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The Influence of Project-Based Learning Models on Critical Thinking Ability and Basic Science Learning Outcomes

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ABSTRACT

The main objective of this study was to analyze: (1) better influence the outcomes of learning science students taught by Projek Based Learning learning model and model of Direct Instruction; and (2) better effect between critical thinking skills that are taught by Projek Based Learning learning model and model of Direct Instruction. This research is a quasi-experiment conducted in SD Negeri 064973 Medan. The population in this study were all 50 students of class VII, while the sample in this study were students of class VI-A total of 25 people with learning models Projek Based Learning, and students of class VI-B as many as 25 people with Direct Instruction models. The instrument used consisted of test learning outcomes to shape totaled 9 points and can test the reliability of 0,374 and totaled 18 items critical points and has a reliability of 0.831. Data analysis was performed using independent samples test t-aided assisted software SPSS 16.0 for windows. The result showed that: (1) the effect of the Project the based Learning learning model is better than the direct instruction model to learn science students' outcomes. It is based on the acquisition tcount of 2,892 scores greater than ttable of 2.060 and (2) the effect of the Project Based Learning learning model is better compared with the direct instruction learning model t the student's critical thinking skills. It is based on the acquisition score tcount of 2,944 greater than ttable of 2.060.

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1. INTRODUCTION

The 21st century education as the need for character education, skills, and academics. Wijaya et al., (2016) [1] explains that education plays an important role in building learning and innovation skills, skills in using technology and information media, as well as the ability to work and survive by using life skills. The process of education begins from the moment a person is born within the family environment and continues with formal, structured, and systematic education in the school environment. At school, there is direct interaction between students and teachers in the learning process. Teachers have a crucial role in the learning process, both as planners and as implementers in teaching and involving students to actively participate in learning activities.

Currently, the learning process still relies on conventional teaching models such as lectures and assignments. As a result, the learning process becomes monotonous, and students have limited opportunities to explore their own abilities. Additionally, the use of instructional media is also very rare. This indicates that the

learning process being used has not been able to accommodate and facilitate the diverse learning abilities of each individual student. There is a need for improvement and creativity to make the learning process more engaging for students as the primary subjects of learning and to develop critical thinking skills in students.

The ability to think critically certainly has an impact on students' cognitive development and adaptability. Therefore, the low level of critical thinking skills among students in Indonesia is an important issue that needs to be addressed promptly. The instructional models used by teachers are not suitable, resulting in low levels of critical thinking skills among students in Indonesia Dari & Ahmad, (2020)[2]. Instructional models have a significant impact on students' mindset. They help students develop their cognitive abilities, especially critical thinking skills. Therefore, an inappropriate instructional model can hinder the optimal cognitive development of students. Critical thinking is a higher-order thinking skill that involves cognitive tendencies and abilities to solve problems, formulate conclusions, assess probabilities, and make decisions about what to believe or do. The inability of learning outcomes to promote critical thinking has become a national issue that needs to be tackled Hardianti, (2013).[3]

Based on preliminary observations conducted through interviews with elementary school teachers in the Medan Tembung sub-district, it is stated that during the teaching and learning process, the majority of the media and instructional models used rely on teacher explanations, with the remaining materials consisting of worksheets. Additionally, other constraints include time limitations and the lack of structured textbooks on the subject matter. The use of monotonous and unstructured teaching materials and instructional models leads to student boredom and reduced interest in learning, which can ultimately affect students' learning outcomes and their ability to think critically in the future.

One of the instructional models that meets the criteria for selecting the appropriate instructional model is the project-based learning model. Project-based learning centers the learning around the child and adopts three principles: context-specific learning, active student engagement in the learning process, and the achievement of learning goals through social interaction and various experiences Kokotsaki et al., (2016) [4]. Based on a literature review conducted by Egul and Kargm (2014) [5], project-based learning trains students to take responsibility for their work during the learning process and sharpens their ability to find solutions to problems, both individually and collaboratively with their peers. The use of the project-based learning model is expected to provide students with the opportunity to enhance their critical thinking skills in building the four pillars of learning, as their understanding can improve (learning to know) through the scientific work process (learning to do) carried out collaboratively (learning to live together). This, in turn, helps students achieve self-directed learning (learning to be).

