed in each student. This is because these two factors can support the learning success of students (Sugihartono, et al., 2007).

It was further explained that critical thinking is the ability to express opinions in an organized way, as well as to systematically evaluate the weight of personal and other people's opinions. This explanation is strengthened by that critical thinking skills include concepts in analyzing information, applying strategies to determine decisions, readiness to consider ideas using logical investigations, obtaining evidence, testing conclusions, making appropriate decisions, and analyzing assumptions (Greenstein, 2012). These abilities provide support to students in solving the problems they face. Therefore, the learning outcomes of students are ultimately in line with their critical thinking skills.

The relationship between critical thinking skills and student learning outcomes is in the strong category because some of the indicators of critical thinking skills are needed to achieve maximum learning outcomes. Critical thinking skills are related to higher order cognitive thinking such as analyzing, synthesizing, and evaluating (Page and Mukherjee, 2006). Critical thinking can also be said as the ability to think at a complex level and use the

process of analysis and evaluation. (Windarti). Critical thinking ability as the art of analyzing and evaluating thinking through the point of view of how to improve it (Elder and Paul, 2008). Therefore, the students' critical thinking skills that increase will affect the increase in cognitive learning outcomes, because critical thinking skills are part of the top cognitive domain, namely C3-C6.

In addition to the explanation above, the relationship between critical thinking skills in improving cognitive learning outcomes is related to the components of these critical thinking skills. Cognitive skills, which are the core of critical thinking skills, include interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2013). The explanation above is closely related to the indicators of learning outcomes in the cognitive domain which is the reference in this study. Cognitive sub-domain in detail as follows:

The first indicator, remembering, is the ability to retrieve information stored in long-term memory. (Antika, et al., 2017). The relationship with critical thinking skills, namely, the more critical students are, the more they will ensure that the knowledge gained or learned can be remembered and last longer in memory so that it will have an impact on increasing student learning outcomes.

The next indicator is understanding, which is the ability to construct meaning or understanding based on the knowledge possessed, or to integrate new knowledge in existing schemes in the minds of students (Antika, et al, 2017). The relationship with critical thinking skills is with critical thinking skills, students are trained to construct their knowledge and cognitive so that they can improve in-depth understanding of the material. Thus, critical thinking skills have real benefits in increasing understanding which consequently will affect student learning outcomes.

The realm of understanding includes cognitive activities of interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining (Antika, et al, 2017).

Interpretation is the ability to interpret and understand the meaning in a problem (Agnafia, 2018). Interpretation is related to the ability of students to interpret and describe the objects observed and train students to re-explain and understand the meaning of an event, data, procedure or rule. One of the important parts of critical thinking that students must learn in order to have the ability to think critically is to make interpretations (Orlich, 2010).

Inference is the ability to identify and obtain concepts or elements in drawing a conclusion (Agnafia, 2018). Students who have critical thinking skills are generally able to identify and solve a problem so that they can make an appropriate conclusion. Conclusions are drawn to interpret what has happened or been observed (Koasih, 2014).

Explanation is the ability to provide arguments and determine them logically based on the data or facts obtained. (Agnafia, 2018). The explanation indicator is the ability to explain or make information about the cause and effect of the problem. With critical thinking skills, students are able to explain the statements or opinions conveyed so that they are arranged into a strong opinion. Through explanation can train students in developing reasoning and critical thinking of students (Pujiono, 2012).

The next indicator is applying or applying is the ability to use a procedure to solve problems or do tasks (Antika, et al, 2017). Critical thinking skills include concepts in applying and choosing the right strategy to make decisions, obtaining logical evidence, making the right decisions, and analyzing assumptions. Through critical thinking, students can apply their knowledge and cognitive skills to find solutions to problems faced so that learning outcomes will also be high.

The next indicator, namely analyzing, is the ability to describe a problem or object into its elements and determine how the interrelationships between these elements are (Antika,

et al, 2017). Students who think critically can analyze their own assumptions, analyze problems to find solutions and are able to identify the interrelationships between the concepts they learn. Analysis is the ability to investigate or identify the relationship between statements, data facts, concepts and can conclude them (Agnafia, 2018).

The next indicator is to evaluate (evaluate), namely the ability to make a judgment based on existing criteria and standards (Antika, et al, 2017). The connection is that students who can think critically can evaluate their thoughts and compare them with data, facts, opinions and thoughts from others (Rugerio, 2012). Students who think critically will be able to determine the right conclusion or solution in overcoming a problem by looking at it from various points of view. This is because students are able to test and evaluate their opinion whether the statement is based on facts or empirical evidence. Evaluation is the ability to assess the credibility of a statement or representation and to access the relationship of statements, data, facts, concepts or other forms (Agnafia, 2018).

The last indicator of learning outcomes, namely creating, is the ability to combine several elements into a unified form or involve elements that are placed together to form a coherence or overall function (Antika, et al, 2017). The relationship is with critical thinking students can generate and plan solutions to problems that have been analyzed and evaluated based on facts that have been learned in previous learning experiences.

So it has been proven that there is a significant relationship between critical thinking skills and student learning outcomes. In this study, critical thinking skills contributed 44.5% to cognitive learning outcomes. So it can be said that critical thinking skills make a big contribution to student learning outcomes.

The ability to think critically of students needs to be improved again and it is necessary to evaluate the learning strategies carried out. By using the right learning strategies, the learning process will be of higher quality so that critical thinking skills can be increased. Critical thinking skills can be improved by applying strategies that have the characteristics of involving active interaction from students and using their cognitive abilities in applying concepts and solving problems (Agboze & Ugwoke, 2013). Critical thinking skills can also be improved by providing investigative questions, fostering students to solve problems and making conclusions based on investigations (Ivokos, 2011).

The ability to think critically is one of the abilities that need to be empowered by teachers in learning at school because through this ability, students can think critically, logically, and systematically so that they can increase their chances of getting maximum learning outcomes. Therefore, students' critical thinking skills are important to be developed further to get maximum learning outcomes by directing students to try to solve problems that are constructed in the form of questions and solved through cooperative teamwork.

Conclusion

Based on the results of research, data processing and hypothesis testing, the authors conclude that there is a correlation between critical thinking skills and student learning outcomes on the human movement system material with a correlation coefficient of 0.667. This shows that there is a positive relationship between critical thinking skills and student learning outcomes with high relationship strength. Hence, it can be stated that if students have high critical thinking skills, their learning outcomes will also increase.

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