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THE INFLUENCE OF PROJECT-BASED LEARNING MODEL ASSISTED BY SDS-BASED INTERACTIVE STUDENT WORKSHEETS (LKPD) ON CRITICAL THINKING

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ABSTRACT (10 PT)

Critical thinking skills are an important aspect emphasized in the Merdeka Curriculum. However, in Indonesia, critical thinking skills are still low among students. This is because learning activities have not been implemented optimally to develop students' skills to the fullest. So that the learning process in the classroom requires an update that can attract students in learning in the classroom. this study aims to improve students' critical thinking skills through the application of the project-based learning (PjBL) learning model assisted by HOTS-based Interactive LKPD. Using a quasi-experimental pretest-posttest control group design and basic random sampling, this quantitative research employed HOTS-based assessment tools and analysis techniques to evaluate critical thinking through essay questions. The analysis involved N-Gain tests and independent sample t-tests to measure the enhancement in students' critical thinking abilities. The N-Gain results indicated an enhancement of 81.14% in the experimental class (deemed effective) compared to 24.50% in the control class (deemed ineffective). The independent sample t-test showed a significance value of <0.001, which is below 0.05, leading to the rejection of the null hypothesis (Ho) and the acceptance of the alternative hypothesis (Ha). Therefore, the study concludes that the PjBL learning model, enhanced by HOTS-based interactive LKPD, significantly enhances students' critical thinking skills.

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1. INTRODUCTION

Education is essential for national development. It should produce high-quality human resources that can compete with other countries (Puspita & Dewi, 2021). The importance of education refers to anyone who has the aim to educate and develop the potential that exists within themselves (Mujiburrahman et al., 2021). This is in line with the education system implemented in Indonesia, namely the existence of a 12-year compulsory education program. This program plays a role in educating the nation and providing wider educational opportunities for every citizen. Thus, education is closely related to ‘students’, because from an early age

education is prepared to guide the souls of students towards their nature, both physically and mentally, towards a better and humane civilization (Sujana, 2019).

In the modern era, students need to develop strong critical thinking skills for effective decision making (Cahyani et al., 2021). It is stated in Law No. 20 of 2003 that critical thinking skills are important, so that teachers can facilitate students to explore (Undang Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, 2003). In order for students to have critical thinking skills, teachers can guide students to observe, ask questions, formulate hypotheses, and draw conclusions (Indawati et al., 2021). Critical thinking means critically assessing oneself, consciously evaluating the quality of one's decisions while effectively using all these skills in appropriate situations and methods (Oktariani & Ekadiansyah, 2020). Critical thinking skills have several important factors in their application to classroom learning. According to Suciono et al (2021) the factors that influence it are; Elementary Clarification, Fundamental Bolster, Infering, Progressed Clarification, and Procedures and Strategies. Meanwhile, the indicator aspects in critical thinking skills according to Kurniasih & Hakim (2019) are interpreting, analyzing, evaluating, and inferring. With critical thinking students can develop student talent, concentration, analytical thinking (Wahyuni, 2015). The characteristics of critical thinking are always looking for and explaining the relationship between the issues discussed and other related issues and experiences (Saputra, 2020).

However, the fact is that students' critical thinking skills in Indonesia are still relatively low. This is often prove by a few past studies. The results of research (Nida Winarti et al., 2022) on third-grade students at SD Negeri Rambay indicates that the key indicators for improving critical thinking skills include asking questions, answering questions, evaluating, and analyzing arguments. However, indicators related to problem-solving and drawing conclusions showed only slight enhancements in each cycle, suggesting that students still struggle with these aspects of critical thinking. The results of research (Handayani et al., 2023) on tenth-grade students at SMA 19 Palembang found that many students had difficulty answering questions, with only 18% scoring above the minimum passing standard of 65 points. These results suggest that students' HOTS (Higher Order Thinking Skills) are often insufficient, and they also face challenges in drawing learning conclusions.