Elisabet (2019) [6]. This study aims to improve the motivation and learning outcomes in Science by using the Project-Based Learning (PjBL) model for 5th-grade students at Gendongan 03 Public Elementary School in Salatiga during the 2018/2019 academic year. This research is a type of action research conducted in two cycles using the spiral model by C. Kemmis and MC. Taggart. The research subjects were 37 students in the 5th grade at Gendongan 03 Public Elementary School in Salatiga. The data collection technique in this study used a comparative descriptive method by comparing the results from the pre-cycle to Cycle II. In the pre-cycle, the percentage of students' learning motivation was 44% in the moderate category and 56% in the low category. It gradually increased to 30% in the high category, 54% in the moderate category, and 16% in the low category in Cycle I. In Cycle II, it further increased to 83% in the high category, 11% in the moderate category, and 5% in the low category. The increase in students' motivation in learning also had an impact on their learning outcomes. In the pre-cycle, the percentage was 40%, and it gradually increased to 62% in Cycle I. For Cycle II, there was a further increase with a percentage of 81%. It can be concluded that using the Project-Based Learning model can help students improve their motivation and learning outcomes in the subject of Science.

Suryaningsih (2021) [7]. The use of less creative teaching models in the learning process results in low critical thinking abilities among students. Therefore, a creative teaching model is needed to develop critical thinking skills. This study aims to analyze the differences in the influence of Problem-Based Learning and Project-Based Learning models on the improvement of students' critical thinking skills in Science at the elementary school level. This research is classified as a meta-analysis study. The subjects in this study are 20 articles on the use of Problem-Based Learning and Project-Based Learning models. Data collection was conducted by searching for articles available in online journals using Google Scholar. The instrument used was a coding category sheet. The data analysis technique used was quantitative statistical analysis. The results of the study show that the Problem-Based Learning model had an average improvement of 24.48, which was greater than the Project-Based Learning model with 17.31. The Ancova test result showed an f value of 11.620 > 3.55, with a significance value of 0.002 < 0.05, and an Effect Size test result of 0.234 with a Sig. value of 0.002. The conclusion of this study is that the Problem-Based Learning model is more effective in influencing the improvement of elementary school students' critical thinking skills in Science compared to the Project-Based Learning model. The implications of this research are the development of problem-solving skills and the acquisition of essential concepts based on the Science subject matter.

2. RESEARCH METHODS

This research was conducted at SD Negeri 064973 Medan, which is located at Jl. Bhayadngkara No 367 D. In the odd semester of the 2022/2023 academic year. The population in this study were all class VI of SD Negeri 064973 Medan in the odd semester of the 2022/2023 academic year, with 2 classes totaling 50 people. Class VIa has 25 students and VIb has 25 students. The sampling technique in this study was carried out randomly (cluster random sampling), namely from 2 classes to be selected 2 classes, namely one class as the experimental class VIa and one class VIb as the control class. This study uses a Quasi Experimental Design, with pre and post-test patterns. Data on pre-test, post-test scores and the number of solutions found by students were analyzed by t-test and Lavene test.

3. RESULT AND DISCUSSION

Project Based Learning

In carrying out the learning process in elementary school, there is a need for innovative learning innovations that are enjoyable and encourage students to develop their creativity by using innovative teaching models. One innovative teaching model is Project-Based Learning. Project-Based Learning Savery, (2006) [8] is a collaborative learning approach. Group work is included in the strategy that promotes participation, interaction, and collaborative work among students. Interaction within the group helps students develop valuable teamwork skills and effective communication skills, making the learning process more active for students.

