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Analyzing the Relationship Between Critical Thinking, Learning Outcomes, and Retention Using Jigsaw Learning Model

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Abstract: Critical thinking skills are one of the key skills needed to face the challenges of the 21st century. However, based on the 2015 PISA study, students' critical thinking skills in Indonesia are still low. Various studies have shown a significant contribution of critical thinking skills to learning outcomes. In addition, the development of critical thinking skills in biology learning can improve student retention. However, not many studies have specifically examined the relationship of critical thinking skills with learning outcomes and student retention, especially with the use of the Jigsaw cooperative learning model. This study aims to examine the relationship of critical thinking skills with student learning outcomes and retention through the Jigsaw learning model. This correlational study involved 72 students in grades X5 and X6 at SMA Negeri 4 Jember. The results of product moment correlation analysis showed a significant relationship between critical thinking skills with learning outcomes ($R = 0.967$, $R^2 = 93.5\%$, significance < 0.001) and student learning retention ($R = 0.511$, $R^2 = 26.1\%$, significance < 0.001). Thus, critical thinking skills contributed 93.5% to learning outcomes, while 6.5% was influenced by other factors. Meanwhile, on student retention, the contribution of critical thinking skills was 26.1%, with 73.9% influenced by other factors.

Keywords: critical thinking skills, learning outcomes, retention, Jigsaw learning model.

▪ INTRODUCTION

Improving the quality of education is one of the main focuses in the world of education today. One important aspect that needs to be considered in improving the quality of education is the ability of students to think critically (Aini et al., 2024). Critical thinking skills are one of the indispensable 21st century abilities, given the increasingly complex challenges in the world of work, social life, and higher education (Erlin et al., 2020). Based on the results of the Program for International Student Assessment (PISA) conducted by the Organization for Economic Co-operation and Development (OECD) in 2022, the prevalence of critical thinking skills of students in Indonesia is still relatively low compared to other countries, with an average score of 383 far below the global average of 485 (Ayurachmawati et al., 2024). This value shows that the majority of students in Indonesia have limitations in the ability to understand, analyze, and apply information in complex situations. This reflects the low critical thinking skills of Indonesian students in facing the challenges of 21st century learning.

Critical thinking skills are an effort made by students to analyze, evaluate, and process information logically, objectively, and systematically in order to make effective decisions or solve problems (Putri et al., 2023). This skill involves a high-level thinking process, where a person is required to question assumptions, identify valid arguments, evaluate evidence, and draw conclusions based on data or facts (Ermin, 2022). In the context of learning, critical thinking skills can help students understand the material in depth, connect the concepts learned, and apply them in real-world situations, so that it will have an impact on good learning outcomes (Youllanda et al., 2020).

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Learning outcomes are changes in behavior or abilities obtained by students after participating in the learning process, which includes aspects of knowledge (cognitive), skills (psychomotor), and attitudes (affective). Learning outcomes not only reflect students' understanding of the material, but also become an important indicator of the success of a learning process (Yandi et al., 2022). Optimal learning outcomes indicate that students not only master the subject matter, but also have retention or the ability to remember a certain period of time so that they can apply it in everyday life (Siregar, 2022). In the context of education, retention refers to the extent to which students can maintain their understanding of learning materials and apply them in relevant situations, both in the short and long term (Sudirman & Yusnaeni, 2022).

The low retention of students may indicate the lack of effective learning methods used to improve critical thinking skills (Juliyantika & Batubara, 2022). Biology learning methods used today still focus on memorization or mastery of theory without actively involving students in higher-order thinking processes. In addition, the lack of use of innovative learning methods that encourage exploration of ideas, in-depth analysis, and critical discussion also affect the development of these skills (Rahim, 2023). Therefore, innovation in potential learning strategies is needed, namely by applying the Jigsaw learning model, a cooperative learning method that provides opportunities for students to learn actively through group cooperation, understanding the material, and conveying information to other group members (Uki & Liunokas, 2021). Thus, students not only learn from the material provided, but are also trained to think critically, discuss, and make decisions based on their own analysis.