To address students' low critical thinking skills, teachers can implement reforms that train students to think critically. One way to do this is by using a Project-Based Learning (PjBL) learning model, which gives students full opportunity to participate in the learning process and effectively develop critical thinking skills. Previous research supports this, a study conducted by Ika et al (2023) indicating that problem-solving and project creation using the PjBL learning model significantly boost critical thinking skills due to the active involvement of students during learning (Kumalasari et al., 2023). Other research researched by Nida et al (2022) found that the PjBL learning model fosters critical thinking by enhancing creativity, questioning skills, independence, responsibility, self-confidence, and overall thinking abilities (Nida Winarti et al., 2022). Furthermore, research by Yuniar et al (2023) highlights the importance of PjBL in the Merdeka Curriculum, which emphasizes PjBL as a key characteristic (Handayani et al., 2023). Therefore, the PjBL learning model is an effective tool for developing critical thinking skills, allowing students to approach problem-solving from various perspectives (Aprida & Mayarni, 2023).

Through a student-centered approach, PjBL becomes a learning model that can also create collaborative situations so that students can work together to develop critical thinking. Therefore, it helps students understand difficult concepts, benefiting both lower and upper group students by working and collaborating together (Dari & Taufina, 2021). Learning conducted through a PjBL learning model involves students in projects related to the material. Students create projects or activities based on specific questions or problems. Subsequently, students can discover concepts with comprehensive knowledge (Natty et al., 2019). According to Jalaludin in (Hartono & Asiyah, 2018), the PjBL learning model involves several stages in its implementation process: 1) Identifying principal questions, 2) Planning the project plan, 3) Developing a schedule, 4) Observing student advance and project development, 5) Testing the results, and 6) Evaluating the experience.

PjBL has characteristics and stages that require active student participation in the learning process. The meaning of "project" in PjBL is closely related to Science (IPA) in elementary school. IPA as a subject in elementary education, points to provide students with systematic knowledge, ideas, and concepts about the natural world and its phenomena, acquired through scientific processes and experiences (Fahrezi et al., 2020). Teachers can enhance students' curiosity, facilitate their independent knowledge acquisition, and develop their critical thinking skills, enabling them to tackle and solve various problems (Ilhamdi et al., 2020). Science education is closely linked to critical thinking, as it involves analyzing and observing natural phenomena and the environment (Legina & Sari, 2022). This subject emphasizes students' critical thinking skills, enabling them to verify each topic through the observation of visible phenomena, interactive videos, and simple experiments.

To facilitate students with high critical thinking skills, PjBL must be supported by ideal refresher strategies in science learning activities to support critical thinking that involves Generation Z students at a higher level of critical thinking (Ramadhani et al., 2021). Strategies that teachers can use include applying interactive HOTS-based LKPD in the learning process as a tool to enhance students' thinking skills and as evaluation material. The aim is for science subjects in elementary schools to produce meaningful learning activities. Interactive LKPD provides visualizations that contain events that students do not experience directly compared to printed LKPD (N.F. et al., 2022). The questions used in making HOTS questions are multiple choice, compound PG (true or false, yes or no), short answer or complete answer, and short answer or short answer and explanation (Rozi & Hanum, C., 2019). Through these interactive LKPD, students who meet the critical thinking skills indicators based on HOTS are able to meet the indicators of analyzing, evaluating, and creating (Neneng Eliana, 2020).

This study is supported by various relevant studies from previous researchers who refer to the topic of PjBL learning models on critical thinking skills, but these studies also differ from the author's research. In the study conducted by Hendrik & Ihtari (2016), the research shows relevance to the author's study, as it states that the PjBL learning model can enhance critical thinking skills. However, there are differences between this study and the author's research, namely in the research method, which uses a pre-experimental design, focuses on the subject of Engineering Physics, and uses second-semester students as the sample. In line with the research conducted by Sulistyani et al (2021), the study showed relevance to the author's research, as it stated that the PjBL learning model is necessary in science education at elementary schools. However, there are differences between this study and the author's research, namely in the

research method, which used a quantitative descriptive approach, and the sample, which consisted of fifth-grade elementary school students. This is also supported by research conducted by Nida Winarti et al (2022), which shows relevance to the author's research, stating that when implementing PjBL, there is an increase in teacher and student activity, as well as an increase in the average critical thinking skills of students. However, there are differences between this study and the author's research, namely in the research method, which uses the Classroom Action Research (PTK) method, and the sample used, which consists of third-grade elementary school students.

