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Problem-Based Learning Model and Motivation on Students' Critical Thinking Ability in Natural and Social Science Learning

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Abstract

This research aimed to explore the problem-based learning model and motivation on students' critical thinking ability in Natural and Social Science earning. The research method was quantitative with a quasi-experimental design, adopting a nonequivalent control group design. The research was carried out at *SD Negeri 13 Padang Gelanggang*. The research population included all the 5th grade students, with the sample selected using random sampling techniques. The research subjects consisted of 18 students in the experimental class and 18 students in the control class. Data were collected through critical thinking ability tests and learning motivation questionnaires. The analysis results using the independent sample t-test and two-way ANOVA test showed that the problem-based learning model had a significant effect on increasing students' critical thinking abilities. It indicated that the critical thinking abilities of students who studied with the problem-based learning (PBL) model were better than those who studied with the conventional approach.

Keywords
School climate, teacher performance, and work commitment

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Introduction

In the 21st century, technological advances and rapid changes related to the curriculum (Syafril & Zen, 2017). The *Merdeka* (independent) curriculum aims to prepare students with relevant and adaptive skills, such as problem-solving, critical thinking, collaboration, and digital skills. The *Merdeka* curriculum encourages teachers to create entertaining learning experiences so that students do not feel pressured during the learning process (Bentri & Hidayati, 2023). In their efforts, teachers are also expected to provide guidance that enables the development of students' interests and talents (Miaz, 2015). With this approach, it is hoped that students can improve their quality in various fields, not only in academics but also in non-academic aspects (Vhalery et al., 2022). In an academic context, students are encouraged to think conventionally and critically (Suryaman, 2020).

The characteristics of critical thinking are character, criteria, arguments, thoughts, points of view, and procedures for applying criteria. According to Komariah (2018), critical thinking skills are students' ability to analyze various situations or problems with careful consideration, so they can make more rational and active decisions. Kurniawan et al. (2020) revealed that critical thinking skills are paramount in social life. Therefore, educators must start training and habituation from an early age and continue this through formal education at school (Miaz et al., 2020). Furthermore, Barlian et al. (2022) also stated that the development of the critical thinking skills process must be accompanied by positive skills and attitudes. Critical thinking is not only the key to student intelligence but is also an integral component of education.

One of the main challenges currently faced is the development of critical thinking skills, which are still relatively low. Winarti et al. (2023) revealed several students who have not achieved maximum results in satisfactory achievement because their scores are still below the *KKM* since students' critical thinking abilities can be considered to be still at a low level. According to Febrita and Harni (2020), teachers have not succeeded in creating innovative learning, encouraging students to participate actively, and creating an entertaining learning process. It has an impact on the feeling of boredom that appears in students during the learning process. Furthermore, Jamaludin et al. (2023) revealed that learning approaches that are more teacher-oriented often do not ask for student input regarding definite topics. Therefore, teachers provide little space for students to develop their understanding. This obstacle arises from a lack of passive student involvement, a lack of practice in analyzing and solving problems objectively by students, and low levels of learning motivation (Lutfiana, 2022).

The relationship between motivation, teaching, and learning is closely related, where motivation acts as an encouragement for students to achieve academic success (Fitri & Masyithoh, 2023; Harahap et al., 2023). Educators and students have a central role in this educational process (Firman & Ardipal, 2021; Yustiara & Sugito, 2023). Therefore, achieving learning objectives depends on the teacher's ability to motivate students through variations in teaching methods and effective classroom management (Zen et al., 2023). One of the subjects that requires motivation is Natural and Social Science.

Furthermore, Firman and Ardipal (2021) and Yustiara and Sugito (2023) stated that in the context of learning at school, educators and students are key elements in this educational process. Therefore, achieving learning objectives is dependent on the teacher's ability to motivate students through variations in learning methods and effective classroom management (Zen et al., 2023). One of the subjects that requires motivation is the Natural and Social Science subject. Natural and Social Science is a subject in the *Merdeka* curriculum. Subjects that combine science and social studies only exist in the elementary school curriculum structure (Sunendar, 2022). Natural and Social Science is systematic knowledge obtained from observation, research, and trials that leads to the recycling of the basic properties or principles of something being studied, studied, and so on.

