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Project Based Learning Integrated with Socio Scientific Issues to Enhance Critical Thinking Skill in Elementary School

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Abstract
The background of this research is based on the urgent need to improve critical thinking skills among students. This research aims to examine the differences between project-based learning (PjBL) integrated with socio-scientific issues and the more commonly used conventional learning model in schools. Critical thinking skills among elementary school students are still low, thus requiring an innovative approach. This study uses a quantitative quasi-experimental design, specifically employing a pretest-posttest model with non-equivalent experimental groups A and B. The sample consisted of 65 sixth-grade students, divided into two groups: the experimental group A, which followed conventional learning, and the experimental group B, which received project-based learning intervention. Data were collected through pretest and posttest assessments, and hypothesis testing was conducted using paired sample t-tests and independent sample t-tests via SPSS 2022. The results show that the project-based learning model integrated with socio-scientific issues significantly enhances students' critical thinking skills, particularly their abilities in problem-solving, decision-making, and developing a deep understanding of the world around them.
Keywords: *Socio scientific issues, critical thinking skill, project base learning*

Abstrak
Latar belakang penelitian ini berangkat dari kebutuhan mendesak untuk meningkatkan keterampilan berpikir kritis di kalangan peserta didik. Penelitian ini berupaya untuk menguji perbedaan antara pembelajaran berbasis proyek (PjBL) yang terintegrasi dengan socio scientific issues dan model pembelajaran konvensional yang lebih umum digunakan di sekolah. Keterampilan berpikir kritis di kalangan peserta didik sekolah dasar masih rendah, sehingga memerulkan pendekatan yang inovatif. Penelitian ini menggunakan desain kuasi eksperimental kuantitatif, khususnya memanfaatkan model pretest-posttest kelompok eksperimen A dan B yang tidak setara. Sampel terdiri dari 65 peserta didik kelas VI, dibagi menjadi dua kelompok: kemlompok eksperimen A yang mengikuti pembelajaran konvensional dan kelompok eksperimen B yang menerima intervensi pembelajaran berbasis proyek. Data dikumpulkan melalui penilaian pretest dan posttest, dan pengujian hipotesis dilakukan dengan menggunakan uji-t sampel berpasangan dan uji-t sampel independen melalui SPSS 2022. Hasilnya menunjukkan bahwa model pembelajaran berbasis proyek yang terintegrasi socio scientific issues secara signifikan meningkatkan keterampilan berpikir kritis peserta didik, khususnya kemampuan dalam pemecahan masalah, pengambilan keputusan dan pengembangan pemahaman yang mendalam tentang dunia disekitar mereka.

Kata kunci: Isu sosial ilmiah, keterampilan berpikir kritis, pembelajaran berbasis proyek.

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INTRODUCTION

Background of the Study

The development and policies of education in Indonesia continue to evolve and change over time. The government and various stakeholders continue to strive to improve the quality of education, accessibility, and the relevance of education to the needs of society and the workforce. Currently, we are entering the era of Industry 5.0, which emphasizes close collaboration between humans and machines, such as artificial intelligence (AI), and critical thinking skills, becoming essential in the increasingly complex and interconnected environment of Industry 5.0. The ability to analyze, evaluate, and interpret information critically is needed to adapt and drive success. Critical thinking skills are core skills that are important for success in school and everyday life.

Critical thinking skills assist learners in the learning process, decision-making, problem-solving, and the development of a deep understanding of the world around them. Therefore, the development of critical thinking skills is one of the main goals in modern education. Critical thinking skills are abilities that need to be developed in the learning process because they will help students make decisions regarding a problem (Ilhamdi, 2020). Students who possess critical thinking skills will be able to understand problems in their lives and thus determine the best solutions.

In achieving successful learning outcomes in elementary schools, teachers should pay attention to the cognitive development characteristics of students who have concrete rather than abstract thinking abilities, presenting real-life problems or issues in daily life and the surrounding environment, commonly referred to as socio-scientific issues (SSI). The use of SSI can serve as a bridge to real societal problems and a foundation for students to explore science content, as stated by (Suastrawan et al., 2021) “the advantages of SSI-based learning are learning becomes more meaningful, develops critical thinking skills, problem-solving, and reflective thinking, increases social awareness, supports character development, and contributes to students' scientific literacy.”