Thus, these studies reinforce that the PjBL learning model can improve critical thinking skills. In this study, the author took a different approach from previous studies. The dependent variable was critical thinking skills, the independent variable was PjBL, and the control variable was interactive HOTS-based worksheets (LKPD). The author used a quantitative experimental research method with a sample of sixth-grade elementary school students. The author used science lessons covering topics such as puberty, the solar system, and celestial objects, and employed a project-based learning model where students worked in groups to create mind maps based on the material provided by the teacher. They also used interactive HOTS-based worksheets (LKPD) developed using an application (such as a quiz) equipped with HOTS questions to evaluate the topics discussed through the Quizziz application.

This is what underlies the author to use a PjBL learning model assisted by HOTS-based interactive LKPD because the application of this learning model can train students in improving critical thinking skills. In addition, it also makes learners have the experience of contributing in the classroom as the center of learning. This experience further trains learners in critical thinking with the projects they work on. HOTS-based interactive LKPD is a new innovation that allows students to easily utilize technology in which there is core material that can be learned as a whole. Based on this description, it is necessary to enhance the learning model and LKPD given to students. This research was conducted by the author aims to prove the application of the PjBL learning model assisted by HOTS-based Interactive LKPD has an influence on students' critical thinking skills in science subjects in grade VI SD Negeri Jatibening I. The author hopes that this research can provide benefits for the development of students' critical thinking skills aspects and can be used as a reference for other researchers.

2. METHOD

This research is a quantitative study that uses experimental methods with a quasi-experimental approach and a pretest-posttest control group design. Quantitative research adopts a deductive approach aimed at hypothesis testing and follows traditional, positivist, experimental, or empirical paradigms (Wijayanti, 2015). Utilizing quantitative methods allows for the collection of precise data in numerical form, facilitating analysis and interpretation through statistical calculations, which are then used to assess students' critical thinking skills. An initial test (pre-test) was administered before the application of the HOTS-based interactive LKPD-assisted PjBL learning model, and a final test (post-test) was given after the treatment. The pretest-posttest control group design is illustrated in Table 1.

Table 1. Schematic of Pretest-Posttest Control Group Design

Group	*Pre-test*	Treatment	*Post-test*
Experimental Class (E)	O_1	x	O_2
Control Class (K)	O_3	-	O_4

When, E is Experimental Class (group treated with PjBL learning model assisted by HOTS-based interactive LKPD), K is Control Class (group that is not treated with PjBL learning model assisted by HOTS-based interactive LKPD), O_1 is Pre-test for experimental class (initial learning outcomes), O_2 is Post-test for the experimental class (final learning outcomes), x is Special treatment of the application of PjBL learning model assisted by HOTS-based interactive LKPD, O_3 is Pre-test for control class (initial learning outcomes), O_4 is Post-test for control class (final learning outcomes). The study population consisted of 87 sixth-grade students from SD Negeri Jatibening I Bekasi during the 2023/2024 school year. The sample comprised 29 students in experimental class and 29 students in control class. These samples were chosen using a probability sampling technique, specifically simple random sampling, which was conducted by drawing lots.

In research, variables refer to objects, properties, attributes, values, or specific activities with varying characteristics that researchers choose to study and analyze (Purwanto, 2019). In this study, the dependent variable is critical thinking skills, while the independent variable is the PjBL learning model, and the control variable is the HOTS-based interactive LKPD. Data collection utilized an essay test instrument aimed at evaluating critical thinking skills, with indicators including interpretation, analysis, evaluation, and inference. The instrument underwent validation with 33 students to verify its suitability for the study. An item is considered valid if the r count exceeds the r table value. Additionally, the instrument's reliability was assessed to ensure data consistency and stability, with items deemed reliable if the r count surpasses the r table value. The results of these validity and reliability assessments are detailed in Table 2.