Putri & Fitri, (2024) in their research found that the Jigsaw learning model is not only effective in improving student learning outcomes, but also strengthening learning retention through meaningful learning experiences. This model provides opportunities for students to master the material better because they have to reteach the information learned to other group members. In line with research conducted by Adam et al. (2021) the Jigsaw learning model is known to be more effective in improving critical thinking skills and student learning outcomes through positive interdependent group learning.

Research on the relationship between critical thinking skills with learning outcomes and student retention in the application of the Jigsaw learning model is important as an effort to answer various challenges in the world of education. Understanding the relationship between critical thinking skills, learning outcomes, and student retention is expected to help design more effective learning strategies to support the development of student abilities. This aims to prepare a generation that is more competent and ready to compete in the modern era. This study aims to address the following research questions:

"Is there a relationship between students' critical thinking skills with learning outcomes and retention using the Jigsaw learning model?"

▪ METHOD

Participant

This study was conducted at SMA Negeri 4 Jember from September to October of the 2024/2025 school year, with a population of all grade X students and a sample of 72 students from classes X5 and X6 using random sampling technique. Samples were taken based on tests/equivalency tests using the previous material daily exam scores which were analyzed by normality and homogeneity tests. The selection of two classes as samples

was done to facilitate data collection and allow researchers to focus more on managing the data obtained in depth. The two classes selected have similar characteristics and have been previously tested to ensure their homogeneity. Therefore, the results of the study are expected to represent the wider population.

Research Design

This study is a correlational study with critical thinking skills as the independent variabel and student learning outcomes and retention as the dependent variable. The purpose of this study is to reveal the correlation between critical thinking skills to student retention and learning outcomes using the Jigsaw learning model. Correlational research studies the relationship between two or more variables, namely the relationship between variations in one variable and variations in other variables (Arifin, 2011). Correlational research requires data collection to determine whether or not there is a relationship between two or more variables (Sukardi, 2011).

In this study, two sample classes, X5 and X6, were given the same treatment using the Jigsaw learning model for two meetings on biodiversity material. The Jigsaw learning process was carried out through several stages. First, students were divided into origin groups consisting of 6 members each heterogeneously, where each member was given a different topic of material. Members with the same topic then join an expert group to study the material in more depth through discussion and working on LKPD. After the discussion, students returned to their home groups to explain what they had learned. Furthermore, representatives from each group presented the results of their discussion. In the next stage, the researcher conducted an evaluation, gave a review of the material, and invited students to draw conclusions together. Before the learning ended, the researcher gave appreciation and rewards for students' participation.

After the learning process was complete, at the last meeting, students were given a posttest to measure their critical thinking skills and learning outcomes related to the material they had learned. Two weeks later, a retest was conducted to assess the extent of students' learning retention of the material. During the Jigsaw learning process, the interaction between students is very active because they have to collaborate and teach each other, which in turn strengthens their understanding of the material taught.

Research Instruments

Research instruments can be used to collect, process, and interpret the data that has been obtained. As for this study, researchers used instruments in the form of observation sheets for the implementation of learning using the jigsaw learning model and tests consisting of posttests and retests or delayed tests given to sample class X5 and X6 students at SMA Negeri 4 Jember to find data on the relationship between critical thinking skills with learning outcomes and student retention of students in the Jigsaw learning model.

The tests used in this study include posttest and retest by giving questions to students to obtain quantitative data, so that students' abilities can be analyzed. The test used in the form of a description test with a total of 8 items, using indicators of critical thinking skills and cognitive learning outcomes. Indicators of critical thinking skills used according to Ennis (in Masitah et al., 2022) consist of elementary clarification, basic support, inference, advanced clarification, strategies and tactics. The questions in the essay test were designed to cover these aspects of critical thinking skills by asking

students to explain, analyze, and evaluate various situations or problems related to biodiversity material. In addition, this study also measured students' cognitive learning outcomes based on Bloom's taxonomy, focusing on the C4 (Analysis) and C5 (Evaluation) levels. The questions in the description test were designed to integrate indicators of critical thinking skills and cognitive learning outcomes, so that students not only understand the material factually but are also able to analyze (C4) and evaluate (C5) the information obtained. The instrument developed has gone through a validation process related to its content and construction, which was carried out using the expert judgment method. This process aims to ensure that the questions used in the instrument are relevant, in accordance with the objectives to be measured, and have been structured in a correct and effective way.