Problem of The Study

In achieving successful learning in elementary schools, teachers should pay attention to the cognitive development characteristics of students who have the ability to think concretely rather than abstractly, which presents real problems or issues in daily life and the surrounding environment, often referred to as socio-scientific issues (SSI). The use of SSI can serve as a bridge to real societal problems and a foundation for students to explore science content. Indonesia's science achievement in the Programme for International Student Assessment (PISA) in 2022 showed a score of 383, ranking 66th out of 81 countries, or 15th lowest in the world. The science score in 2022 indicated a decline (learning loss) of 12-13 points compared to 2018 and was equivalent to the score obtained in 2009. The low scores of Indonesian students in the PISA assessment indicate that the competencies of students around the age of 15 in 21st-century skills, which include critical thinking, problem-solving, and Higher Order Thinking Skills, are still lacking. (HOTS).

Difficulty in understanding abstract IPAS material causes students to be unable to solve scientific problems and limits their ability to think critically during the learning process. This is evidenced by (Ramadhani et al., 2021) in their research titled "Analysis of the Need for the Development of a Project-Based Learning Model to Enhance Students' Critical Thinking in Elementary Schools," which proves that the constraints faced by students in science learning include students struggling to understand abstract science concepts at 81.5%, material being difficult for students to comprehend at 35.1%, lack of learning resources for students at 76.7%, and students finding it difficult to think critically at 65.2%.

The researchers also conducted a preliminary study at 5 public elementary schools in the Bulukerto district, namely SD Negeri 2 Conto, SD Negeri 1 Nadi, SD Negeri 3 Krandegan, SD Negeri 1 Ngaglik, and SD Negeri 1 Krandegan, using observation and interview methods. The observation was conducted on August 13, 2024. The results of the observation show that the IPAS learning process is still dominated by the teacher and not the students. The IPAS learning has not been adjusted to the learning needs of the students, making it difficult for them to understand abstract material concepts, which impacts the low scores on the Critical Reasoning Indicator in the Education Report. Proven by the results of the Education Report obtained from 5 elementary schools in the district in 2024, namely SD Negeri 2 Conto with 46.79%, SD Negeri 1 Nadi with 46%, SD Negeri 1 Conto with 61.68%, SD Negeri 1 Ngaglik with 53.53%, and SD Negeri 1 Krandegan with 58.48%.

The results of this analysis, when correlated with interview and observation results, indicate that the low Education Report results on the Critical Thinking indicator are due to students not daring or being accustomed to expressing their arguments or opinions, teachers not providing enough space for students to explore, limited use of teaching models, and suboptimal classroom management. In this case, teachers are required to be innovative in creating an active and creative classroom atmosphere through the use of media and learning resources that align with the social environmental issues of the students, in order to motivate students in their learning and encourage them to think critically.

Research's State of the Art

Project-based learning is an educational model that focuses on student activities to understand a concept and principle by conducting in-depth research on a problem and seeking relevant solutions. Students learn independently, and the outcome of this learning is a product (Huda et al., 2024). Hosnan (2014: 319) in (Huda et al., 2024) states that project-based learning is an educational model that uses projects/activities as media. This educational model uses problems as the initial step in gathering and integrating new knowledge based on their experiences in real activities.

Sintaks pembelajaran mengacu pada tahapan atau bab yang harus dilalui dalam pembelajaran. Sintaks memperjelas dan menstrukturkan alur kegiatan pembelajaran. Sintaks model pembelajaran berbasis proyek menurut (Huda et al., 2024) yaitu: 1) Menentukan Pertanyaan Mendasar, 2) Menyusun Rancangan Perencanaan Proyek, 3) Menyiapkan Jadwal Kegiatan, 4) Memantau Perubahan Kinerja peserta didik, 5) Menguji Kinerja peserta didik, 5) Evaluasi Pengalaman.