Table 2. Validity and Reliability Test Results

Question Number	r count	r table	Description	Alpha Cronbach's	Description of Reliability
1	0.358	0.355	VALID	0.699	12
2	0.374	0.355	VALID		
3	0.501	0.355	VALID		
4	0.406	0.355	VALID		
5	0.514	0.355	VALID		
6	0.784	0.355	VALID		
7	0.522	0.355	VALID		
8	0.564	0.355	VALID		
9	0.463	0.355	VALID		
10	0.487	0.355	VALID		
11	0.448	0.355	VALID		
12	0.453	0.355	VALID		

These questions were tested to measure students' critical thinking skills. The results were analyzed using N-gain, which is used to measure changes or improvements in a group after treatment, and independent sample t-tests, which are used to compare the means of two independent (unpaired) groups to see if there are significant differences between them. The high and low N-gain test results are divided into four categories (ineffective, less effective, moderately effective, effective) which are presented in Table 3.

Tabel 3. N-Gain Effectiveness Interpretation Category

Presentation (%)	Interpretation
< 40	Not Effective
40 – 55	Less Effective
56 – 75	Moderately Effective
> 76	Effective

Source: Hake, R.R 1999

3. RESULTS AND DISCUSSION

Learning activities based on the PjBL learning model were carried out for 29 students of grade VI of the experimental group of SD Negeri Jatibening I. Before the implementation of learning, students took a pre-test to determine initial skills. Critical thinking test score data is presented in Table 4, Pre-test and Post-test scores.

Table 4. Percentage of Critical Thinking Skills

Interval Value	Category	*Pre-test*				*Post-test*			
		Experimental Class		Control Class		Experimental Class		Control Class	
		F	%	F	%	F	%	F	%
90.00 – 100.00	Very Critical	-	-	-		29	100	-	-
80.00 – 90.00	Critical	19	66	-		-	-	-	-
70.00 – 80.00	Moderately Critical	10	34	-		-	-	-	-
60.00 – 70.00	Less Critical	-	-	5	17	-	-	27	93
< 60.00	Not Critical	-	-	24	83	-	-	2	7
Number of Samples		29		29		29		29	

Table 4 shows the percentage of students critical thinking skills during the learning of process. The data indicate that the experimental group demonstrated a significant enhancement after the learning process. In contrast, the control group showed an increase, although it was not very significant. This disparity is attributed to the experimental group's exposure to the PjBL learning model, where students were trained to develop their critical thinking skills. They engaged in group mind-mapping projects based on problem topics and used HOTS-based

interactive LKPD as evaluation materials to enhance their critical thinking skills from the taught material.

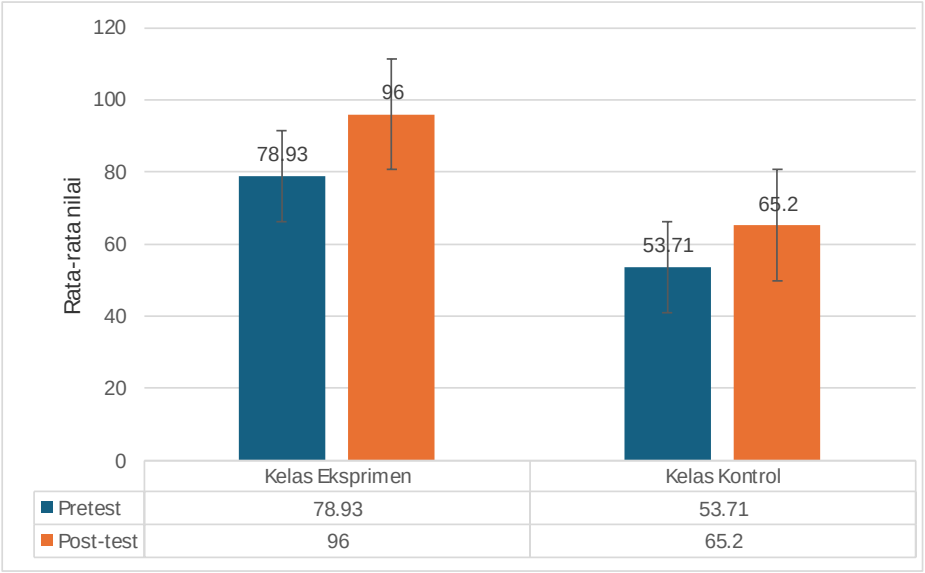

Figure 1. Average critical thinking skills score

The average value of the experimental class and control class of all students on the pre-test and post-test is shown in Figure 1. With this value, it shows that the PjBL learning model assisted by HOTS-based interactive LKPD significantly enhances students' critical thinking skills in the experimental class. The data obtained from the critical thinking test results were processed into N-Gain data through SPSS 29 to measure the enhancement of critical thinking skills after learning. The results are shown in Table 5.