To measure students' learning retention ability, after two weeks of posttest implementation, a retest or delayed test is carried out using the same questions. The choice of two weeks to measure learning retention is generally based on research that shows that this period is sufficient to test the extent to which students can remember and apply the material that has been learned, as well as find out whether the information is maintained or begins to be forgotten. However, this time can be affected by various factors, such as differences in student characteristics including learning style, memory capacity, and information processing speed (Hermanto et al., 2022).

Data Analysis

The data analysis method in this study includes several important stages. First, data description was conducted to analyze and describe the data collected to determine the categorization of the level of students' critical thinking skills towards retention and learning outcomes. Second, the analysis prerequisite test includes normality test and linearity test. The normality test uses the Kolmogorov-Smirnov Test with the help of SPSS.30 to determine whether the data has a normal distribution, with significant criteria (P-value) > 0.05 for normal data and < 0.05 for abnormal data. The linearity test aims to test the linear relationship between critical thinking skills and student learning outcomes using the test of linearity, with a linear relationship if the deviation from linearity value> 0.05. Third, hypothesis testing was conducted to determine the acceptance or rejection of the hypothesis using Pearson Product Moment correlation and simple linear regression analysis with the help of SPSS.30, to identify the level of relationship between critical thinking skills and student learning retention.

▪ RESULT AND DISSCUSSION

This study aims to determine the relationship between students' critical thinking skills with learning outcomes and student retention by applying the Jigsaw learning model. Before the data analysis stage, a prerequisite analysis test was conducted to ensure the validity of the data, namely by using normality and linearity tests.

Based on the learning implementation observation sheet, in the first and second lessons, the implementation of the Jigsaw type cooperative learning model had an average percentage of 100% implemented. The percentage indicated that the overall learning stages were well implemented. During the learning process, the researcher was accompanied by an observer who was in charge of filling in the learning implementation observation sheet so that the learning stages that were implemented and those that were not implemented were known. Overall, the jigsaw syntax can be said to be well

implemented in this study. The researcher has successfully managed each stage of the jigsaw learning model carefully and structurally, starting from group division, learning in groups, presentations, to class discussions. The teacher's skill in managing this learning model greatly influences the effectiveness of learning, where students can be more active in learning, think critically, and help each other in the learning process together.

The data normality test was conducted to determine whether the research variables had a normal distribution. Critical thinking skills, learning outcomes, and student retention were all variables tested in the normality test. The Kolmogorov-Smirnov normality test was used at the 0.05 (5%) testing level. Based on the Kolmogorov-Smirnov statistical test, the significance value of the critical thinking skills post-test, learning outcomes post-test, and retest has a p value > 0.05, which indicates that the data from both groups on all variables studied are normally distributed.

The linearity test in this study has the aim of knowing whether the independent variable (critical thinking skills) and the dependent variable (learning outcomes) and (student learning retention) have a linear relationship or not. In the linearity test the significance level (deviation for liearity) is more than 0.05. If the significance level is less than 0.05, then the data does not have a linear relationship, if the significance level is more than 0.05 then the data is said to be linear. Based on the linearity test conducted, a significance value of 0.839 was obtained for the relationship between the critical thinking skills variable and student learning outcomes (Y1), and a significance value of 0.842 for the relationship between critical thinking skills and student learning retention (Y2). Because both significance values are greater than 0.05, it can be concluded that between the critical thinking skills variable and student learning outcomes and student learning retention have a linear relationship.