Dengan menyediakan SSI sebagai konteks di mana siswa belajar sains, mereka dapat memperoleh kesadaran tentang hubungan timbal balik antara perspektif sosial, politik, dan ilmiah saat mereka mempelajari konten dan mempraktikkan sains penting seperti argumentasi, penalaran, dan pengambilan keputusan. (Presley dkk., 2013). Pentingnya penelitian dan praktik SSI dalam pendidikan sains kontemporer dan masa depan ditekankan oleh kebutuhan keterlibatan siswa dengan dunia tempat mereka tinggal, dan yang akan mentransformasi serta membentuknya untuk generasi yang akan datang. (Zeidler et al., 2019)

The application of the SocioScientific Issue (SSI) approach has the potential to become a strategy for shaping a critical generation of Indonesians in order to face the developments in science and technology. The implementation of the SSI learning approach influences the enhancement of students' critical thinking skills, thereby making the SSI learning approach a potential strategy for forming a critical generation of Indonesians. (Sholehah et al., 2023). Dalam menggunakan pendekatan SSI, masalah atau isu sosial yang diangkat harus memenuhi kriteria, yaitu: (1) memiliki dasar ilmiah (2) melibatkan pembentukan opini (3) sering terlihat oleh media (4) informasi masih kurang (5) bertujuan pada lokal, nasional, dan global yang memiliki kerangka politik dan

sosial (6) memiliki nilai dan pertimbangan etika (7) memiliki pemahaman tentang kemungkinan yang terkait dengan peristiwa di lingkungan sekitar. (Rasyih et al., 2024).

Critical thinking is a process of directed, clear, skillful, and active interpretation and evaluation of a problem that includes observation, problem formulation, decision-making, analysis, and conducting scientific research that ultimately produces a concept. (Rositawati, 2019). Critical thinking skills are cognitive skills that encourage learners to think reflectively about problems. Critical thinking involves mental activities such as problem-solving, analyzing assumptions, providing rationales, evaluating, conducting investigations, and making decisions. (Saputra, 2020). Based on the descriptions of several opinions above, it can be concluded that critical thinking skills are a person's ability to think logically, systematically, and reflectively in identifying, analyzing, and evaluating a problem by asking questions, gathering relevant information, and considering perspectives in decision-making or problem-solving.

Gap Study & Objective

To optimize learning that meets the needs and characteristics of students, learning can be conducted using the project-based learning model or Project Based Learning. NYC Department of Education (2009) states that PjBL is a learning strategy where students must build their own content knowledge and demonstrate new understanding through various forms of representation. In addition to being able to tailor content to students, Project-Based Learning (PjBL) makes learning experiences more meaningful because it involves students' real-life situations.

Project-Based Learning (PjBL) is an approach that positions students at the center of the learning process and prepares them for real life by exposing them to real-life problems (Nurhadiyati et al., 2020). By using a project-based learning model and incorporating learning that connects with real-life issues, known as Socio-Scientific Issues, it will help students develop critical thinking skills. This is supported by (Ramadhani et al., 2021) in their research, which concluded that project-based learning materials in the 5th-grade Science subject in elementary school, accompanied by real-life examples relevant to everyday issues, are necessary to enhance students' critical thinking.

Similarly, the integration of socio-scientific issues can enhance students' critical thinking skills as (Rosyidah & Subekti, 2023) concluded in their research titled “Implementation of Socio-Scientific Issues Learning to Improve Students Critical Thinking Skills.” The research results and discussion show that learning with the socio-scientific issues approach can be carried out very well. Students can complete learning, starting from stating problems, identifying problems, and presenting impacts to solving problems. Learning with a socio-scientific issues approach can improve students' critical thinking skills.

Differences occur between the theory and previous research regarding the expected ideal conditions and the issues raised. Problems were also identified through a preliminary study conducted at the research location. The focus of this research is based on studies previously presented regarding the application of the project-based learning model, and socio-scientific issues integrated into a unified whole aimed at enhancing critical thinking skills in science learning materials for sixth-grade elementary school students.

In Socio Scientific Issues learning activities, students are helped to recognize controversial issues in their environment. Socio Scientific Issues involve issues that are often controversial and complex, such as climate change or the use of technology. SSI-based learning does discuss a controversial scientific issue and is a hot topic in social life. So it is possible that there are opposing facts where both have their respective strengths (Budinarianti & Susiyawati, 2024). Learning activities involving SSI allow students to learn in a broader or contextual context. Socio-Scientific issues in the environment are contextual issues that occur in Indonesia, these important issues arise

to students with the aim of stimulating critical thinking, analysis, and argumentation (Çalık & Wiyarsi, 2021).

