



Comparative Analysis: The Effects of Reciprocal Teaching Model and Problem Based Learning Assisted by Pictorial Riddles on Students' Critical Thinking

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ABSTRAK

Dalam proses pembelajaran, keterlibatan aktif setiap siswa sangat penting untuk mencapai tujuan pembelajaran. Akan tetapi, masih banyak sekolah yang menggunakan metode ceramah tanpa menyertakan model pembelajaran yang menarik sehingga kurang mampu menarik perhatian siswa. Untuk mengatasi hal tersebut, penerapan model pembelajaran yang tepat dan media pembelajaran yang menarik sangat penting untuk memotivasi siswa dalam proses belajar mengajar. Tujuan penelitian ini adalah menganalisis pengaruh komparatif model pembelajaran resiprokal dan model pembelajaran berbasis masalah berbantuan media teka-teki bergambar terhadap kemampuan berpikir kritis siswa sekolah dasar. Penelitian ini menggunakan metode kuasi eksperimen dengan pendekatan kuantitatif, yaitu Pre-test-Post-test Control Group Design. Populasi penelitian adalah seluruh siswa kelas V yang berjumlah 52 siswa yang melibatkan dua kelas. Dari populasi tersebut, diambil sampel sebanyak 26 siswa dari masing-masing kelas. Hasil penelitian kelas eksperimen 1 menunjukkan pengujian hipotesis dengan uji-t dua sisi menghasilkan nilai signifikansi sebesar 0,000 yang berarti lebih kecil dari 0,05 ($0,000 < 0,05$). Sementara itu, pada kelas eksperimen 2 dengan penerapan model pembelajaran berbasis masalah diperoleh nilai Sig. t sebesar $0,000 < \text{probabilitas } 0,05$. Dengan demikian, perbedaan ini menegaskan adanya pengaruh yang signifikan dari masing-masing model terhadap peningkatan kemampuan berpikir kritis. Berdasarkan hasil penelitian ini, dapat disimpulkan bahwa model pembelajaran berbasis masalah lebih berpengaruh terhadap peningkatan kemampuan berpikir kritis dibandingkan dengan model pembelajaran resiprokal.

ABSTRACT

The process of learning, it is imperative to actively engage every student to achieve the learning objectives. However, many schools still employ lecture-based methods without incorporating engaging instructional models, thereby failing to capture students' attention. To address this issue, the implementation of appropriate teaching models and captivating learning media is essential to motivate students in the teaching and learning process. The aim of this research is to analyze the comparative impact of the reciprocal teaching model and the problem-based learning model assisted by pictorial riddle media on the critical thinking abilities of elementary school students. This study utilizes a quasi-experimental method with a quantitative approach, employing the Pre-test-Post-test Control Group Design. The research population comprises all fifth-grade students, totaling 52 students, involving two classes. From this population, a sample of 26 students from each class was selected. The results of the experiment 1 class indicate hypothesis testing with a two-tailed t-test yielding a significance value of 0.000, which is less than 0.05 ($0.000 < 0.05$). Meanwhile, in the experiment 2 class applying the problem-based learning model, a Sig. t value of $0.000 < \text{probability } 0.05$ was obtained. Consequently, this difference confirms a significant influence of each model on the enhancement of critical thinking abilities. Based on these findings, it can be concluded that the problem-based learning model has a more pronounced effect on improving critical thinking abilities compared to the reciprocal teaching model.