Table 5. N-Gain Test Results

Number	Descriptive Statistics	Group	
		Experimental Class	Control Class
1.	Mean	81.14	24.50
2.	Median	83.07	24.34
3.	Variance	105.90	34.21
4.	Std. Deviation	10.29	5.84
5.	Minimun	56.52	13.18
6.	Maximum	100.00	35.15
7.	Interquartile Range	13.45	9.73
8.	Skewness	-0.257	-0.210
9.	Kurtosis	0.077	-0.796

Table 5 shows that in the experimental class (Class VI A), which consisted of 29 students and was taught using the PjBL learning model supported by HOTS-based interactive LKPD, the high score achieved was 100.00 and the lowest was 56.52. The average score was 81.14, with a median of 83.07 and a standard deviation of 10.29. In contrast, in the control class (Class VI B), also comprising 29 students and taught using the conventional lecture-based learning model, the highest score recorded was 35.15 and the lowest was 13.18. The mean

score was 24.50, with a median of 24.34 and a standard deviation of 5.84. According to Hake (1999) categorization, the experimental class with an average score of 81.14 is classified as "Effective," whereas the control class, with an average score of 24.50, is categorized as "Ineffective." The findings of this study reveal that students in the experimental class demonstrated superior critical thinking skills compared to those in the control class. This enhancement is likely due to the PjBL learning model, which offers numerous opportunities for student- centered learning. In contrast, the conventional learning model, which is more teacher-centered, may restrict student engagement and the development of critical thinking skills. Additionally, the integration of HOTS-based interactive LKPD, featuring new visualizations and in-depth knowledge through its hyperlink features, contributed to a more thorough understanding of the material among students.

The above opinion is in line with the study conducted by Hendrik & Ihtari (2016) *"the calculation of normalized N-gain obtained the average increase in critical thinking skills of 20 students is 0.45 (medium category)"* (Pratama & Prastyaningrum, 2016). Another study conducted by Mira & Inggi (2021) *"N-gain obtained that as many as 16 students (66.7%) had a Medium category N-Gain level, and 8 students (33.3%) had a Low category N-Gain level"* (Azizah & Sholikhah, 2021). And research conducted by Mayarni et al (2023) *"N-Gain score of 0.65 in the control class and an N-Gain score of 0.80 in the experimental class with very high category"* (Mayarni et al., 2023). These studies used the n-gain calculation, thus comparing the results of the n-gain score between the author's research and the research conducted by other researchers whose results were categorized according to (Hake, n.d.) in table 6.

Table 6. Comparison Of N-Gain Score With Other Studies

Research	Researcher name	Research Design	N-Gain Score (%)		Interpretation	
			Experimental Class	Control Class	Experimental Class	Control Class
This Research	Farah Yusep Azzahra	Pretest-Posttest Control Group Design	81.14	24.50	Effective	Not Effective
Other Research	Hendrik Pratama Ihtari Prastyaningrum	One Group Pretest-Posttest Design	45		Less Effective	
	Mira Azizah, et al	One Group Pretest-Posttest Design	66.7 (16 students) 33.3 (8 students)		Moderately Effective (16 students) Not Effective (8 students)	
	Mayarni, et al	Nonequivalent Control Group	80	65	Effective	Moderately Effective

Design

Based on the results of the comparison of the N-Gain scores in the table above, it shows that there are 2 researchers who show the N-Gain score in the *"Effective"* category, namely the research I conducted in the experimental class with a score of 81.14 and the research conducted by (Mayarni et al., 2023) in the experimental class with a score of 0.80. As well as 1 researcher who showed the N-Gain score in the *"Less Effective"* category, namely research conducted by (Pratama & Prastyaningrum, 2016) showing a score of 45. There are 2 researchers who show the N-Gain score in the *"Moderately Effective"* category, namely research conducted by (Azizah & Sholikhah, 2021) showing a score of 66.7 and research conducted by (Mayarni et al., 2023) in the control class with a score of 65. And there are 2 researchers who show the results of the N-Gain score in the *"Not Effective"* category, namely research conducted by myself in the control class with a score of 24.50 and research conducted by (Azizah & Sholikhah, 2021) which shows a score of 33.3. After that, to determine the normal state, the Kolmogorov-Smirnov normality test was conducted. Table 7 displays the details of the normality test results.