The literature reveals that the project-based learning model can guide students to analyze arguments, draw conclusions using reasoning, assess or evaluate, and make decisions or solve problems. This research uses the value clarification technique model based on socio-scientific issues, which are social problems related to conceptual or procedural issues in science. The application of the project-based learning model is integrated with socio-scientific issues so that students can identify the problems being faced, design projects, and conduct scientific investigations. The project-based learning model integrated with socio-scientific issues is believed to enhance critical thinking skills by identifying scientific problems, describing, evaluating, and formulating solutions, as well as analyzing problems by presenting scientific ideas to draw conclusions.

METHOD

Type and Design

This research uses a quantitative approach with a quasi-experimental research type. This type of research is used by the researcher because they cannot fully control the external variables that affect the experiment. The design used in this research is a non-equivalent control group pretest-posttest design. The treatment used to conduct the research was carried out a maximum of three times. This study aims to determine the effect of the project-based learning model integrated with socio-scientific issues on the improvement of critical thinking skills of sixth-grade elementary school students. (Tabel 1).

Table 1. Nonequivalent Control Group Pretest Posttest Design

Group		Pretest	Treatment	Posttest
Experimental Group	R	O1	X_1	O2
Control Group	R	O3	X_2	O4

Sumber: (Sugiyono, 2017)

Description:
R : Randomization process
O1 : Observation of Pretest results for the experimental group
O2 : Observation of Posttest results for the experimental group
X_1 : Intervention of implementing Socio Scientific Issues-Based Learning Module
X_2 : Conventional learning
O3 : Observation of Pretest for the control group
O4 : Observation of Posttest for the control group

Data and Data Sources

The variables in this study are two, namely the independent variable which is the project-based learning model integrated with socio-scientific issues, and the control variable which is critical thinking skills. The population of this study consists of all sixth-grade students in Bulukerto District, Wonogiri Regency, Central Java Province. The sample is a representative of the population taken for the research.The sampling technique used is the probability sampling technique with the simple random sampling technique. The sample in this study were grade VI Elementary School students in Bulukerto District, The population in this study was 65 students in the 2024-2025 academic year. All samples were divided into two groups, namely Group A as an experimental class with the application of conventional learning and Group B with the application of a project-based learning model integrated with socio-science issues. (Tabel 2)

Table 2. Sample Grouping

Group	Class	Student
Experimental A	IVA	32
Experimental B	IVB	33
Amount		65

Sumber: Student data for the school 2024-2025 year

Data Collection Technique

The data collection technique in the form of pretest and posttest questions to measure critical thinking skills, using questions that have been tested for validity and reliability. The questions were given to the students before and after the treatment in each group, namely the experimental group A and the experimental group B, each three times. The experimental group A was treated with the conventional learning model, while the experimental group B was treated with project-based learning integrated with socio-scientific issues. (Tabel 3).

The stages of the Socio-Scientific Issues (SSI) learning approach include: 1) problem analysis; 2) clarification of science; 3) refocus on socio-scientific dilemma; 4) role play; and 5) meta-reflective activity. The SSI approach stages can be integrated with critical thinking ability indicators, including: 1) analysis; 2) explanation; 3) interpretation; 4) evaluation; 5) inference; and 6) self-regulation. (Febriana et al., 2023).

Table 3. Development Indicator of Critical Thinking Skills

No	Indicator	Critical Thinking Skills Indicator
1	Interpretation	Categorizing;
		Explaining important meanings;
		Clarifying meanings
2	Analysis	Testing ideas;
		Identifying arguments;
		Identifying reasons and claims
3	Conclusion	Evidence questioning;
		Alternative hypotheses;
		Drawing valid and logically justified conclusions
4	Evaluation	Assessing the credibility of claims;
		Assessing the quality of arguments made;
		using inductive methods or deductive thinking
5	Explanation	Justifying procedures;
		Presenting arguments.
6	Self-regulation	Self-monitoring;
		Self-correction.

Data Analysis

Data is analyzed using inferential statistics for advanced analysis involving hypothesis testing and confidence intervals. Before conducting inferential statistics, prerequisite tests are first carried out, namely normality tests and homogeneity tests. Next, hypothesis testing is conducted to determine the significant effects and differences between experimental group A and experimental group B using paired sample t-test and independent sample t-test with SPSS 2022 (Guetterman, 2019).