The characteristics of Natural and Social Science are that it is changing and is a continuous effort made by humans to uncover the truth and use it in life, inviting students to observe, ask questions, collect and analyze data, and conclude research results in the context of Natural and Social Science and relate concepts in Natural and Social Science with the social issues that exist around them. Students are invited to collaborate, communicate, think critically, and solve problems in the context of Natural and Social Science (Baroya, 2018).

Based on observations and interviews that the researchers conducted with high-class teachers in cluster II, Matur District, the researchers got the picture that the primary problem in Natural and Social Science learning was found to be a lack of student interest in Natural and Social Science lessons as well as a lack of student motivation to learn and critical thinking skills, which affected students' understanding of the subject matter. Additionally, there is a lack of teacher creativity in implementing various student-centered learning models. Where students only listen to lectures, questions, and answers and students are not guided enough to sort out the information provided.

The researchers also feel this as the 5th grade teacher, when in class, the students will study material that is a continuation of the previous grade, which means that students' understanding of the Natural and Social Science concepts in the previous grade will be very beneficial and make the students easier to learn Natural and Social Science in the 5th grade. However, most students remember very little of the material they have studied in previous classes. Therefore, in the end, in class, the teacher has to repeat the concept of the material from the beginning. Of course, it cannot be separated from how teachers motivate and teach Natural and Social Science concepts to students.

Students' low ability to think critically can be influenced by a lack of motivation to learn and the teaching methods used by teachers. In the 21st century, the importance of student learning motivation has become a serious concern in developing critical thinking skills. When the learning process takes place, student motivation becomes a key factor that encourages them to learn actively so the learning goals can be achieved. Ideally, students' learning motivation arises when they have the desire to learn, and the teacher's role in motivating students is also paramount.

One learning model that is effective in improving students' critical thinking skills and learning motivation that is recommended in the *Merdeka* curriculum is the Problem-Based Learning model. The Problem-Based Learning model is an innovative learning model used to develop student's abilities to think critically and solve problems. Problem-Based Learning

Model also aims to help students become independent individuals. The main characteristic of the Problem-Based Learning model is student collaboration in solving problems given by the teacher, which encourages the development of critical thinking skills and motivation internally and externally (Bajung et al., 2021). According to Duch (1997), the Problem-Based Learning model provides opportunities for students to improve critical thinking, analysis, and complex problem-solving skills related to real life. Problem-Based Learning model encourages a culture of active thinking in students by requiring them to be actively involved in the learning process, not just depending on the role of the teacher. It can increase student learning achievement regarding the subject matter taught. This concept is in line with Abidin et al. (2021), where the Problem-Based Learning model creates authentic experiences for students to learn actively, build knowledge, and naturally integrate the learning context at school with real life.

Problem-Based Learning model utilizes the type of intelligence needed to face real-world challenges and the ability to deal with novelty and complexity (Tan, 2003). The Problem-Based Learning model involves students in the independent learning process to face challenges in life and careers in today's increasingly complex environment (Nugroho, 2013). Scientific phenomena that use scientific evidence using the Problem-Based Learning model facilitate better achievement of scientific competence (Trisna et al., 2020). The Problem-Based Learning model in independent learning can increase students' learning activities, motivation, and ability. Problem-Based Learning model invites students to correlate the knowledge they learn to the real world. The students learn how to apply knowledge and skills in solving problems and dealing with daily situations (Novelita & Darmansyah, 2022). The Problem-Based Learning model has the advantage that it can help students develop thinking skills, like the ability to adapt new knowledge and apply it to understanding everyday problems. The Problem-Based Learning model is more effective in the problem-solving process because this approach focuses more on the learning process and concepts and can address problems related to students' real lives, compared to conventional learning models.

Literature Review

Problem-based learning

According to Sholihah and Lastariwati (2020), the Problem-Based Learning (PBL) model emphasizes that learning is a process that involves problem-solving and developing critical thinking skills in real contexts. The Problem-Based Learning (PBL) model also provides opportunities for students to learn more broadly, focusing on their preparation to become active and responsible citizens. In the Problem-Based Learning (PBL) model, students are given experience in dealing with real problems, with an emphasis on using communication, cooperation, and existing resources to design ideas and develop reasoning skills. Additionally, the Problem-Based Learning (PBL) model has been proven to improve student learning outcomes in cognitive, affective, and psychomotor aspects (Susilowibowo & Hardini).