Based on the prerequisite test analysis, the results are positive where the data is normally distributed and linear. Furthermore, hypothesis testing is carried out where researchers use two stages of analysis, namely correlation test and simple linear regression test, to answer the problem formula and reach conclusions. The results of the correlation test on the critical thinking skills variable with student learning outcomes are presented in Table 1 below:

Table 1. Correlation test results of critical thinking skills with student learning outcomes

Correlations

		Critical Thinking Skills	**Learning Outcomes**
Critical thinking skills	Pearson Correlation	1	0.967**
	Sig. (2-tailed)		<0.001
	N	72	72
Learning outcomes	Pearson Correlation	0.967**	1
	Sig. (2-tailed)	<0.001	
	N	72	72

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation analysis shows a significance value of <0.001 (<0.05), so the critical thinking skills variable (X) and student learning outcomes (Y1) have a significant

relationship. The correlation coefficient (r) is 0.967, indicating a very strong positive relationship.

The following results of the coefficient of determination analysis and regression coefficient analysis of the critical thinking skills variable with student learning outcomes are presented in Tables 2 and 3below:

Table 2. Results of the coefficient of determination of critical thinking skills with student learning outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.967	0.935	0.934	3.348

a. Predictors: (Constant), Critical thinking skills

Table 3. Regression coefficient results of critical thinking skills with student learning outcomes

Coefficient

Model		Unstardardized B	Coefficient Std. Error	Stardardized Coefficient Beta	t	Sig.
1	(Constant)	1.161	2.207		0.526	0.601
	Critical thinking skills	0.981	0.031	0.967	31.697	<0.001

a. Dependent Variable: Learning outcomes

The coefficient of determination is a measure that shows the proportion of shared variance between variable X and variable Y, expressed in percentage form by multiplying the result by 100%. This shows that the proportion of critical thinking skills to learning outcomes is 93.5%. The remaining range of 6.5% is another factor not examined by the researcher. Regression analysis shows a constant value (α) of 1.161, meaning that if critical thinking skills (X = 0), student learning outcomes (Y1) remain 1.161. The regression coefficient (R) of 0.981 indicates that each increase of one value of critical thinking skills increases student learning outcomes by 0.981. With a significance value of <0.001 (<0.05), this relationship is highly significant, so the regression model can predict learning outcomes based on critical thinking skills.

The study showed a positive relationship between students' critical thinking skills and learning outcomes through the application of the Jigsaw type cooperative learning model. Correlation analysis resulted in a significance value of <0.001 (<0.05), with a correlation coefficient (R) of 0.967, which is in the very strong category. Regression analysis shows a constant value (α) of 1.161, meaning that if critical thinking skills (X = 0), student learning outcomes (Y1) remain 1.161. The regression coefficient (R) of 0.981 indicates that each increase of one value of critical thinking skills increases student learning outcomes by 0.981. With a significance value of <0.001 (<0.05), this relationship is highly significant, so the regression model can predict learning outcomes based on critical thinking skills. The coefficient of determination (R^2) of 93.5% indicates critical

thinking skills contribute significantly to learning outcomes, while 6.5% is another factor not examined by the researcher.

Previous studies have also revealed that students' critical thinking skills have a significant relationship with the learning outcomes of grade V students of SDN 2 Metro Utara. The correlation coefficient (R) value of 0.974 indicates a very strong relationship between critical thinking skills and student learning outcomes. In addition, the coefficient of determination (R^2) of 0.949 reveals that 94.9% of the variation in learning outcomes can be explained by the level of students' critical thinking skills, while the remaining 5.1% is influenced by other factors (Mutmainnah et al., 202). The results of this study are also in line with the findings of Raturoma & Liasnima (2023) where there is a positive relationship between critical thinking skills and learning outcomes of grade X students of Yabt Manokwari Christian High School in the 2023/2024 learning year where the correlation coefficient value r = 0.885, indicating that critical thinking skills contribute 89% to student learning outcomes. This indicates that the higher the critical thinking skills of students, the stronger the functional relationship to the achievement of learning outcomes.

In line with this opinion, Silas et al. (2024) in their research stated that the results of the calculation of the Pearson correlation coefficient showed a value of 0.933, a positive value indicating a very strong positive relationship between critical thinking skills and student learning outcomes. This means that an increase in critical thinking skills will be followed by an increase in learning outcomes, and vice versa. In addition, the findings of this study are also consistent with previous research which shows that critical thinking skills contribute 40.5% to student learning outcomes at SMPN 5 Kota Kupang class VIII C which uses the Discovery Learning learning model (Fransiskus et al., 2022). Despite using different learning models, the relationship between critical thinking skills and learning outcomes still shows a positive relationship.