1. INTRODUCTION

With the rapid global development, the demands for progress and creativity in Human Resources (HR) are increasing. Despite Indonesia's significant workforce, the hope is that education can be more effective in enhancing its quality. However, the reality does not align with this expectation. One step that can be taken is to improve the quality of education, as education serves as the foundation for the development of Human Resources (Febri et al., 2023; Ina et al., 2021; Priyadi et al., 2018). The advancements in science, technology, and information require human resources with critical thinking skills. The Basic and Secondary Education Process Standards in Regulation Number 22 of 2016 explain that the series of teaching and learning activities in schools must be conducted actively, motivating students, creating a comfortable learning atmosphere, and providing a supportive, creative environment that encourages students' independence in line with their abilities, interests, talents, and physical as well as psychological development (Handayani & Koeswanti, 2021; Mayudana & Sukendra, 2020). Indonesia has undergone several curriculum changes, closely related to the importance of the curriculum in implementing the national teaching system (Prasetyo & Rahman, 2023; Ruaya et al., 2022).

The curriculum holds paramount importance in the field of education as it serves as a tool, reference, foundation, and worldview. It is constantly updated, with several factors influencing its refinement, including the need to keep pace with the rapid advancements in science and technology within the realm of education (Naude et al., 2014; Suryana et al., 2022). The Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) has introduced a new curriculum known as the Merdeka Curriculum. The Merdeka Curriculum aims to create a more enjoyable educational experience for both students and teachers. This curriculum provides students with the freedom to develop their potential in accordance with their interests (Pratycia et al., 2023; Sulistyosari et al., 2022). Within the framework of the Merdeka Curriculum, educational institutions are expected to develop curricula that align with the unique characteristics of the school and the demands of individualized learning. However, in practice, challenges persist, with many educational institutions still struggling to fully adapt their curricula to the diverse needs of students in each institution (Hanif Evendi et al., 2023; Gusteti et al., 2022). Therefore, educational institutions should grant students the opportunity to hone their skills, including altering the methods of teaching to align with the principles of the Merdeka Curriculum.

In the process of learning, every student must be actively engaged in order to achieve the learning objectives. This requires guidance from teachers to motivate and encourage students to be fully involved in the learning process. Teachers must possess mastery of both the subject matter and effective teaching strategies. As motivators, teachers have the responsibility to inspire students to actively participate in the learning process. In instances where students encounter difficulties in understanding the material, teachers must be proactive in addressing these learning challenges (Kuning & Rohaina, 2021; Novitasari & Fathoni, 2022). However, many schools still deliver content through lecture-based methods without incorporating engaging learning models. Based on observations and interviews conducted with 4th-grade teachers of Elementary School at Mataram city, it was found that students' critical thinking abilities in learning are still low. This is attributed, in part, to the use of lecture-based methods by teachers. The lack of interactive learning models leads to student boredom, hindering their understanding of the taught material. Consequently, teachers bear a significant responsibility to transform dull learning environments into enjoyable atmospheres, fostering high levels of student interest (Kholil, 2021; Samosir, 2019; Yulianti et al., 2022). Teachers are not only tasked with imparting knowledge but also with creating an enjoyable classroom environment. Thus, teachers play a crucial role in aiding the optimal development of students to achieve their life goals (Yulianingsih et al., 2019; Yulianti et al., 2022). Therefore, teachers must possess the necessary skills to ensure that the learning process not only runs smoothly but is also enjoyable. To address these challenges, an appropriate learning model is essential to motivate students in the teaching and learning process.

The instructional model represents a planned form of creativity designed by a teacher before initiating the teaching process. This model serves as a guide to implementing classroom instruction to prevent students from feeling bored with monotonous teaching approaches (Mahesti & Koeswanti, 2021; Tanjung & Ashadi, 2019). Reciprocal teaching (RTM) is an instructional model involving the activity of teaching content to peers. In this instructional model, students take on the role of the "teacher" to convey information to their peers (Machbubah & Nisa', 2019; Muafikoh et al., 2019). Meanwhile, the teacher acts as a facilitator and guide who provides scaffolding. Scaffolding is guidance provided by someone with more knowledge to someone with less or no knowledge (Ammy, 2021; Lestari, sandra, 2022). Reciprocal Teaching employs four strategies: clarifying, predicting, generating questions, and summarizing. In addition, students are also capable of presenting it in front of the class (Gulo et al., 2022; Khairani, 2022; Ningsih & Sutriningsih, 2019).