Paired sample t-test
H0: The project-based learning model integrating socio-scientific issues does not have a significant positive effect on the critical thinking skills of sixth-grade students at Kebonpedes Elementary School.
H1: The project-based learning model integrating socio-scientific issues has a significant positive effect on the critical thinking skills of sixth-grade students.

Independent sample t-test
H0: There is no difference in the critical thinking skills of sixth-grade students using the project-based learning model and the conventional learning model.
H1: There is a significant difference in the critical thinking skills of sixth-grade students applying the project-based learning model integrated with socio-scientific issues compared to the problem-based learning model.

Hypothesis testing uses the paired sample t-test and independent sample t-test with SPSS 22, with the condition that if Sig < 0.05, then H0 is rejected and H1 is accepted.

RESULTS AND DISCUSSION

Results

The results of the pretest and posttest of IPAS learning on the solar system material by applying the conventional learning model (Group A) and the project-based learning model (Group B) on the critical thinking skills of sixth-grade elementary school students, which consist of the lowest scores. The data obtained in this study are the posttest and pretest scores of critical thinking skills. The comparison of the critical thinking skills measurement results is presented in Table 1.

Table 1. Comparison of the Critical Thinking Skills Score Results of the students

Pengukuran	Rata-rata Skore (Mean)		Selisih
	Kelompok A	Kelompo B	
Pretest	70,41	73,39	3,39
Posttest	73,94	83,18	9,79

Based on the results of the average comparison in Table 1, the average pretest scores between the class that received the conventional learning model treatment and the class that received the project-based learning model treatment showed a difference of 3.39. Meanwhile, for the average posttest scores between the class that received the conventional learning model treatment and the class that received the project-based learning model treatment, there was a difference of 9.79. The results of the normality test for experimental group I and experimental group II can be seen in tables 2 and 3 below.

Table 2. Results of Normality Test for Critical Thinking Skills Data of Group A

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VAR00001	.122	32	.200*	.953	32	.181
VAR00002	.096	32	.200*	.940	32	.073

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 3. Results of Normality Test for Group B Critical Thinking Skills Data

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VAR00001	.086	33	.200*	.964	33	.345
VAR00002	.145	33	.077	.913	33	.011

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on tables 2 and 3, the results of the normality test of critical thinking pretest and posttest results in Group A and Group B can be determined. The normality test uses the Kolmogorov-Smirnov Z technique with SPSS 26.0 for Windows; if the significance value is 0.05, then the data is normally distributed. Based on the above data, it means the data is normally distributed.

Table 4. Homogeneity Test Before Treatment

ANOVA

VAR00001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2400.219	22	109.101	1.712	.204
Within Groups	573.500	9	63.722		
Total	2973.719	31			

Table 5. Homogeneity Test After Treatment

ANOVA

VAR00001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2463.375	18	136.854	2.048	.096
Within Groups	868.500	13	66.808		
Total	3331.875	31			

Based on tables 4 and 5, the results of the homogeneity test using the Levene Statistic method were obtained. The results of the homogeneity test before treatment obtained a significance value of 0.204, which is > 0.05, meaning that both classes before treatment have the same or homogeneous variance. Meanwhile, table 5 shows the results of the homogeneity test after treatment obtained a significance value of 0.096, which is > 0.05, meaning that both classes after treatment have different or homogeneous variance.

Based on the prerequisite tests that have been conducted, it is known that the data is normally distributed and homogeneous. Next, a T-test analysis was conducted using the Independent Sample Test with the help of SPSS 26.0 for Windows to determine whether there is a difference in effectiveness between the two experimental groups regarding thematic critical thinking ability. The results of the analysis using the T-test are presented in Table 6.

Paired sample t-test

Table 6. Paired sample t-test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2-tailed)
Pair 1	VAR00001 – VAR00002	-9.78788	7.40674	1.28935	-12.41420	-7.16156	-7.591	32	.000

Based on Table 6, the Sig. (2-tailed) value is 0.000 < 0.05.
H0: The project-based learning model integrated with socio-scientific issues does not have a significant positive effect on the critical thinking skills of sixth-grade elementary school students.
H1: The project-based learning model integrated with socio-scientific issues has a significant positive effect on the critical thinking skills of sixth-grade elementary school students.
Therefore, H0 is rejected and H1 is accepted.