Critical thinking skills have a very important role in improving student learning outcomes. These skills include the ability to objectively analyze information, identify assumptions, and evaluate arguments in a logical and systematic way (Siswati et al., 2020). When students are trained to think critically, they not only memorize information, but are also able to understand concepts more deeply, make informed decisions, and solve complex problems. Improving student learning outcomes is closely related to improving critical thinking skills (Annisa et al., 2020). Jigsaw learning model is one of the effective learning models to improve students' critical thinking skills and learning outcomes (Rusdin & Hafiz, 2023). In the Jigsaw learning model, students work in groups to break down the learning topic into small parts, where they must master certain material and teach it to their groupmates. This activity encourages students to think more critically as they need to understand the material well before teaching it, as well as being able to question and evaluate the information obtained (Yunus, 2020). The Jigsaw learning model not only improves students' critical thinking skills, but also supports deeper understanding and contributes to improving their learning outcomes.

This approach allows students who have more ability to help their peers who are having difficulty, so that it can also improve group understanding. This has a positive impact on student learning outcomes as students have a better understanding of the concepts taught (Purwaningsih & Harjono, 2023). Therefore, this model can be suggested as a useful learning method to improve students' learning outcomes simultaneously along

with improving their critical thinking skills. The findings also indicate that critical thinking skills are an important factor that is directly related to student learning outcomes.

The results of the correlation test on the critical thinking skills variable with student learning retention are presented in Table 4 below:

Table 4. Correlation test results of critical thinking skills with student retention

Correlations

		Critical Thinking Skills	Student Retention
Critical Thinking Skills	Pearson Correlation	1	0.511**
	Sig. (2-tailed)		<0.001
	N	72	72
Student Retention	Pearson Correlation	0.511**	1
	Sig. (2-tailed)	<0.001	
	N	72	72

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation analysis shows a significance value of <0.001 (<0.05), so critical thinking skills (X) and student learning retention (Y2) are significantly correlated. The correlation coefficient (r) of 0.511 shows a positive relationship with a moderate correlation category.

The results of the coefficient of determination analysis and regression coefficient analysis of critical thinking skills variables with student learning retention are presented in Tables 5 and 6 below:

Table 5. Results of the coefficient of determination of critical thinking skills with student retention

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.511	0.261	0.251	9.478

a.Predictors: (Constant), Critical thinking skills

Table 6. Regression coefficient test results of critical thinking skills with student retention

Coefficient

Model		Unstardardized B	Coefficient Std. Error	Stardardized Coefficient Beta	t	Sig.
1	(Constant)	35.779	6.249		5.726	<0.001
	Critical thinking skills	0.436	0.088	0.511	4.974	<0.001

Dependent Variable: Student retention

This shows that the proportion of critical thinking skills to learning outcomes is 26.1%. The remaining 73.9% range is another factor not examined by the researcher. The regression test results show a constant value (α) of 35.779, which means if critical thinking skills (X) = 0, student retention (Y2) is estimated to be 35.779. The regression coefficient of 0.436 indicates that every one point increase in critical thinking skills will increase student retention by 0.436. With a significance level of <0.001 (<0.05), this regression model is proven to be statistically significant.

This study shows that critical thinking skills have a significant relationship with student learning retention, especially through the application of the Jigsaw type cooperative learning model. The correlation analysis results yielded a significance value of <0.001 (<0.05) and a correlation coefficient of 0.511, indicating a positive relationship with a moderate category. The coefficient of determination (R^2) of 26.1% indicates critical thinking skills contribute to learning retention, while 73.9% is influenced by other factors such as learning strategies, material quality, academic ability, and retention test time.