On the other hand, Problem-Based Learning (PBL) is a model where students focus on presenting a real-world problem. They are required to solve the problem and conduct a series of investigations based on theory, concepts, and principles of impulse and momentum independently or in groups. PBL has the potential to connect various issues in everyday life, including those of the students (Boy Bonny.S, 2020; Faqiroh, 2020). This model helps teachers develop students' critical thinking skills during the learning process. The syntax of the Problem-Based Learning model includes: (1) orienting students to the problem; (2) organizing students for learning; (3) guiding individual/group experiences; (4) developing and presenting results; (5) analyzing and evaluating problem-solving processes (Cohen et al., 2020; Tri Pudji Astuti, 2019). Choosing a suitable instructional model can create motivation in the learning process. To support these models, the use of instructional media becomes crucial in teaching activities.

The implementation of instructional media is an appropriate method to enhance students' understanding. Incorporating instructional media in the teaching-learning process is an effort to improve the effectiveness and quality of learning processes, ultimately enhancing the quality of students' learning outcomes. The judicious use of media can aid students in understanding the taught material (Khalbu & Ulfa, 2023; Mufliha et al., 2023). Pictorial riddles are a type of media that can enhance students' critical thinking skills by presenting visual or textual puzzles, aiming to train students' critical thinking abilities. Visual presentation through pictorial riddles is intended to stimulate critical thinking, enabling students to solve problems through group discussions (Azizah et al., 2022; Hidayati et al., 2023). In essence, students possess critical thinking skills in the learning process, such as questioning, hypothesizing, classifying, observing, and interpreting. Critical thinking can stimulate students to solve problems related to the learning material. Critical thinking skills involve the ability to have curiosity about available information to achieve a profound understanding (Sarangih, 2019; Supena et al., 2021). Through visual puzzles, we can enhance students' problem-solving abilities and cultivate their thinking patterns.

This research is important because it examines two learning models that have the potential to improve student's critical thinking skills, namely the reciprocal teaching model and the problem-based learning model assisted by pictorial riddle media. Critical thinking skills are important to help students understand information, solve problems, and make wise decisions. Previous studies, as per have indicated an enhancement in students' mathematical critical thinking abilities when taught using the reciprocal teaching model (Umam, 2018). Similarly, research has elucidated that learning outcomes and critical thinking skills of students taught using the problem-based learning model aided by pictorial riddles have shown improvement (Hasriani et al., 2020).

From prior research, it is evident that both the RTM and PBL models are effective in enhancing students' critical thinking abilities. However, studies comparing these two models in the same context are limited, and there is no research comparing RTM and PBL aided by pictorial riddles concerning students' critical thinking abilities. Thus, this research is essential to fill this knowledge gap and provide a deeper understanding of effective learning approaches in developing students' critical thinking abilities. The objective of this research is to analyze the comparative effects of the reciprocal teaching and problem-based learning models, both employing pictorial riddles, on the critical thinking ability of elementary school students.

2. METHOD

The research method adopted in this study is a quasi-experimental method with a quantitative approach. The applied research design is the pre-test post-test control group design. Devine quasiexperimental design, is defined as a research method used to determine the influence of a specific treatment on another under controlled conditions (Malmia, 2019). The pre-test post-test control group design involves two groups of students subjected to different treatments. Experimental Group 1 is treated with the reciprocal teaching model aided by pictorial riddles, while Experimental Group 2 receives treatment through the Problem-Based Learning model with the support of pictorial riddles. The research design or plan is presented in Table 1.