Problem-based Learning encourages students to think systematically and dare to solve problems so that students can solve problems by searching for data and drawing conclusions (Saiful et al., 2020). The Problem-Based Learning model is a learning approach that uses real-

world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to gain essential knowledge and concepts from the subject matter (Zabit, 2010).

Learning motivation

According to Alderman (2013), motivation is a psychological factor that encourages individuals or groups to achieve achievements according to their wishes. Hakim (2020) explained that motivation is an impulse or desire that encourages a person to take definite actions to achieve the desired goal. Huitt (2001) stated that motivation is an internal state, which is sometimes interpreted as a need or desire or directs individuals to act actively to achieve a goal. Cook and Artino (2016) added that motivation involves several processes, internal and external to the individual, which produce an attitude of enthusiasm and persistence in carrying out certain activities. Cates et al. (2003) emphasized the importance of teachers always paying attention to the following things to increase student learning motivation:

- *Optimizing the application of learning principles by viewing students' presence in class as* learning motivation from the students themselves.
- Optimizing dynamic elements in learning to revive students' enthusiasm for learning, which is sometimes hampered by various problems.

Think critically

According to Facione (2011), every person can think critically, but not everyone can use it optimally. Developing critical thinking skills at the elementary school level is the first step in helping children develop intellectual and problem-solving abilities, even though this level may not be very complex. Critical thinking skills play a paramount role in achieving success in education and social interactions. This ability can be improved through the learning process (Gleason et al., 2011). Critical thinking is the ability to produce logical answers or solutions based on evidence and strong reasons in dealing with problems or questions. It includes the ability to recognize problems, formulate questions, analyze data, synthesize information, solve problems, make conclusions, and carry out evaluations.

The understanding above shows that developing students' critical thinking skills is crucial to achieving success in education and social interaction. This ability can be improved through a learning process that involves in-depth analysis, evaluation based on strong evidence, and the ability to identify and solve problems skillfully. According to Felix (1999), critical thinking aims to achieve an 'objective' position. When thinking critically, individuals will evaluate all aspects of an argument and identify existing strengths and weaknesses. Critical thinking skills require activities in exploring all points of view of an argument and testing statements with available evidence to support the argument. The most essential thing in critical thinking is to ensure that the arguments put forward are objective. Critical thinking aims to evaluate all sides of an argument and identify its strengths and weaknesses. In addition, critical thinking allows a person to make better decisions, solve problems effectively, open the mind

to diverse points of view, understand information more deeply, improve communication skills, and provide a foundation for personal and professional development.

Methodology

This research was conducted in quantitative with a quasi-experimental design. According to Ross and Morrison (2013), the experimental method involves providing opportunities for students individually or in groups to practice carrying out a process or experiment. This method hoped to make students fully involved in planning experiments, running experiments, finding facts, collecting data, controlling variables, and solving problems faced in a real way. The research consisted of two classes, namely the experimental and the control class. The experimental class is a class that is deliberately given Problem-Based Learning (PBL) model treatment, while the control class uses a conventional approach with the same number of study hours. In experimental research, the treatment is different from another research (Zen et al., 2023). The research design used to measure the influence of the Problem-Based Learning (PBL) model and motivation on critical thinking skills is the nonequivalent posttest-only control group design. This research design is in the following table:

Table 1. *Research **d**esign*

Class	Treatment	Final Test
Experimental	X	T
Control	O	T

The population in this research were all the 5th grade elementary school students in cluster II, Matur District, who were registered in the 2023/2024 academic year. Data collection tools used in this research include interviews, observations, and questionnaires. Motivational questionnaires are to determine students' learning motivation in Natural and Social Science (IPAS) learning in the experimental and control classes. A questionnaire is a data collection technique that is carried out by giving respondents a set of questions or written statements to answer (Sugiyono, 2016). In addition, a questionnaire is several written questions used to obtain information from respondents in reports about their personality or things they know (Arikunto, 2019). Therefore, a questionnaire is a set of questions to obtain information from respondents. The test that has been prepared aims to collect data about students' ability to understand material demonstrating the concept of sound waves and how it is applied in everyday life. This test instrument was given after students used the LKPD (*Lembar Kerja Peserta Didik*- student worksheet). The results of this test were to analyze student learning progress.