The R^2 of 26.1% indicates that there is a moderate relationship between critical thinking skills and retention. The lower contribution compared to learning outcomes may be due to the fact that retention requires additional strategies such as repeated practice or the use of mnemonic techniques to reinforce memories. In addition, the characteristics of biodiversity materials often involve many technical terms and interrelated concepts, such as ecosystems, species and interactions between organisms. These characteristics of complexity can make information retention more challenging. Students may be able to apply critical thinking skills to solve posttest questions, but without repetition or mnemonic techniques, they may struggle to recall the information in the future (Yulanda & Rahmi, 2022). This suggests that a deep understanding of the material does not necessarily guarantee that students will be able to recall the information in the long term.

Retention is the ability to store material that has been learned in memory so that it is not easily forgotten. When students are invited to think critically, they do not just receive information passively, but are actively involved in the process of understanding, analyzing, and evaluating. This process helps them connect new concepts with existing knowledge, so that the information is easier to remember and more meaningful (Majid, 2022). Retention is related to memory, which is a mental process that involves mastering, storing, and retrieving knowledge. Memory itself is divided into two types, namely short-term memory (Short-Term Memory) and long-term memory (Long-Term Memory). The transfer of newly acquired information from short-term memory to long-term memory is a major factor in retention. When information is critically understood, the brain is more likely to store it in long term memory, because the cognitive processes involved in critical thinking strengthen neural pathways that facilitate long-term memory. Students tend to have good memory skills if they are able to process information effectively (Saleh et al., 2023).

Good retention is an important asset for students to achieve optimal learning outcomes, because learning success is measured through mastery of material which is closely related to memory ability. With good memory, students are able to recall subject matter and use it when needed, for example in solving problems related to learning. Problem solving occurs when students' brains construct concepts through a reasoning process to make decisions. This process utilizes information stored in long-term memory.

Without this information, the reasoning process cannot run properly. The brain activity in checking the validity of the reasoning involves critical thinking skills. Therefore, students' retention directly contributes to their ability to think critically (Lailaturrahmah et al., 2020).

Active student involvement in the learning process can improve students' ability to remember material that has been learned in the long term, known as student retention. The application of the Jigsaw type cooperative learning model is an effective approach to encourage student activeness in teaching and learning activities (Azizah et al., 2020). The Jigsaw type cooperative learning model can be used to improve students' understanding of previously learned material. This model is effective because it involves students directly in the learning process, thus allowing them to understand the topic and teach it to other members in their group. Students work in groups to discuss and master certain parts of the material, then teach it to their peers. This activity forces students to process the material more deeply, as they need to be able to explain the material clearly and answer critical questions from their groupmates (Putri & Fitri, 2024).

The discussion that occurs during this learning process can enrich students' understanding and encourage them to store the material in a more structured and long-lasting manner in long term memory. Interaction between students also allows them to clarify each other's understanding, which further strengthens the process of remembering material and improves student retention (Wahyu, 2022). According to Ahmad et al. (2023), the Jigsaw cooperative learning model affects learning retention because it is able to help students process material information effectively, so that the material is stored in long-term memory and can be recalled easily. This happens because students are accustomed to looking for the correct answer after the test, so that when a retest is conducted, students more easily remember the correct answer. This learning process creates a learning environment that supports deep understanding, so that the knowledge gained by students tends to last longer, so it can improve students' retention or memory and students' critical thinking skills.

The findings of this study indicate that critical thinking skills have a positive relationship with student learning retention, with a moderately strong or moderate level of relationship. This confirms that critical thinking skills not only help students understand the material in depth, but also strengthen the memory and application of knowledge that has been learned. Therefore, the development of critical thinking skills in the learning process is essential to improve students' learning retention and support the overall improvement of education quality.

One of the main challenges in examining the relationship between critical thinking skills and students' learning outcomes and learning retention with the application of the Jigsaw type cooperative learning model is the variability in students' critical thinking ability levels, which may affect the accuracy of the research results. Future research is recommended to expand the sample to include students from various educational backgrounds in order to obtain more representative results. In addition, the application of the Jigsaw model, which requires group cooperation, may face obstacles in varied student involvement, so future research can examine factors that affect students' active participation in groups, such as motivation, students' academic ability, retention test time and environment.