Independent sample t-test

Table 7. Independent Sample Test

		Levene's Test 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
Ket Kritis	Equal variances assumed	1.150	.288	-2.742	63	.008	-7.36553	2.68575	-12.73258	-1.99848
	Equal variances not assumed			-2.746	62.840	.008	-7.36553	2.68233	-12.72601	-2.00506

Based on Table 7, the Sig. (2-tailed) value is 0.008 < 0.05.
H0: There is no difference in critical thinking skills of sixth-grade students using the project-based learning model integrated with socio-scientific issues and the conventional learning model.
H1: There is a difference in critical thinking skills of sixth-grade students using the project-based learning model integrated with socio-scientific issues and the conventional learning model.
Therefore, H0 is rejected and H1 is accepted.

Discussion

The project-based learning model that integrates socio-scientific issues based on learning outcomes has proven to be very effective and can enhance students' critical thinking skills. The effectiveness of using this learning model can be applied by teachers in addressing real-life problems faced by students in the future. Because its implementation uses concrete media and involves students directly in designing and completing projects. Through this learning model, students are able to demonstrate new knowledge in the form of works or products by building content knowledge and integrating new knowledge based on real experiences. Thus, it indirectly fosters students' critical thinking skills, especially in solving problems in their surroundings.

SSI refers to socially controversial issues related to science in conceptual, procedural, and technological aspects (Rubini & Pursitasari, 2022). The real strength of SSI lies in its use as a tool in science education, as research findings suggest that SSI can enhance several skills, such as argumentation skills, critical thinking and problem-solving skills (HOTS), and understanding of science concepts. (Rahayu, 2019). PjBL emphasizes the active involvement of students in the learning process through real projects that are relevant to their lives. This is expected to enhance students' deep understanding and develop skills such as critical thinking, collaboration, and problem-solving. (Arsih et al., n.d.).

Post-implementation assessment of students' critical thinking skills showed significant improvement compared to the initial assessment results. Through participation in a learning project that integrated socio-scientific issues, students demonstrated increased ability to analyze data, make rational decisions, and create creative solutions to complex problems. The hands-on nature of this learning gave students the opportunity to apply critical thinking skill.

Comparison of students' abilities, particularly in enhancing critical thinking skills using the project-based learning model and the conventional learning model. The effectiveness of the project-based learning model is that students can make decisions on problems or issues in their surroundings by solving problems, presenting alternative solutions, collaborating, and presenting a project that students can apply not only in the learning process but also in life. This statement is more effective compared to the use of conventional learning models.

The application of SSI in learning can encourage students to actively seek information, evaluate sources, and form their own opinions. With the implementation of SSI, students are trained to face complex and unstructured real-world problems, which are the main characteristics of challenges in the era of the Fourth Industrial Revolution. This prepares them to face complex problems in the future with more confidence. (Zahroh et al., n.d.). Students can make appropriate decisions using SSI because SSI is scientific and society-oriented. SSI contains complex and open-ended problems and does not have clear or definite answers (Özbuÿutu, 2022). When students encounter problems in their daily environment, they need to think openly to solve them. The characteristics of elementary school students according to Piaget in the concrete operational stage mean that at this stage, students begin to develop logical and systematic thinking abilities, but are still limited to real and concrete experiences. The real and concrete experiences referred to can be presented based on surrounding social issues.

This research aims to enhance the critical thinking skills of sixth-grade elementary school students. Critical thinking skills can influence students in making decisions related to personal and social issues around them. The role of the teacher is to influence students' abilities by viewing science holistically. Based on the statement about critical thinking skills, it can be concluded that critical thinking skills are the ability of a person to think logically, systematically, and reflectively in identifying, analyzing, and evaluating a problem by asking questions, gathering relevant information, and considering different perspectives in decision-making or problem-solving. The selection of the project-based learning model is very appropriate based on the consideration of choosing learning strategies to foster students' critical thinking skills. (Hartini, n.d.).

CONCLUSION

The results of this study prove that the application of the project-based learning model integrated with socio-scientific issues can enhance the critical thinking skills of sixth-grade students. The application of the project-based learning model integrated with socio-scientific issues is also proven to be more effective compared to the application of the conventional learning model in science education. The limitations of this study can

be followed up with further research to determine other factors that influence the critical thinking skills of elementary school students. It is hoped that the results of this study can serve as an inspiration in the implementation of project-based learning models, socio-scientific issues, and critical thinking skills.

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