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The Influence of the Problem-Based Learning Model on Students' Comprehension of the Concept of Pressure in Solids in Grade IX

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ABSTRACT

The learning model used in learning science concepts should have a strong influence or impact on students' understanding of a science concept. Researchers in this case conducted research related to the Influence of the Problem Based Learning Learning Model carried out at SMPN 2 Solokanjeruk with samples of class IX-I on the concept of Pressure on Solids .Researchers conducted a pretest test before conducting learning with the Problem Based Learning learning model, and conducted a posttest test after conducting learning using the Problem Based Learning Learning Model. After conducting inferential statistical analysis (2 related samples), Researchers found that Science Learning with the Problem Based Learning Learning model had a strong impact on student learning outcomes. The results of the N-Gain data analysis had an average score of 59.9817 or 0.599817, namely, the increase in students' science understanding was in the moderate category, with an N- Gain percentage of 59.9817% having a fairly effective category. The results of this research study identified an increase in high science understanding of 41%, an increase in medium science understanding of 49%, an increase in low science understanding of 5%, no increase in understanding of 2.5%, and a decrease in understanding of 2.5%. Based on this, the Problem based learning model on the concept of Pressure on Solids for class IX-I students of SMPN 2 Solokanjeruk has a fairly good impact on students' science understanding.

INTRODUCTION

One key indicator of success in Science learning is an increase in students' comprehension. According to Hamzah, as cited in Yulianti & Gunawan (2019), concept comprehension is a crucial component in the learning process and in problem-solving, both within the learning process itself and in daily life. Student comprehension is achieved when learning is conducted in an effective, conducive, and solution-oriented environment. A good learning environment is challenging, stimulates students to learn, and provides a sense of security and satisfaction in achieving objectives (Darmadi, 2015). In practice, teachers should provide students with a learning environment that encourages them to solve real-life problems through the use of an appropriate learning model.

One such learning model utilized in Science instruction is the Problem-Based Learning (PBL) Model. Problem-Based Learning is an instructional model that uses real-world problems as a context for students to learn about critical thinking and problem-solving, and to connect these problems with the subject matter (Syahraini et al., 2022). Problem-Based Learning (PBL) presents a real problem for students to solve, thereby encouraging them to engage in critical thinking to enhance their knowledge. This model helps students practice various skills such as communication, discussion, collaboration, and more, not just knowledge acquisition. The PBL model prompts students to think critically about the problems presented and how to resolve them (Puspitasari Regita, Faridah Nur Tsana, 2023).

Problem-Based Learning encompasses several stages that facilitate effective problem-solving. The phases of Problem-Based Learning (PBL) consist of several steps designed to help students solve problems effectively. Problem-Based Learning encompasses a structured series of stages designed to help students solve problems effectively. This process commences with the Problem Orientation stage, where students are introduced to a relevant and engaging problem, while the teacher explains the learning objectives and motivates student involvement. Subsequently, the Organizing Students for Learning stage is carried out by grouping students into small teams, who then plan problem-solving strategies and begin formulating questions related to the issue at hand. This process is followed by the Guiding Independent and Group Investigation stage, in which students conduct research to gather the necessary information, with the teacher acting as a facilitator who provides direction. After the data is collected, students proceed to the Developing and Presenting the Work stage by formulating a solution and creating a presentation or report, which may take the form of a written document, video, or relevant model. Finally, the process concludes with the Analyzing and Evaluating the Problem-Solving Process stage, where students are encouraged to reflect on the entire process they have completed, evaluate the effectiveness of the strategies used, and draw lessons from the overall experience (Utami et al., 2025).

By examining the steps of PBL, it can be concluded that the Problem-Based Learning model is one that commences with a problem, thus making students more active in the learning process. Students are able to develop thinking skills, search for solutions to problems, and enhance intellectual skills (Astutik, 2023). Research conducted by Setyaningsih (2022) states that the application of the PBL model can be used as an alternative, allowing students to comprehend the given problem by trying various approaches and methods to solve it, and by finding answers through practical work. Similarly, research conducted by Amiruddin (2024) found that PBL provides an effective contribution to increasing student comprehension. In the study by Raida et al. (2021), it was also found that the implementation of the Problem-Based Learning (PBL) model in the learning of light properties material was deemed effective because the learning is problem-based, where the teacher provides problems, in the form of either questions or statements, related to the material and asks students to solve them in groups.

Consequently, positive interaction among students takes place during this activity, further boosting student engagement and activity.

Based on the aforementioned discussion, and considering the inherent advantages of the Problem-Based Learning Model, the author is motivated to conduct this research, titled:The Influence of the Problem-Based Learning Model on Students' Comprehension of the Concept of Pressure in Solids in Grade IX. The main objective of this study is to measure the extent to which the Problem-Based Learning model impacts students' Science comprehension concerning the Pressure in Solids concept.