In carrying out the process in elementary schools, it is necessary to have learning innovations that are fun and encourage students to develop their creativity, namely by using the project based learning (PjBL) learning model. The project based learning (PjBL) learning model is an innovative learning model that uses projects as learning media, so that students are actively involved in the learning process and problem-solving activities, as well as providing opportunities for students to work in their groups to produce a valuable product Melinda & Zainil, (2020) [9].

The PjBL model is a learning model that involves students in analyzing competencies and abilities with a systematic, factual and accurate process that is made to create products Suang, Yanti & Farida (2022) [10]. Which aims to enable students to gain knowledge through the realization of projects created by working together to solve problems that can generate problems that can create services and goods Suang, Yanti & Farida, (2022) [10].

The application of the project based learning (PjBL) model in learning in elementary schools makes the learning process centered on students (student center), because the application of the project based learning (PjBL) model places demands on students to make decisions, create frameworks, and design processes to achieve results independently, besides that students are also given the responsibility to obtain and manage the information obtained, carry out continuous evaluations, and evaluate the final results of the projects they are working on in order to obtain quality final results (Wilman & Indrawati, 2020) [11].

Critical Thinking Ability

The ability to think critically is one of the basic capital or intellectual capital that is very important for everyone. According to Liberna (2011) [12] "The ability to think critically, the brain is forced to think seriously to solve problems faced by individuals who think or think about actions to be taken later." .

The purpose of critical thinking training in teaching is to create a spirit of thinking and encourage students to question what they hear and examine their own thoughts to ensure inconsistent or incorrect logic occurs. Therefore critical thinking skills are needed in solving problems/finding solutions.

Richard W. Paul Liberna (2011) [12] "Critical thinking is an intellectually disciplined process in which a person actively and skillfully understands, applies, analyzes, synthesizes and evaluates various information that he collects or that he takes from experiences, observations, reflections he does, reasoning or the communication it does." So, someone who thinks critically will always be active in understanding and analyzing all the information he gets.

So it can be stated that the ability to think critically is a very important ability for everyone who is used to solve life's problems by thinking seriously, actively, carefully in analyzing all the information they receive by including rational reasons so that every action to be taken is correct.

2. Direct Instruction Learning

Arends (2013) [13] states that the personal learning model is specifically designed to improve student learning about well-structured factual knowledge that can be taught in a gradual manner and to help students master the procedural knowledge needed to display simple skills in groups.

The personal learning model (direct instruction) is a teacher-centered learning model (teacher center), with an emphasis on declarative learning (knowledge about something in the form of information, concepts, principles, or generalizations), or procedural (knowledge about how to do something) as well as guided academic skills. teacher as a facilitator to disseminate knowledge to students Saefuddin, (2014)[14].

Apriana (2014) [15] concluded that the direct instruction model is an example of learning that can help students examine basic skills and obtain information that can be taught step by step. Through direct learning students can develop declarative and procedural understanding in a structured and well-structured manner.

Based on some of the opinions above, it can be stated that the exclusive learning model (direct instruction) is a teacher-centered learning model using conveying knowledge about concepts and skills which are carried out in stages. So if the teacher uses this direct instructional model, the teacher has the responsibility to identify learning objectives and great responsibility for structuring content/material or skills, explaining to students, demonstrating combined with exercises, providing opportunities for students to practice applying concepts. or skills that have been learned and provide feedback.

The characteristics of this learning model according to in Shoimin,(2014) [16] are: (1) There are learning objectives and the influence of the model on students including learning assessment mechanisms; (2) the overall syntax or pattern and flow of learning activities; and (3) the expected management system and model learning environment. in this case a learning model that pays attention to environmental variables, namely academic emphasis, teacher direction and control, high expectations for student progress, and the consequences of learning.