Tabel 7. N-Gain Percent Score Normality Test Result

	Class	***Kolmogorov-Smirnov***		
		Statistic	**df**	**Sig.**
Critical Thinking Skills	Experimental Pre-test (PjBL)	.136	29	.182
	Experimental Post-test (PjBL)	.134	29	.197
	Control Pre-test (Konvensional)	.135	29	.185
	Control Post-test (Konvensional)	.127	29	.200

Based on the calculations, the Sig. value for the experimental class was 0.182 > 0.05 for the pre-test and 0.197 > 0.05 for the post-test. Similarly, the Sig. value for the control class was 0.185 > 0.05 for the pre-test and 0.200 > 0.05 for the post-test. These results suggest that the pre-test and post-test scores for both the experimental and control classes follow a normal distribution. After performing a normality test, a homogeneity test is conducted to determine whether two or more groups of sample data come from populations with equal variances (Wahyuliani et al., 2016). The results of the homogeneity test can be seen in Table 8.

Tabel 8. N-Gain Percent Score Homogeneity Test Results

		Levene Statistic	**df1**	**df2**	**Sig.**
Critical Thinking Skills	Based on Mean	7.520	1	56	.008
	Based on Median	6.264	1	56	.015
	Based on	6.264	1	42.873	.016

	Median and with adjusted df				
	Based on trimmed mean	7.949	1	56	.007

The results showed that Levene's statistical approach was used to conduct a homogeneity test and the Sig. result obtained was 0.008 which indicates that the variance is not homogeneous (heterogeneous). After conducting normality and homogeneity tests, hypothesis testing was carried out using the independent sample t-test. This statistical method compares the means of two independent groups to assess whether there is a significant difference between them. The independent sample t-test was performed with SPSS 29, and the results of the critical thinking skills assessment are presented in Table 9 below.

Tabel 9. N-Gain Percent Score Independent sample t-test results

		t-test for Equality of Means						
		t	**df**	**Sig. (2-tailed)**	**Mean Differences**	**Std. Error Differences**	**95% Confidence Interval of The Difference**	
							Lower	**upper**
NGain_ Persen	Equal variances not assumed	25.768	44.382	<.001	56.64070	2.19813	52.21173	61.06967

In the independent sample t-test conducted using SPSS 29, a significance value of <0.05 indicates a significant difference in critical thinking skills between the experimental and control classes. The test results revealed a significance value of <0.001, which is below 0.05. Consequently, the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted. This result highlights a significant difference between the experimental class, which was taught using the PjBL learning model supported by HOTS-based interactive LKPD, and the control class, which utilized a traditional lecture-based approach.

The above opinion is in accordance with a study conducted by Suhanadji & Riyanto (2020) *"The results of the independent samples t-test of students' critical thinking skills show that tcount (2.461) > ttable (1.674) with df = 54 and a significance level of 0.05"* (Yusnina,L,P, Riyanto Yatim, 2020). Another study conducted by Tika (2021) *"The results of the Independent Sample T Test test show that the propensity value or sig. (2-tailed) is 0.000> 0.05"* (Aprilia, 2021). Also research conducted by Soleh & Zulkarnain (2021) *"The results of the independent sample t-test obtained ρ (0.000) < α (0.05)"* (Ritonga & Zulkarnain, 2021). And research conducted by Rifki et al (2024) *"independent sample t-test using SPSS 26 for Windows showed that there was an average difference in final observation results between the experimental class and the control class of 2.625 with a sig (2-tailed) p-value of 0.000"* (Janah et al., 2024). These studies use independent sample t-test calculations, so they compare the results of the significance value of the independent sample t-test between the author's

research and research conducted by other researchers, the results of which are in table 10.