Table 1. Pre-Test Post-Test Control Group Design

Group	Pre-test	Treatment	Post-test
Experimental Group 1	O ₁	X ₁	O ₂
Experimental Group 2	O ₃	X ₂	O ₄

In Table 1, it is shown that, X₁ (Teaching using the Reciprocal Teaching model), X₂ (Teaching using the Problem Based Learning model), O₁ (Pre-test result for Experimental Group 1), O₂ (Post-test result for Experimental Group 1), O₃ (Pre-test result for Experimental Group 2), and O₄ (Post-test result for

Experimental Group 2). The subjects of this study were all 5th-grade students of SDN 15 Mataram and SDN 28 Mataram, totaling 52 students. The sampling technique utilized was group random sampling, wherein one experimental class was designated at SDN 15 Mataram and another experimental class at SDN 28 Mataram, each consisting of 26 students. This research's data collection techniques include test. The utilized instruments consists of essay-type question sheets. The essay-type questions, totalling 10 items, are utilized to gather data on students' critical thinking abilities. The test administered to students consisted of five indicators: formulating problems, providing arguments, deduction, induction, and evaluation. Before testing the students, we conducted validation of the instrument. This validation process involved two experts. The purpose was to assess the accuracy of the content, relevance to the objectives, and precision of the question construction. The test instrument specifications are presented in [Table 2](#).

Table 2. Test Question Specifications

No	Aspects of Critical Thinking Abilities	Indicators	Number of Items
1	Formulating problems	Ability to formulate problems in the form of questions	2
2	Providing arguments	Providing appropriate reasons for each question	2
3	Deduction	Determining conclusions from the general to the specific	2
4	Induction	Determining conclusions from the specific to the general	2
5	Evaluation	Ability to evaluate an argument	2
Total Items			10

The data collected in this research are analyzed using SPSS 24 for Windows to interpret the results of the data analysis. The data obtained in this research is then analyzed using descriptive and inferential statistical analyses. Descriptive statistical analysis is conducted to evaluate students' critical thinking abilities in each treatment group, whether taught by implementing the Reciprocal Teaching Model (RTM) with the aid of Pictorial Riddles or by employing the Problem-Based Learning (PBL) Model with the support of Pictorial Riddles. Inferential statistics that can be used in this study include tests for normality to ensure that the data are normally distributed, tests for homogeneity of variances to check for equality of variances between groups, and hypothesis testing using the paired sample t-test to compare critical thinking abilities before and after the implementation of RTM and PBL models. Additionally, the calculation of N-Gain Scores will be conducted to evaluate the effectiveness of both models in enhancing students' critical thinking abilities. Categories for N-Gain score attainment can be determined based on the N-Gain values. The categories for N-Gain score attainment can be observed in [Table 3](#).

Table 3. List of N-Gain Score Categories

N-Gain Attainment	Criteria
N-Gain > 0.70	High
0.30 ≤ N-gain ≤ 0.70	Medium
N-Gain < 0.30	Low

3. RESULT AND DISCUSSION

Result

Descriptive analysis was conducted on two sets of data, namely Pre-test and Post-test data. The Pre-test data were utilized to measure the critical thinking abilities of the eksperiment groups before the intervention. It was also used to determine the entry behavior of the students on critical thinking abilities before the treatments, while the Post-test data were employed to measure the critical thinking abilities experiment groups after the treatment. Additionally, the Post-test data were used to assess the effect sizes of reciprocal teaching and problem-based learning models supported by pictorial riddle media on students' critical thinking abilities. The results of the Pre-test and Post-test data for critical thinking abilities in experimental classes 1 and 2 are hereby presented in [Table 4](#).