▪ CONCLUSION

Based on the results of the study, it can be concluded that critical thinking skills have a positive and significant relationship with student learning outcomes and retention through the Jigsaw type cooperative learning model. Correlation analysis shows a very strong relationship between critical thinking skills and student learning outcomes, with a correlation significance value <0.001, a correlation coefficient (R) of 0.967, and a coefficient of determination (R^2) of 93.5%, which means critical thinking skills contribute 93.5% to learning outcomes, while 6.5% is influenced by other factors. In addition, critical thinking skills also have a significant relationship with student learning retention, with a correlation significance value <0.001, a correlation coefficient (R) of 0.511, and a coefficient of determination (R^2) of 26.1%, which indicates a contribution of critical thinking skills of 26.1% to learning retention, while 73.9% is influenced by other factors.

▪ REFERENCES

Adam, D. H., Hasibuan, M. N. S., Hasibuan, E. R., & Nazliah, R. (2021). The effect of the jigsaw cooperative learning model on improving student learning outcomes. Jurnal Education and Development, 9(2), 437-439.

Ahmad, R. R., Hafid, R., Bahsoan, A., Ilato, R., Sudirman, S., & Damiti, F. (2023). The effect of jigsaw type cooperative learning model on improving student learning Outcomes at SMA Negeri 1 Biluhu. Journal of Economic and Business Education, 1(2), 66-77.

Aini, A. N., Masfuah, S., & Fakhriyah, F. (2024). Development of science adventure trail media (jps) to improve critical thinking ability of elementary school students. Basicedu Journal, 8(1), 719-728.

Annisa, L., Oktaviana, C., & Habibi, A. A. (2020). The relationship between critical thinking skills and student learning outcomes. Edubiologica Journal of Biology Science and Education Research, 8(1), 35-37

Arifin, Z. (2011). Educational Research. Bandung: Remaja Rosda.

Ayurachmawati, P., Asmara, R., & Nopriyanti, T. D. (2024). The Effect of STEM (science, technology, engineering, mathematics) approach on critical thinking ability of class V SD Negeri 01 Rasuan. Indonesian Research Journal on Education, 4(2), 380-384.

Azizah, A., Bahri, A., & Syamsiah, S. (2020). Cognitive retention in biology of high school students with jigsaw cooperative learning. Jurnal Biology Teaching and Learning, 3(1), 148-155.

Danil, M., Corebima, A. D., Mahanal, S., & Ibrohim, I. (2023). The connection between students' retention and critical thinking skills in diverse academic skills in biology learning. Indonesian Journal of Science Education, 12(2), 241-251.

Erlin, S., & Purwianingsih, W. (2021). Analysis of various strategies and learning models that empower metacognitive skills in biology education. Bioedu: Journal of Biology Education, 9(2), 30-40.

Ermin, E. (2022). The relationship between metacognitive skills, critical thinking skills, and social attitudes of middle school students in ternate city towards retention in science subjects. Journal of Biology Learning Innovation, 3(2), 110-120.

Franciscus, A. (2023). The relationship between critical thinking ability and student learning outcomes through the application of the discovery learning model at SMP Negeri 5 Kupang City. JBIOEDRA: Journal of Biology Education, 1(1), 7-12.

Hermanto, I. M., Nurhayati, N., & Samatowa, L. (2022). Identification of students' knowledge retention profile through the application of guided context-problem based learning model (GC-PBL). Normalita (Journal of Education), 10(2).

Juliyantika, T., & Batubara, H. H. (2022). Trends in critical thinking skills research in basic education journals in Indonesia. Jurnal Basicedu, 6(3), 4731-4744.

Lailaturrahmah, E., Tahir, M., & Rosyidah, A. N. K. (2020). The effect of problem based learning (pbl) model on retention and science critical thinking ability of elementary students. PENDAS Scientific Journal: Primary Educational Journal, 1(1), 1-11.

Majid, I. (2022). Study of metacognition, critical thinking and retention skills in biology learning of students of SMAN 10 Kota Ternate. Scientific Journal of Wahana Pendidikan, 8(1), 583-593.