Tabel 10. Comparison of N-Gain Percent Score Independent sample t-test results With Other Studies

Research	Researcher name	Signigicance Value	Interpretation
This research	Farah Yusep Azzahra	<.001	Significant
Other Research	Linda Pebtin Yusnina, et al	0.05	Significant
	Tika Aprilia	0.000	Significant
	Soleh Ritonga & Zulkarnain	0.000	Significant
	Rifki Wardatul Janah	0.000	Significant

Based on the results of the comparison of the significance of the independent sample t-test in the table above, this shows that all researchers have the same results, namely in the *"Significant"* category, which means that the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted. This is obtained because the significant value of all studies shows significance <0.05, it is interpreted that there is a significant difference in critical thinking skills between the experimental and control classes. The PjBL learning model serves as an effective stimulus for enhancing students' critical thinking skills. This model emphasizes feedback from students and develops their ability to explain projects, which in turn boosts critical thinking abilities (Pratama & Prastyaningrum, 2016). Additionally, students' critical thinking skills are enhanced because they focus on completing projects based on their designs (Hartini, 2017). When applied, the PjBL learning model fosters critical thinking by encouraging creativity, questioning skills, independence, a sense of responsibility, self-confidence, and overall thinking abilities (Nida Winarti et al., 2022).

Thus, these studies are relevant to this research, supported by theories that support PjBL, namely constructivism theory, which explains that PjBL is related to cognitive psychology and the concept of learning that enables students to have problem-solving skills, be motivated to learn, and have critical thinking and communication skills (Daniel, 2017). Additionally, the theory of progressivism explains that learning should be student-centered, involve real-world experiences, and encourage the development of creativity and critical thinking skills (Kumedi et al., 2024). Thus, progressive and constructivist philosophies emphasize student independence in the learning process, so that when carrying out practical activities in accordance with the planned product, students can develop their creativity through active collaboration among fellow students in a group that can spark critical thinking in each student in completing each stage of the project given (Mones et al., 2023).

In line with the research conducted by the author, the results show a positive effect on students who were given treatment using the PjBL learning model assisted by interactive worksheets (LKPD) based on HOTS. This occurs because there is a difference in the learning process between students who received special treatment (experimental class) using the PjBL

learning model and students who did not receive special treatment and were only taught using the lecture method (control class). The experimental class received treatment using a student-centered learning approach, where students became the main actors in the learning process, allowing them to freely express their opinions during the learning process. In the learning process, students were given a project to create a mind map about today's material in groups and present it in front of the class. This made the students who received the treatment understand better because the project made them memorize and understand critically through group discussions. In addition, students in the experimental group gained experience using smartphones to complete HOTS-based interactive worksheets (LKPD). The author utilized the Quizziz application, which offers various interesting features. The main feature used was Hyperlink, which allows students to engage in interactive learning by watching videos and accessing additional references outside the textbook while completing questions. Additionally, the learning process becomes more enjoyable and increases student interest due to the motivational music in the application and the real-time ranking feature, which encourages students to quickly answer questions correctly.

4. CONCLUSION

The use of the PjBL learning model assisted by interactive LKPD based on HOTS received a very good response from students, so this learning model is feasible for teachers to apply more deeply in improving students' critical thinking skills. Through project-based learning models and interactive LKPD through digital applications, it provides an atmosphere, creativity, enthusiasm, activity, and other positive attitudes that will shape students into more active individuals in learning. This occurs because students gain experience in learning through concrete means to understand the material more deeply in an easy way. Supported by an independent sample t-test showing a significance value of <.001, which is less than 0.05 and thus falls into the category of statistical significance. This result is evident from the increased pre-test and post-test scores in class VI A in science learning across three different topics. Therefore, the PjBL learning model assisted by interactive LKPD based on HOTS can be used as a learning activity aimed at improving the critical thinking skills of sixth-grade students. The author hopes that this research has theoretical implications by providing new evidence about existing learning model theories, as well as practical implications by providing recommendations about more effective learning models to use in schools.

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