Table 4. Descriptive Data Description of Pre-test and Post-test

Descriptive Statistics	Experimental Class 1		Experimental Class 2	
	Pre-test	Post-test	Pre-test	Post-test
Mean	72.46	82.38	69.92	83.00
Median	71.00	85.00	70.00	84.00
Mode	56	86	70	90
Standard Deviation	13.91	9.39	13.42	8.34
Minimum	42	38	42	68
Maximum	92	98	90	96
Range	50	38	48	28

Based on the output in Table 4, it can be inferred that students' critical thinking abilities in experimental class 1 showed improvement from Pre-test to Post-test. The Pre-test mean was 72.46 with a standard deviation of 13.91. However, after the intervention or treatment, experimental class 1 demonstrated an improvement with a Post-test mean of 82.38, and the standard deviation decreased to 9.39. These results suggest that the reciprocal teaching model assisted by pictorial riddle media is effective in enhancing students' critical thinking abilities. Similarly, experimental class 2 also exhibited improvement from the Pre-test to the Post-test. The Pre-test mean was 69.92 with a standard deviation of 13.42. After the experiment, the post-test mean increased to 83.00, with a decreased standard deviation of 8.34. This findings indicate that the problem-based learning model supported by pictorial riddle media in experimental class 2 improved students' critical thinking abilities. Thus, both experimental classes showed improvement after being treated with reciprocal teaching and problem-based learning models supported by pictorial riddle media. Moreover, the maximum scores obtained by each class increased after the treatment, by 6 points for experimental class 1 using the reciprocal teaching model and by 6 points for experimental class 2 using the problem-based learning model. To ensure that the Pre-test and Post-test data are normally distributed, a normality test was conducted. The results of the normality test for students' critical thinking abilities are presented in Table 5.

Table 5. Normality Test for Pre-test and Post-test Data

	Statistic	Df	Sig.	Description
Pre-test Experimental Class 1	0.956	26	0.321	Normal
Pre-test Experimental Class 2	0.959	26	0.370	Normal
Post-test Experimental Class 1	0.936	26	0.106	Normal
Post-test Experimental Class 2	0.957	26	0.342	Normal

Based on Table 5, the significance value (Sig.) for the Pre-test in experimental class 1 is 0.321, indicating normal distribution. Similarly, the Pre-test in experimental class 2 has a Sig. value of 0.370, confirming normality. Moving to the post-test, experimental class 1 also exhibits normality with a Sig. value of 0.106. Likewise, the post-test in experimental class 2 has a Sig. value of 0.342, confirming normal distribution. These results indicate that both Pre-test and Post-test data for critical thinking abilities in experimental classes 1 and 2 are normally distributed, as their significance values are greater than 0.05. Furthermore, a homogeneity test was conducted to confirm that the obtained data were homogenous. The results of the homogeneity test for students' critical thinking abilities are presented in Table 6.

Table 6. Homogeneity of Variance Test Results

Data Source	Levene Statistic	df1	df2	Sig.	Description
Pre-test Critical Thinking Abilities	0.315	1	50	0.577	Homogen
Post-test Critical Thinking Abilities	0.108	1	50	0.744	Homogen

According to Table 6, the homogeneity test results show that the significance values for the Pre-test and Post-test of critical thinking abilities are 0.577 and 0.744, respectively. Both values are greater than 0.05, indicating that the Pre-test and Post-test data for critical thinking abilities in students are homogeneous. Having established that the data distribution is normal and the variances are homogeneous, the next step is to determine the effects of reciprocal teaching and problem-based learning models supported by pictorial riddle media on critical thinking abilities. The t-test results are displayed in Table 7.

Table 7. t-Test Results (Payred Sample t-test)

Data	Class	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	Df	Sig.
Critical Thinking Abilities	Experimental Class 1	9.92	11.01	2.158	14.368	5.478	4.598	25	0.000
	Experimental Class 2	13.08	11.68	2.290	17.794	8.360	5.709	25	0.000