Masitah, T., Wulandari, A. Y. R., Hadi, W. P., & Qomaria, N. (2022). Profile of critical thinking ability of class vii students on environmental pollution material. Natural Science Education Research (NSER), 4(3), 209-213.

Mutmainnah, S. L., & Suhartono, K. C. S. (2020). The relationship between critical thinking skills in the aspects of analyzing and drawing conclusions with science learning outcomes in class V SDN Sekecamatan Klirong academic year 2020/2021. Scientific Journal of Education. 9(3), 860-865.

Putri, H. K., Pratiwi, I. A., & Masfuah, S. (2023). Student team achievement division model assisted by mind mapping to improve students' critical thinking ability. Journal of Educatio. 9(4), 1769-1776.

Putri, R. Y., & Fitri, R. (2024). The effect of the jigsaw learning model on student learning outcomes. Jurnal Pendidikan Tambusai, 8(1), 3951-3954.

Purwaningsih, A. S., & Harjono, N. (2023). Jigsaw type cooperative learning model to improve critical thinking and mathematics learning outcomes of elementary school students. Journal of Educatio, 9(3), 1204-1212.

Rahim, A. (2023). Improving critical thinking skills through critical learning. JSE Journal of Science and Education, 1(3), 80-87.

Raturoma, T. L. R., & Laisnima, L. (2023). The relationship between critical thinking skills and cognitive learning outcomes of students on class x molecular forms material at Sma Kristen Yabt Manokwari. Arfak Chem: Chemistry Education Journal, 6(1), 487-494.

Rusdin, R., & Hafiz, H. S. (2023). Implementation of jigsaw type cooperative learning model assisted by whatsapp media and zoom meeting in english language learning class XI Religion at MAN Dompu. Bullet: Journal of Multidisciplinary Sciences, 2(1), 55-62.

Saleh, R., Zubaidah, S., & Mahanal, S. (2023). The correlation between critical thinking and metacognitive skills on student retention across genders in senior high school. Uniciencia, 37(1), 119-138.

Silas, E. I., Ismail, I., & Suryani, I. (2024). The relationship between critical thinking and student learning outcomes in class XI at SMAN 3 Palopo. BIOPROSPEK: Scientific Journal of Biology, 16(1), 20-28.

Siswati, B. H., Hariyadi, S., & Corebima, A. D. (2020). The relationship between critical thinking and metacognition to biology student learning outcomes with the application of the rwrs learning model. LENSA (Science Lantern): Journal of Science Education, 10(2), 74-82.

Sudirman, S., & Yusnaeni, Y. (2022). The correlation of metacognitive skills with learning retention in high school students in rote ndao district, east nusa tenggara. Journal of Chemical Education Research (JRPK), 12(1), 1-9.

Sukardi. (2011). Methodology of educational research competencies and practices. Jakarta: PT Bumi Aksara.

Uki, N. M., & Liunokas, A. B. (2021). The effect of jigsaw and make a match type cooperative learning models on students' cognitive learning outcomes. Basicedu Journal, 5(6), 5542-5547.

Wahyu, S. (2022). Efforts to increase social studies learning retention social interaction materials through jigsaw learning model: efforts to increase social studies learning retention social interaction materials through jigsaw learning model. Balance: Journal of Economic Education, 7(2), 77-85.

Yandi, A., Putri, A. N. K., & Putri, Y. S. K. (2023). Factors that influence learner learning outcomes (Literature Review). Journal of Siber Nusantara Education, 1(1), 13-24.

Youllanda, W., Medriati, R., & Swistoro, E. (2020). The Relationship between Critical Thinking Skills and Learning Outcomes through the Guided Inquiry Model. Journal of Physics Coils, 3(3), 191–198.

Yulanda, G., & Rahmi, Y. L. (2022). Needs analysis of STEM-Integrated learner worksheets on biodiversity material for class X SMA/MA. Bioilmi: Journal of Education, 8(2), 128-136.

Yunus, R. (2020). Improving mathematics learning outcomes through the jigsaw learning method in class VI at SDN 06 Indralaya Utara. Bina Edukasi Scientific Journal, 13(1), 16-26.