Findings

During the implementation of research on Natural and Social Science (IPAS) in elementary schools, the researchers identified several problems, which are low student learning

motivation and low levels of critical thinking (Bajung et al., 2021). Some students seemed less focused during learning and preferred doing other activities, such as talking with friends, coloring, drawing, and other activities. According to Nurma and Kuswaty (2023), students with low motivation tend to be indifferent, get bored quickly, and get involved in various activities during the learning process. The research results also show that the critical thinking abilities and intrinsic motivation of students taught using the problem-based learning model are higher compared to students taught using the conventional learning model (Bajung et al., 2021). These findings are based on the results of research that examine the impact of using a problem-based learning model on improving the critical thinking skills of 5th grade students in learning Natural and Social Science.

Table 2. *Data normality test for students' critical thinking ability*

Sample Class	Learning Motivation	Sig. Value
Experimental Class	High	0,065
	Moderate	0,521
	Low	0,224
	Total	0,053
Control	High	0,046
	Moderate	0,113
	Low	0,683
	Total	0,134

Based on Table 2, the sig value is greater than 0.05 for data on students' critical thinking abilities in the experimental and control classes, both for students with high, moderate, and low learning motivation. Thus, the null hypothesis is accepted, indicating the data has a normal distribution. Information regarding the normality test of critical thinking ability data for students with high, moderate, and low learning motivation in the experimental and control classes can be found in the data normality test for students' critical thinking ability with moderate learning motivation. With this value, it shows that the null hypothesis is accepted, which means that the data is normally distributed. Next, a homogeneity test was carried out.

The homogeneity test is a procedure used to ensure that two or more sample data groups come from populations that have similar variances. According to Sudjana (2005), several methods can be used to test homogeneity, one of which is the Bartlett test. This step is necessary before carrying out other analyses, such as the T-test and ANOVA. By carrying out a homogeneity test, the researchers can ensure that the data group being tested comes from a similar population. Based on the table above, the data is homogeneous.

Table 3. *Data homogeneity test for students' critical thinking ability*

Sample Class	Learning Motivation	Sig. Value
Experimental and Control	High	0,442
	Moderate	0,819
	Low	0,345
	Total	0,819

Hypothesis test 2

Table 4. *Results of hypothesis testing 1 with t-test*

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	M Mean	SStd. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Experimental class- Control class	0,313	5,965	3,991	1,805	18,820	0,584	15	0,021

The results of calculations using the t-test obtained a sig value of 0.021, which is smaller than 0.055, so H0 is rejected. It means there is a difference in the average critical thinking ability of experimental and control class students.

Hypothesis testing 2

Table 5. *Results of hypothesis testing 2 with t-test*

Independent Samples Test										
		Levene's Test for Equality of Variances	t-test for Equality of Means							
								Std. Error Difference	95% Confidence Interval of the Difference	
			Sig.	t	df	Sig. (2-tailed)	Mean Difference		Lower	Upper
Results	Equal variances assumed	0,250	0,168	30,918	9	0,004	14,167	3,615	5,988	22,345
	Equal variances not assumed			40,029	8,942	0,003	14,167	3,51 6	6,205	22,128

The results of calculations using the t-test obtained a sig value of 0.004, which is smaller than 0.05, so H0 is rejected, and H1 is accepted. It means that in the critical thinking abilities of students with high motivation who study using the Problem-Based Learning (PBL) model, there is an average difference between the learning outcomes of the experimental and control classes.