METHOD

The research method used in this study is pre-experiment, employing a one-group pretest- posttest design with one class sample as the research subject (Taufiq & Basir, 2018). Students were given a pretest before the implementation of the Problem-Based Learning (PBL) Model, and a posttest after they completed the learning process using the Problem-Based Learning (PBL) Model. The research subjects were 39 students from Class IX-I of SMPN 2 Solokanjeruk. The instruments utilized were the pretest and posttest questions.

Data processing in this study used the SPSS Version 27 application, involving a Normality test using the t-test (Parametric Statistics) or the Wilcoxon test (Non-Parametric Statistics), which was then followed by the N-Gain test. The N-Gain test was conducted to measure the extent to which the use of the PBL learning model impacts the comprehension of Science concepts, and the degree of improvement in students' comprehension ability after using this PBL model. The N-Gain score ranges from -1 to 1. A positive value indicates an increase in student learning outcomes after the intervention, while a negative value indicates a decrease in student learning outcomes. The formula below is used to calculate the N-Gain score:

$$N_{Gain} = \frac{\text{Skor Posttest} - \text{Skor Pretest}}{\text{Skor Ideal} - \text{Skor Pretest}}$$

To determine the category of the N-Gain score increase, we can refer to the Normalized Gain criteria presented in the table below.

Table 1. N-Gain Value Interpretation

N-Gain Value (g)	Interpretation Category
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Medium
$g < 0.30$	Low

RESULTS AND DISCUSSION

Pretest and Posttest Results Data

The following table presents the individual pretest and posttest scores of the students in Class IX-I of SMPN 2 Solokanjeruk.

Tabel 2. Student Pretest and Posttest

No	Siswa	Pretest	Posttest
1	A1	10	100
2	A2	40	70
3	A3	70	80
4	A4	10	100
5	A5	10	80
6	A6	30	60

7	A7	50	80
8	A8	40	70
9	A9	20	40
10	A10	40	40
11	A11	60	50
12	A12	20	100
13	A13	20	70
14	A14	70	100
15	A15	70	70
16	A16	30	70
17	A17	50	100
18	A18	30	70
19	A19	40	80
20	A20	20	60
21	A21	20	60
22	A22	40	90
23	A23	30	100
24	A24	20	70
25	A25	20	60
26	A26	50	70
27	A27	50	90
28	A28	20	40
29	A29	60	90
30	A30	40	70
31	A31	30	70
32	A32	60	80
33	A33	10	60
34	A34	60	100
35	A35	50	60
36	A36	70	100
37	A37	40	90
38	A38	40	100
39	A39	20	60

Data Analysis (Normality Test)

Hypothesis Determination for 2-Sample Analysis

The following hypotheses were established to test the influence of the PBL model on student comprehension:

H_0 : Learning using the Problem-Based Learning (PBL) model does not provide an influence on students' concept comprehension.

H_1 : Learning using the Problem-Based Learning (PBL) model provides an influence on students' concept comprehension.

Table 3. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Postest Score	.159	39	.014	.913	39	.005
Pretest Score	.159	39	.014	.928	39	.015

Based on the normality test, the resulting significance (Sig.) values for the Kolmogorov- Smirnov and Shapiro-Wilk tests indicated that 0,005 and 0,15. At least one data set had a sig < 0,05. This result leads to the conclusion that the Pretest and Posttest scores are not normally distributed, in accordance with the assessment guidelines for normal data. Consequently, due to the non-normal distribution of the data, a Non-Parametric statistical test must be performed, which yielded the following results:

Table 4. Wilcoxon Signed Ranks Test

Ranks

PRETEST SCORE POSTEST SCORE	Negative Ranks	36[a]	19.47	701.00
	Positive Ranks	1[b]	2.00	2.00
	Ties	2[c]		
	Total	39		

Based on the Wilcoxon Signed Ranks Test Analysis, it can be concluded that the obtained Z value is -5,29 with a p-value (Asymp. Sig. 2-tailed) of 0.000, Since this p-value 0,000 is less than the significance level of 0,05, the hypothesis decision is to accept H1 reject H0. Therefore, the conclusion is that learning using the Problem-Based Learning (PBL) model provides a significant influence on students' concept comprehension.

Table 5. Data Analysis (N-Gain Test)

	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
N_Gain_Persen	39	100.0%	0	0.0%	39	100.0%

To determine the category of the N-Gain score increase, we can refer to the Normalized Gain criteria presented in the table below.

Table 3. Normalized Gain Criteria(Moh Irma Sukarelawa,dkk, 2024)

Nilai NGain	Interpretasi
0,70 ≤ g ≤ 1,00	Tinggi
0,30 ≤ g < 0,70	Sedang
0,00 ≤ g < 0,30	Rendah
g= 0,00	Tidak terjadi peningkatan
-1,00 ≤ g < 0,00	Terjadi penurunan

Overall, the average N-Gain Score is 59.9817 or 0.599817, which places the increase in students' Science concept comprehension within the "Moderate" category.