Based on the results in [Table 7](#), the t-test calculations for Pre-test and Post-test data in experimental classes 1 and 2 indicate that the Sig. value of 0.000 is less than the significance level of 0.05. With t-values of 4.598 for experimental class 1 and 5.709 for experimental class 2, both exceeding the critical t-value of 1.711, the null hypothesis (H0) is rejected, and the alternative hypothesis (H1 or H2) is accepted. This implies a significant difference in students' critical thinking abilities between the application of reciprocal teaching and problem-based learning models. The mean critical thinking ability score for experimental class 1, using the reciprocal teaching model, is 9.92, while for experimental class 2, employing the problem-based learning model, it is 13.08. From the results, it can be observed that the average value and t-test value in experiment 2 are higher compared to experiment 1. Therefore, the Problem-Based Learning model has a more pronounced impact on students' critical thinking abilities compared to the Reciprocal Teaching model. Additionally, the N-Gain test strengthens the effectiveness of implementing both the reciprocal teaching and problem-based learning models. The average N-Gain test results for experimental class 1 and experimental class 2 can be seen in [Table 8](#).

Table 8. Average N-Gain Test Results

No	Group	N-Gain Score
1	Experimental 1	0.22
2	Experimental 2	0.34

Based on the data from the N-Gain test presented in [Table 8](#), reveals a change in improvement of 0.22. This implies that the mean score of experimental class 1 has experienced an increase in the low category, whereas the mean score of the class subjected to treatment using the problem-based learning model, or experimental class 2, has shown an increase of 0.34, indicating that the average control group also experienced an increase in the moderate category. From this data, it can be inferred that experimental class 2 exhibits a higher improvement compared to experimental class 1. Therefore, it can be concluded that the problem-based learning model aided by pictorial riddles is more effective than the reciprocal teaching model in enhancing students' critical thinking abilities.

Discussion

Based on the data analysis using SPSS version 24, the t-test calculations for Pre-test and Post-test data in experimental classes 1 and 2, with t-values of 4.598 and the N-Gain test value of 0.22 is categorized as low for experimental class 1 and t-values of 5.709 and the N-Gain test value of 0.34 is in the medium category for experimental class 2. And the post-test scores for experimental group 1, which implemented the reciprocal teaching model with the assistance of pictorial riddles, reached 9.92 points. Meanwhile, experimental group 2 demonstrated an improvement in critical thinking skills after undergoing treatment with problem-based learning aided by pictorial riddles, with a score of 13.08 points. Based on the results, it is evident that the implementation of the problem-based learning model using pictorial riddles as a medium is more effective in enhancing students' critical thinking abilities compared to the reciprocal teaching model.

The utilization of a problem-based learning model aided by pictorial riddles demonstrates significance in enhancing students' critical thinking abilities. This is influenced by several factors, one of which is the effectiveness of a systematic and student-centered instructional model syntax. In general, the problem-based learning model comprises five stages: orientation to the problem, organizing students for learning, guiding individual or group investigations, presenting work results where students present their findings in front of the class and analyzing and evaluating problem solutions ([Ginting & Muhammad, 2020](#); [Halim, 2020](#); [Setyaningsih, 2022](#)). Problem-based learning is an approach where learning takes place through problem-solving. The problems used are related to real-world issues faced by learners. This aligns with the perspective of study that the problem-based learning model is based on real-world issues. In PBL, learners' activities involve collaboration to uncover or solve problems within groups. By utilizing this method, students can evaluate the investigative process regarding real-world problems, enhancing their

engagement, enthusiasm, and critical thinking abilities in learning (Darmawan, 2023). This is supported by the research who said the problem-based learning model has the advantage that students are not only expected to be able to improve critical thinking skills through problem-solving, but students must also be able to provide arguments based on valid evidence and can rationally be used to solve a problem (Ariyanto et al., 2020). In applying the PBL model, students will work in groups to gather information and solve problems given by the teacher. In learning, the teacher will only be a motivator and facilitator, so students are required to be active and also get used to being active and also get used to thinking critically. Through discussions in groups, students will indirectly train to improve their ability to think critically.