1. Description of Critical Thinking Ability Posttest

The post-test was carried out to determine students' critical thinking ability tests after being given treatment. Post-test data were analyzed using descriptive statistics assisted by SPSS 16.0 for Windows software, which summarized the calculation results presented in Table 1.1.

Tabel 1.1 Description of Critical Thinking Ability Posttest

	N	Lowest	Highest	Average	Baku Devi	Variance
Project Based Learning	25	7	16	10.84	2,511	6,307
Direct Instructions	25	5	13	8.92	2080	4,327
Valid N	25					

Table 1.1 shows that the posttest average score for students' critical thinking skills in the Project Based Learning class is 10.84 and in the direct instruction class is 8.92. it can be concluded that the average score of the Project Based Learning class and the direct instruction class have relatively different values, but to find out the equality of scores, a normality test and data homogeneity test are carried out.

Tabel 1.2 Posttest Normality Test of Critical Thinking Ability

		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Class	Statistics	et al	Sig.	Statistics	et al	Sig.
KBK posttest	Project Based Learning	.118	25	.200 *	.962	25	.452
	Direct Instructions	.111	25	.200 *	.974	25	.744

a. Lilliefors Significance Correction

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

Based on Table 1.2, it is obtained that the posttest data for critical thinking skills of students in the Project Based Learning class have a sig. (0.452) is greater than the value of α (0.05) and direct instruction class students have sig. (0.744) is greater than the value of α (0.05), so that H0 is accepted, in other words, the Project Based Learning class and the direct instruction class each come from a normally distributed population. While the post-test homogeneity test of Critical Thinking Ability

Tabel 1.3 Posttest Homogeneity Test of Critical Thinking Ability

		Levene Statistics	dk1	et al2	Sig.
KBK posttest	Based on Average	1,260	1	48	.267
	Based on Mid Value	1,242	1	48	.271
	Based on the Middle Value and degrees of freedom (dk)	1,242	1	47,146	.271

		Levene Statistics	dk1	et al2	Sig.
KBK posttest	Based on Average	1,260	1	48	.267
	Based on Mid Value	1,242	1	48	.271
	Based on the Middle Value and degrees of freedom (dk)	1,242	1	47,146	.271
	Based on trimmed Average	1,273	1	48	.265

Based on Table 1.3 , it is obtained that both data on students' critical thinking skills have a sig. (0.267) is greater than the value of α (0.05) so that H0 is accepted, in other words the two samples come from populations with Project Based Learning variance.

Tabel 1.4 Posttest Difference Test of Critical Thinking Ability

		Levene's Test for Equations of Variance		The t-test for the Mean Equation						
									95% Confidence Level of Difference	
		F	Sig.	t	et al	Sig. (2-way)	Average Difference	Standard Error of Difference	bottom	Top
KBK posttest	Assuming the variances are the same	1,260	.267	2,944	48	005	1920	.652	.609	3,231
	It is not assumed that the variances are equal			2,944	46,391	005	1920	.652	.608	3,232

Based on Table 1.4, it is found that the two post-test data for students' critical thinking skills have a tcount (2.944) greater than the ttable (2.060) and tcount is positive so that H0 is rejected, in other words the first hypothesis test concludes that "the effect of the Project learning model Based Learning is more tested than the direct instruction model on students' thinking skills.

Tabel 1.5 Description of Science Learning Outcomes Posttest

	N	Lowest	Highest	Average	Baku Devi	Variance
Project Based Learning	25	9	27	18.36	5514	30,407
Direct Instructions	25	9	23	14.48	3,820	14,593
Valid N	25					

Table 1.5 shows that the average score of students' science learning outcomes in the Project Based Learning class is 18.36 and in the direct instruction class is 14.48. it can be concluded that the average score of the Project Based Learning class and the direct instruction class have relatively different values, but to find out the equality of scores, a normality test and data homogeneity test are carried out.