Table 4. Criteria for Determining the Level of Effectiveness

Presentase (%)	Interpretasi
< 40	Tidak Efektif
40 – 55	Kurang Efektif
56 – 75	Cukup Efektif
>76	Efektif

The determination of the effectiveness of the Problem-Based Learning (PBL) model in enhancing students' Science comprehension can be seen from the N-Gain results. The N-Gain percentage obtained is 59.9817%, which falls into the "Fairly Effective" category.
Based on the results of the N-Gain calculation processed above, they are then summarized in a table (as follows) which is intended to facilitate interpretation.
Table 5. Summary of Student N-Gain Score Analysis

No	Students	Pretes	Postes	N_Gain_Score	Interpretation	% N_Gain
1	ANP	10.00	100.00	1.00	**High**	100.00
2	AN	40.00	70.00	.50	Moderate	50.00
3	CEA	70.00	80.00	.33	Moderate	33.33
4	DB	10.00	100.00	1.00	High	100.00
5	DRP	10.00	80.00	.78	High	77.78
6	DM	30.00	60.00	.43	Moderate	42.86
7	DZ	50.00	80.00	.60	Moderate	60.00
8	EP	40.00	70.00	.50	Moderate	50.00
9	EKM	20.00	40.00	.25	Low	25.00
10	E	40.00	40.00	.00	No Increase	.00
11	HH	60.00	50.00	-.25	Decrease	-25.00
12	IM	20.00	100.00	1.00	**High**	100.00
13	IN	20.00	70.00	.63	Moderate	62.50
14	ILN	70.00	100.00	1.00	**High**	100.00
15	LSK	70.00	70.00	.00	No Increase	.00
16	M FJ	30.00	70.00	.57	Moderate	57.14
17	MU	50.00	100.00	1.00	**High**	100.00
18	MN	30.00	70.00	.57	Moderate	57.14
19	NFS	40.00	80.00	.67	Moderate	66.67
20	NS	20.00	60.00	.50	Moderate	50.00
21	NRMR	20.00	60.00	.50	Moderate	50.00
22	NR	40.00	90.00	.83	High	83.33
23	RR	30.00	100.00	1.00	High	100.00
24	SFS	20.00	70.00	.63	Moderate	62.50
25	SAm	20.00	60.00	.50	Moderate	50.00
26	SA	50.00	70.00	.40	Moderate	40.00
27	SM	50.00	90.00	.80	**High**	80.00
28	SN	20.00	40.00	.25	Low	25.00
29	SAS	60.00	90.00	.75	**High**	75.00
30	SLS	40.00	70.00	.50	Moderate	50.00
31	TW	30.00	70.00	.57	Moderate	57.14
32	TC	60.00	80.00	.50	Moderate	50.00
33	TN	10.00	60.00	.56	Moderate	55.56
34	TNF	60.00	100.00	1.00	**High**	100.00
35	VF	50.00	60.00	.20	Low	20.00
36	WS	70.00	100.00	1.00	**High**	100.00
37	W	40.00	90.00	.83	Moderate	83.33
38	ZKA	40.00	100.00	1.00	**High**	100.00
39	ZZR	20.00	60.00	.50	Moderate	50.00

Based on the analysis results summarized in Table 3, it is identified that the N-Gain of 59.9817% falls into the "Fairly Effective" category. The findings of this research identified the following distribution of Science comprehension improvement: High improvement reached

33.3\%, Moderate improvement was 51\%, Low improvement was 7.7%, No improvement was experienced by 5%, and a decrease in comprehension occurred in 3% of the students. Based on these results, the Problem-Based Learning model applied to the concept of Pressure on Solids among Grade IX-I students of SMPN 2 Solokanjeruk provides a "Fairly Good" impact on students' Science comprehension.

CONCLUSION

In this study, it was found that the Problem-Based Learning (PBL) Model provides a significant impact on the improvement of students' concept comprehension. This is demonstrated by the marked difference and increase between the pretest and posttest scores. Based on the N-Gain results, however, the model is categorized as "Fairly Effective" in enhancing Science comprehension concerning the concept of pressure in solids. The distribution of student Science comprehension improvement showed that the majority experienced a gain in the Moderate category, comprising 20 individuals (51% of the 39 students). A significant increase in the High category was also recorded, observed in 13 individuals (33.3%). Meanwhile, improvement in the Low category was experienced by 3 individuals (7.7%). Furthermore, a small number of students did not experience any increase in comprehension, totaling 2 individuals (5%), and a decrease in comprehension occurred in 1 student (3%).

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