While the reciprocal teaching model has decreased in improving critical thinking skills, this is due to several factors that occur in the field including limited involvement of passive students and lack of confidence in speaking in front of the class it hinders the learning process and requires a fairly long time allocation. This is in line with study statement which suggests that (1) students lack confidence when allowed to ask or answer questions, (2) students are also less active in making summaries and formulating conclusions and (3) students lack the courage to show and explain the results of discussions in front of the class (Mujiono, 2022). The reciprocal teaching model consists of four stages, namely: 1) summarizing, 2) questioning, 3) predicting, and 4) clarifying (Rawengwan & Yawiloeng, 2020; F. F. Sari, 2022). Limitations on the application of the PBL model include (1) time limitations, because this method usually demands more time to solve problems, especially when equipped with pictorial riddle media so that it extends each learning session, (2) disorganization of students during learning, and (3) challenges in identifying problems (Habibah et al., 2022; Rodiyah, 2023). Ways to overcome these limitations are providing support to students who are less active and confident in participating in learning, implementing effective classroom management techniques to ensure students remain focused and organized during learning, managing learning time efficiently by creating a structured schedule and involving students in decision-making and learning planning so that they feel more ownership and involvement in the process.

During the initial implementation of Problem-Based Learning (PBL), students were administered a Pre-test before commencing the learning process. Upon completing the Pre-test, students expressed confusion as, at the beginning of the learning session, before grasping the content, the instructor posed questions. The majority of students appeared to remain silent, with only a few able to respond. This indicated that when the PBL model was introduced, students may have felt bewildered. Following an explanation that the learning approach would involve the PBL model and an initial understanding of its steps provided, students became aware that the learning process was centered on problem-solving (Ina et al., 2021; Yuniyanto et al., 2020). Consequently, when questions were posed subsequently, students began actively participating in the learning process. During the application of the reciprocal teaching model, students are directed to summarize or conclude the contents of the reading material and ask questions from the reading results. After that, students explain back the knowledge that has been obtained and predict. Reciprocal teaching is a learning strategy through teaching friends. So learning does not go as expected because of the lack of knowledge of students and the confidence of students to come forward. In this strategy, students act as "teachers" replacing the role of the teacher to teach their friends. Inverted learning is mainly developed to help teachers use cooperative learning dialogs to teach reading comprehension independently in class (Chu, 2009; Gunawan & Nahdi, 2023).

Based on research on improving students' mathematical critical thinking skills through reciprocal teaching-learning with the results studied showed that (1) there was an increase in the mathematical critical thinking skills of students taught using reciprocal teaching and (2) the results showed that count $4.73 > t_{table} 1.67$ can be interpreted that the reciprocal teaching model influences on improving students' mathematical critical thinking skills (Umam, 2018). According to other study obtained the results that there was an effect of reciprocal teaching on the critical thinking skills of elementary school students where the normality test was 0.087, the homogeneity test was 0.205 and the T-test results were $0.001 < 0.05$ from the analysis results obtained (A. P. Sari et al., 2023). In addition, research according to other study on the effect of reciprocal teaching and problem-based learning on the critical thinking skills of high school students showed that there was an effect of reciprocal teaching and problem-based learning on students' critical thinking skills with an average post-test in the RTM experimental class of 78.70, while the PBL experimental class was 75.67, and the control class was 73.36 (Anggraeni et al., 2018).

Meanwhile, research conducted by previous study obtained the results that (1) the cognitive learning outcomes of class XI IPA students on the subject matter of elasticity and Hooke's Law taught using a problem-based learning model assisted by pictorial riddle increased where in cycle I an average score of 74.71 was obtained while in cycle II an average score of 79.83 was obtained (Hasriani et al., 2020). and (2) the critical thinking skills of class XI IPA students taught using a problem-based learning model assisted by pictorial riddle have increased. In addition, according to previous study showed the results that there was a significant difference between critical thinking skills in the PBL learning model through hybrid learning

more effectively applied to human reproductive system material to improve critical thinking skills obtained from the N-Gain percent of 64.78% compared to the reciprocal teaching model through hybrid learning only 44.28% (Akpur, 2020). Based on the results of research that has been conducted by researchers, the findings of this study are consistent with several previous studies that show that the PBL model approach can improve students' critical thinking skills.