Tabel 1.6 Posttest Normality Test of Science Learning Outcomes

		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Class	Statistics	et al	Sig.	Statistics	et al	Sig.
Posttest HB	Project Based Learning	.106	25	.200 *	.948	25	.225
	Direct Instructions	.142	25	.200 *	.942	25	.165

		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Class	Statistics	et al	Sig.	Statistics	et al	Sig.
Posttest HB	Project Based Learning	.106	25	.200 *	.948	25	.225
	Direct Instructions	.142	25	.200 *	.942	25	.165

a. Lilliefors Significance Correction

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

Based on Table 1.6 , it is obtained that the post-test data on science learning outcomes for Project Based Learning class students have a sig. (0.225) is greater than the value of α (0.05) and direct instruction class students have sig. (0.165) is greater than the value of α (0.05), so that H0 is accepted, in other words the Project Based Learning class and the direct instruction class each come from a normally distributed population.

Tabel 1.7 Posttest Homogeneity Test of Science Learning Outcomes

		Levene Statistics	dk1	et al2	Sig.
Posttest HB	Based on Average	3,968	1	48	052
	Based on Top Rated	3,284	1	48	076
	Based on the Highest Value and Degrees of Freedom dk	3,284	1	43,269	077
	Based on Trimmed Average	3,899	1	48	054

Based on Table 1.7, it is obtained that both data on students' relational understanding abilities have a sig. (0.052) is greater than the value of α (0.05) so that H0 is accepted, in other words the two samples come from populations with Project Based Learning variance.

Tabel 1.8 Test Differences Posttest Science Learning Outcomes

		Levene's Test for Equations of Variance		The t-test for the Mean Equation						
									95% Confidence Level of Difference	
		F	Sig.	t	et al	Sig. (2-way)	Average Difference	Standard Error of Difference	bottom	Top
Posttest HB	Assuming the variants are the same	3,968	052	2,892	48	006	3,880	1,342	1,182	6,578
	It is not assumed that the variants are the same			2,892	42,724	006	3,880	1,342	1,174	6,586

Based on Table 1.8, it is found that the two post-test data on student science learning outcomes have a tcount (2.892) greater than the ttable (2.060) and tcount is positive so that H0 is rejected, in other words the first hypothesis test concludes that "the effect of the Project learning model Based Learning is more tested than the direct instruction learning model on student science learning outcomes.

The Influence of Project Based Learning and Direct Instruction Learning Models on Critical Thinking Abilit.

Based on the research results, the average score of students' critical thinking skills taught using the Project Based Learning learning model was 10.84, while those taught using the direct instruction model was 8.92. The results of this study indicate that students' critical thinking skills taught by the Project Based Learning

learning model are higher than the direct instruction model. Based on the results of the t-test calculation on students' critical thinking skills, the tcount score (2.944) is greater than the ttable score (2.060) so that H0 is rejected, it can be concluded that the effect of the Project Based Learning learning model is better than the direct instruction model on critical thinking skills student. The ability to think critically is one of the basic capital or intellectual capital that is very important for everyone. According to Liberna (2011) [12] critical thinking skills, brains that think seriously to solve problems faced by individuals who think or think about the actions to be taken.

The assessment of the critical thinking ability instrument is carried out by scoring, namely 1 for the correct answer choice without using reasons, a score of 2 for the correct answer choice with a brief reason, and a score of 3 for the correct answer choice with the correct and complete reasons according to the rubric that has been prepared. Students who are taught with the Project Based Learning learning model in answering the choice of critical thinking ability test questions more often get a score of 3, namely students who answer the correct choice and with complete reasons, while students who are taught with the direct instruction model more often answer a score of 2 which only gives reason briefly. this is because learning Project Based Learning is basically a way of solving real problems originating from individuals in a group by cultivating student skills, making students independent, increasing student self-confidence and opening students' mindsets so they are able to develop their abilities. Learning Project Based Learning is useful in the learning process through real experiences.