Hypothesis testing 3

Table 6. *Results of hypothesis testing 3 with t-test*

Independent Samples Test										
		Levene's Test for Equality of Variances		T-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Results	Equal variances assumed	0.016	0.901	2.324	15	0.035	7.917	3.407	0.654	15.179
	Equal variances not assumed			2.326	14.82	0.035	7.917	3.403	0.655	15.178

The results of calculations using the t-test show the combined sig value of the two samples is 0.035, which is smaller than 0.05, so H0 is rejected, and H1 is accepted. It means there are differences in the critical thinking abilities of students with moderate learning motivation who study using the Problem-Based Learning (PBL) model.

Hypothesis testing 4

Table 7. *Results of **h**ypothesis testing 4 with t-test*

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Experimental-Control	11.250	6.292	3.146	1.239	21.261	.576		0.037

The calculation results using the t-test show that the combined sig value of the two samples is 0.037, which is smaller than 0.05, so H0 is rejected, and H1 is accepted. It means there are

differences in the critical thinking abilities of students with low learning motivation who study using the Problem-Based Learning (PBL) model.

Hypothesis testing 5

Table 8. *Results of hypothesis testing 3 with a two-way ANOVA test*

Tests of Between-Subjects Effects

Dependent Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6641,667[a]	5	1328.333	16.087	0.000
Intercept	133249.370	1	133249.370	1613.785	0.000
Class	1450.882	1	1450.882	17.572	0.000
Motivation	4807.668	2	2403.834	29.113	0.000
Motivation Class*	15.902	2	7.951	0.096	0.908
Error	2477.083	30	82.569		
Total	167125.000	36			
Corrected Total	9118.750	35			

a. R Squared = ,728 (Adjusted R Squared = ,683)

The calculation results using the two-way ANOVA test obtained an interaction value of 0.908, which is greater than 0.05. It means there is no significant interaction between the PBL model and learning motivation on students' critical thinking abilities.

Discussions

This research has revealed that the problem-based learning model has a positive influence on students' critical thinking abilities. When implementing the problem-based learning model in real learning, researchers see that student's abilities can be raised in generating ideas and finding various correct solutions to a problem. The problem-based learning model succeeded in influencing students' critical thinking abilities. The results of conceptual understanding of students who received treatment using the problem-based learning model showed a significant increase compared to students who did not receive treatment. Therefore, the advantages of the Problem-Based Learning model can be found and are beneficial in the learning process.

The results of testing the first hypothesis using the t-test obtained a sig value of 0.021, which is smaller than 0.05, so H0 was rejected, and H1 was accepted. It means that the critical thinking ability of students who study with the Problem-Based Learning model is better than the student's critical thinking ability who study with the conventional approach. It happens because in the learning process with the Problem-Based Learning model students have been trained to solve high-level questions where students are given the widest opportunity to express their opinions.

Students are invited to overcome challenges from the real world or theory and are expected to find solutions to these problems (Syamsidah & Suryani, 2018). This process stimulates students' curiosity about the situation they are facing, encouraging them to seek solutions to problems actively (Wardoyo et al., 2021). In testing the first hypothesis, the critical thinking abilities of students who studied using the problem-based learning model were higher than the students' critical thinking abilities who studied using conventional approaches (Nurma & Kuswaty, 2023). It happens since in the learning process using the problem-based learning model, students have been trained to solve high-level questions where students get the widest opportunity to express their opinions. Therefore, problem-based learning questions can hone students' critical thinking skills.

In learning with this problem-based learning model, students are facilitated with *LKPD* (student worksheets), which contains problems designed to achieve learning objectives at each meeting. Students solve problems presented in the *LKPD* (student worksheets) by discussing with group members. It aims to enable students to discuss with each other, share ideas, and then collect the ideas they get so that from one problem they will be trained to think critically in solving problems.

It is then reflected in the results of the critical thinking ability test obtained by students, where students who study using the problem-based learning model show better critical thinking skills. Test results show that students who take part in learning using the problem-based learning model tend to give answers that reflect higher critical thinking abilities (Binasdevi et al., 2022). The explanation of the answers given by students is also quite clear and detailed, so they are easy to understand. It happens because, in learning activities using the problem-based learning model, students are encouraged to discuss with peers to find solutions. Every idea that emerges in the group is then put together allowing for the broad solutions discovery to each problem.