These findings suggest that the use of problem-based learning can train students in problem-solving, indicating an improvement in their critical thinking skills. The implementation of the PBL model with the aid of pictorial riddles in the learning process can support a high level of understanding in learners, thus achieving progress in critical thinking skills. Pictorial riddles are visual images that depict a problem in the surrounding environment and represent a form of visual media relying on vision (Darfia et al., 2020; Syukri et al., 2022). Teachers pose a series of questions related to the riddle to stimulate learning motivation, enhance critical thinking skills, and reinforce learners' understanding of concepts during small or large group discussions. By employing pictorial riddles as a learning tool, it is expected to facilitate users in recalling and delivering the material. The selection of pictorial riddles as a means to enhance student's critical thinking abilities is an effective and reliable approach. The purpose of the problem-based learning model assisted by pictorial riddle media in this study is to stimulate students' analytical thinking through the provision of pictorial riddle media that requires deep thinking, careful interpretation, and analytical skills to achieve appropriate problem-solving. This can be explained by several factors. First, the PBL model places students as active agents in their learning so that they can build a deeper understanding of the concepts of the material being studied. In addition, by forming small groups students can discuss and help each other in solving problems. Second, the use of pictorial riddle media in learning can help students more easily understand difficult science concepts. Pictorial riddle media can make learning more interesting and stimulate thinking, so it can improve students' critical thinking skills (Ibrahim, 2019; Septiasari et al., 2020). Third, in small groups, students can learn to work together, communicate, and respect the opinions of others. These abilities are very important in everyday life so that they can help students face future challenges.

The results of this study are reinforced by previous research. For instance, previous study revealed that using problem-based learning aided by pictorial riddles can enhance cognitive learning outcomes and critical thinking skills (Darfia et al., 2020). In the same vein, study found that problem-based learning influences students' critical thinking abilities compared to conventional learning models (Nurlaeli et al., 2018). Additionally, other study found that the problem-based learning model is more effective in improving critical thinking abilities in civic education compared to problem-solving learning (Kiranadewi & Hardini, 2021). Furthermore, the findings of the research conducted by previous study assert that the critical thinking skills and science learning outcomes of students taught through reciprocal teaching based on the scientific approach are significantly higher than those of students taught through the scientific approach either individually or simultaneously (Septiasari et al., 2020).

There are several implications of this research for the development of the scientific field under study, including (1) Adding to our understanding of the effectiveness of certain learning models in improving students' critical thinking skills. These findings can be an important contribution to the literature related to basic education and skills-based learning (2) Provide an empirical basis for improving or developing learning models that are more effective in improving critical thinking skills. These results may trigger further research in designing more innovative and adaptive learning methods and (3) provide useful information for educators, decision-makers, and education practitioners to select the most effective learning approaches in advancing students' critical thinking skills at the primary school level. This can contribute to improving the overall quality of education.

4. CONCLUSION

Based on the results of data analysis, it can be concluded that the effect of problem-based learning model assisted by pictorial riddle media has a more significant effect in improving students' critical thinking skills in elementary school compared to the reciprocal teaching model, this is evidenced by higher N-Gain values and t-test results. These findings underscore the importance of integrating innovative teaching methods that encourage critical thinking, imagination, and experimentation with new ideas. Furthermore, the implication of this research is to train students in improving critical thinking, and imagination, reflection on models and theories, introducing and experimenting with new ideas, and encouraging students to be confident in presenting and gaining self-confidence. In addition, it can provide insight to educators and policymakers about the effectiveness of two learning approaches, namely the reciprocal teaching model and problem-based learning model assisted by pictorial riddle media in improving the critical thinking skills of elementary school students. The results of this study can be used as a basis for

developing learning strategies that are more effective in improving students' critical thinking skills at the basic education level.

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