The Project Based Learning learning model makes students more active in seeking and finding their own solutions to the problems given to them. Whereas the direct instruction group in the learning process tends to ask for guidance from the teacher, during the learning process, students' critical thinking skills are not developed, because students learn more individually by receiving, and only expecting guidance from the teacher so students are not able to solve their own problems. The results of this study support Nerru's research (2013)[17], also suggesting that there is an influence of the Project Based Learning model on communication and being able to improve students' critical thinking skills. By learning Project Based Learning students are encouraged to carry out investigations and discuss learning issues identified in groups with the teacher as a facilitator. In line with research Meanwhile, the direct instruction model, waiting for guidance from the teacher.

Thus, based on research results, statistical testing and theories that there is evidence that students who are taught with the Project Based Learning learning model have a more proven influence compared to students who are taught the direct instruction model on students' critical thinking abilities.

The Effect of the Project Based Learning Model and the Diricet Instruction Model on Science Learning Outcomes.

Based on the research results, it was found that the average science learning outcomes of students taught using the Project Based Learning learning model was 18.36 while those taught using the direct instruction model was 14.48. The results of this study indicate that the science learning outcomes of students who are taught with the Project Based Learning learning model are higher than the direct instruction model. Based on the results of the t-test calculation on students' natural science learning outcomes, the tcount score (2.892) is greater than the ttable score (2.060) so that H0 is rejected, it can be concluded that the effect of the Project Based Learning learning model is better than the direct instruction model on student science learning outcomes . The difference in the average score of students' science learning outcomes is a natural thing. This is due to the learning model and also the learning theory set by the teacher during the learning process. In this study, there were two learning models that were compared, namely the Project Based Learning and direct instruction learning models.

The Project Based Learning learning model is learning that requires students to teach students about cognitive strategies and to help students understand reading well. According Widayati, (2012) [18] the steps of the Project Based Learning learning model are clarifying – predicting – questioning – summarizing to be applied in learning. Based on the steps of the learning model, students are able to make observations in the school environment to find problems about ecosystems. Students determine ecosystem problems that are considered the most important and find solutions to them, are able to formulate problems and compile hypotheses, students try to formulate problem formulations in the form of questions and hypotheses or temporary answers based on students' knowledge of ecosystems. Then, students can re-explain the material learned to other students. After getting information about the ecosystem from various learning sources. Then make conclusions which are solutions to solving problems that exist in the ecosystem.

In line with the results of Setiawan's research (2013) [19], stated that students who were taught with the Project Based Learning learning model were successful in overcoming student errors in understanding ecosystem material and in solving problems. Mardiyanti (2014) [20] The direct instruction model is a teaching approach that can assist students in learning basic skills and obtaining information that can be taught step by step. Hidayah (2012) [21] "The Project Based Learning model prioritizes the active role of students in learning activities, so that students are given the freedom to communicate to explain their ideas and listen to their ideas, thus students' ability to communicate becomes good.

In the study it was found that the effect of the Project Based Learning learning model was more tested than the direct instruction model on students' natural science learning outcomes, because in the Project Based Learning learning model students searched for the subject matter to be discussed themselves, and students explained the material they had learned to other students, how to answer, remember learning material better, be able to solve questions well, and improve communication skills. Meanwhile, in the direct instruction model, students do presentations, do exercises, and do guided exercises without looking for the material to be learned on their own.

With the application of the Project Based Learning learning model and the direct instruction model and through statistical tests and theories there is evidence that students who are taught with the Project Based Learning learning model give a more tested influence compared to students who are taught the direct instruction model on student science learning outcomes.

4. CONCLUSIONS

Science learning that applies the Project Based Learning and direct instruction learning model can have an impact on students' science learning outcomes and students' critical thinking skills. The effect of the Project Based Learning learning model is more tested than the direct instruction model on students' critical thinking skills. The effect of the Project Based Learning learning model is more tested than the direct instruction model on student science learning outcomes.

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