The problem-based learning model has been proven to improve critical thinking skills in students with high learning motivation due to the nature of the problem-based learning Model, which challenges students to actively learn and find solutions to existing problems (Bajung et al., 2021). Students with high learning motivation and who use the problem-based learning model are faced with challenges to develop their critical ideas and find various solutions to every problem they face (Putri et al., 2023). They interact with group members and exchange information. The ideas gathered from these interactions are then combined, enriching students with various solutions, and helping them become more confident in conveying ideas and critical thinking.

From these results, the students with high learning motivation are more enthusiastic during learning because they automatically have an interest in learning, so it will be easy to follow each stage in the learning process using the problem-based learning model. According to Putri et al. (2023), students who are motivated to learn something will use a higher cognitive process in studying the material so that students will absorb and comprehend the material better. Indirectly, students with high learning motivation will also be more persistent in doing assignments, interested in new things, and have high enthusiasm in following each stage of the learning process presented by the teacher.

Different from students with high learning motivation who study with a conventional approach, students with high learning motivation who study with a conventional approach think that learning feels normal and is no different from their learning activities on previous days (Yustiara & Sugito, 2023). The learning process feels rigid where students are given explanations by the teacher, then students work on questions guided by the teacher's explanation and the textbook. Students are not used to expressing their opinions, and there is no effort to find various correct answers to a problem. Students feel it is enough to solve a question or problem with just a simple answer without having to look for or think about others in more detail. From the critical thinking ability, of course, this kind of answer gives a low score for questions. Critical thinking ability lies in how active the students are in finding out the cause and effect of the answer, so the correct solution can be found for a problem, while students in the control class only give a simple answer (Putri et al., 2023). Therefore, when compared with the problem-based learning model, students with high learning motivation who study with a conventional approach have lower critical thinking abilities on average (Sholihah & Lastariwati, 2020).

In contrast to learning using the problem-based learning model, the conventional approach places students as learning objects who act as passive recipients of information. In general, learning delivery uses lectures, questions and answers, and assignment methods. Learning activities are dominated by the teacher where the teacher provides an example of solving the problem presented, and students will be given other questions that resemble the questions given by the teacher. Students who learn with a conventional approach tend not to be confident in expressing different ideas. They only focus on simple ways of solving problems, so that students' critical thinking skills in solving problems do not appear, and students tend to be simple in answering a problem.

Even though the answers given by students were quite clear and complete, students made no effort to explain. Therefore, the indicators required for critical thinking abilities are not achieved optimally. It happens because, in the conventional learning process, students are only fixated on the explanations given by the teacher. They are not allowed to express their ideas openly and confidently. The calculation results of testing the fourth hypothesis using the two-way ANOVA test obtained an F-count of 0.096. Meanwhile, the significance obtained was 0.908. Since sig. value is greater than 0.05, H0 is rejected, and H1 is accepted. It means there is no significant interaction between the problem-based learning model and students' learning motivation towards critical thinking abilities. In addition, the Problem-Based Learning (PBL) model and learning motivation are not related to each other in influencing students' critical thinking.

Conclusion

Based on the research results presented above, the problem-based learning model in natural and social science learning for the 5th grade students of elementary school in Matur District is quite effective in improving students' critical thinking abilities. The advantage of this approach is that it can provide a learning experience by expressing various critical ideas that students have to solve problems because this problem-based learning model allows

students to provide different ideas in solving a problem that has been designed to have several correct answers.

The problem-based learning model provides students with the opportunity to develop critical thinking skills. In problem-solving, students are asked to develop different ideas, resulting in in-depth problem-solving. Learning activities encourage students to answer problems with ideas and answers, thereby exploring students' intellectual potential and experience in discovering something new. The problem-based learning model also allows students to think freely according to their interests and abilities, creates class activities full of ideas, and triggers students' higher-level thinking abilities.

The average value of the critical thinking ability of students who study with the problem-based learning model is higher than those with the conventional approach. Therefore, for future researchers, it is hoped that the research results will become a basis and input for conducting relevant research. Furthermore, what happened to students with moderate and low learning motivation in the 5th grade of elementary school, where the critical thinking skills of students who used the problem-based learning Model were higher than those who used the conventional approach.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest.

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