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The Effect of Implementing Problem-Based Learning (PBL) with Window Shopping (WS) on Problem-Solving Skills and Critical Thinking Skills in Vocational Education

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ABSTRACT: The Effect of Implementing Problem-Based Learning (PBL) with Window Shopping (WS) on Problem- Solving Skills and Critical Thinking Skills in Vocational Education This study aimed to investigate the effect of applying the Problem-Based Learning (PBL) model integrated with Window Shopping (WS) on the problem-solving and critical thinking skills of students in vocational education.

This quantitative study employed a quasi-experimental design. The population comprised 54 10th-grade vocational high school students, all of whom served as the research sample. The sample was divided into two classes: the experimental group (n=27), taught using the PBL model with WS, and the control group (n=27), taught using a conventional learning model. Data were collected via pre- and post-tests designed to assess problem-solving and critical thinking skills. The validity of the research instruments was established through expert judgment, and their reliability was confirmed using Cronbach's Alpha. Data analysis involved descriptive and inferential statistics, specifically the independent samples t -test. The results of the independent samples t-test indicated a significant value (2-tailed) of 0.013 (< 0.05) for the problem- solving skills test and 0.000 (< 0.05) for the critical thinking skills test. Thus, it can be concluded that the Problem -Based Learning (PBL) model integrated with the Window-Shopping method had a significant positive effect on the problem - solving and critical thinking skills of vocational high school students, specifically concerning Mechanical Measuring Tools (Vernier caliper) material. This study suggests that the PBL with WS approach offers a promising pedagogical strategy for fostering essential 21st-century skills in vocational settings.

KEYWORDS: Problem-Based Learning (PBL), Window Shopping, problem-solving skills, critical thinking skills, vocational Education.

I. INTRODUCTION

Education constitutes a fundamental component in cultivating skilled human resources, preparing individuals for workforce adaptability, and fostering societal contributions (Afandi, Chamalah, & Wardani, 2013; Agustian & Wibowo, 2015). Within this context, vocational education assumes a pivotal role, specifically aiming to produce industry -ready graduates (Kertiasih, 2018). However, the prevalent focus in vocational education often remains primarily on technical skill development, frequently overlooking the cultivation of higher-order thinking skills such as critical thinking and problem-solving, which are increasingly indispensable in the contemporary industrial landscape (Mutohhari et al., 2021). In the current era of globalization and rapid technological advancement, graduates are expected not only to possess technical expertise but also to effectively analyze information, critically evaluate arguments, and make judicious decisions to compete and adapt swiftly (Nurlailiya, 2013). These critical thinking and problem-solving skills are paramount for navigating the complexities of industrial challenges. Nevertheless, practical implementation in vocational education institutions frequently encounters significant hurdles in adequately developing these competencies. Preliminary studies across various vocational schools indicate prevalent issues such as diminished student motivation and underdeveloped critical thinking skills, particularly within technical concentrations.

Such prevailing conditions underscore the imperative for innovative and pertinent learning models that can effectively address modern industry demands. While Problem-Based Learning (PBL) is widely recognized for its efficacy in fostering problem-solving and critical thinking by engaging students with real-world problems (Nariman & Chrispeels, 2016), its implementation within many vocational education institutions often remains suboptimal. For instance, educational evaluation reports suggest that extant teaching practices do not fully support the optimal development of students' critical thinking and problem-solving capabilities. This observation highlights a discernible gap in both existing literature and current pedagogical practices concerning the specific

and effective implementation of PBL models, particularly within the Indonesian vocational education context.

To ameliorate these challenges, this study proposes integrating the Window-Shopping approach into the PBL model. The Window-Shopping approach encourages students to observe, rigorously analyze, and critically evaluate solutions generated by other groups, thereby broadening their perspectives and significantly enhancing their creativity in devising solutions. This methodology enables students to learn not only from their own direct experiences but also from the discerning observation of others' work (Nariman & Chrispeels, 2016, [If you have another specific reference for Window Shopping method related to critical observation or learning from others, please add it here]). Through this synergistic combination, it is anticipated that students will cultivate more robust problem-solving and critical thinking skills. Consequently, this research aims to thoroughly explore and analyze the effect of applying the PBL model integrated with Window Shopping on the problem-solving and critical thinking skills among vocational education students.

II. METHOD

This study employed a quantitative methodology with a quasi-experimental design to investigate the effect of applying Problem-Based Learning (PBL) integrated with Window Shopping (WS) on students' problem-solving and critical thinking skills. This design was chosen as it allows for examining cause-and-effect relationships within pre-existing, intact groups, aligning with the study's objective to compare the effectiveness of different instructional approaches. An experimental group implemented the PBL model with WS, while a control group received conventional instruction.

The study was conducted at a vocational high school in Bandung Barat Regency, West Java, Indonesia. The school's Motorcycle Engineering vocational program was specifically chosen due to its direct relevance to the research focus. The research was carried out over three months, from February to April 2025, enabling consistent observation and measurement of student skill development.

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Experimental	O1	X	O2
Control	O3	-	O4

Notes:

O1: Pre-test administered to the experimental group

O2: Post-test administered to the experimental group after treatment O3: Pre-test administered to the control group

O4: Post-test administered to the control group after treatment X: Treatment (PBL with Window Shopping)

-: No treatment (Conventional Learning)

The study's population consisted of all 54 10th-grade students enrolled in the Motorcycle Engineering vocational program at the selected high school. Due to the manageable size of the population, a saturated sampling (census) method was utilized, meaning all 54 students participated as the research sample. The sample was naturally divided into two classes: Class 10 TSM 2 (n=27) served as the experimental group, and Class 10 TSM 1 (n=27) as the control group. This comprehensive sampling aimed to obtain highly accurate and representative data for assessing the intervention's impact.

Data were collected using pre- and post-tests specifically designed to assess problem-solving and critical thinking skills. The validity of these instruments was established through expert judgment, and their reliability was confirmed using Cronbach's Alpha. Data analysis primarily involved descriptive and inferential statistics, specifically the independent samples t-test.

III. RESULT AND DISCUSSION

A. RESULT

This study investigated the effect of Problem-Based Learning (PBL) with Window Shopping (WS) on problem-solving and critical thinking skills among 10th-grade vocational high school students. Two intact classes, an experimental group (n=27) and a control group (n=27), were involved. Data were collected via pre-test and post-test administrations for both skills. Statistical analysis was performed using SPSS version 21.

Deskkrifsi	Experimental Class Data				Control Class Data			
	lem Solving Skills		cal Thinking Skills		lem Solving Skills		cal Thinking Skills	
	Pre-Tes	Pos-Tes	Pre-Tes	Pos-Tes	Pre-Tes	Pos-Tes	Pre-Tes	Pos-Tes
Mean	57,33	75,33	49,04	79,59	56,15	68,81	33,74	65,67

Median	60	74	50	83	55	68	33	67
Mode	50	63	25	67	55	60	8	58
Standard Deviation	8,19	9,95	17,95	11,45	11,12	8,63	21,88	13,00
Variance	67,00	99,00	322,27	131,02	123,59	74,46	478,82	169,00
Maximum Score	78	100	78	95	76	83	67	83
Minimum Score	45	58	25	50	30	55	8	43

Table 2 presents the descriptive statistics for problem solving skills in both groups. The mean pre-test score of the experimental group was 57.33, increasing to 75.33 in the post-test. In comparison, the mean problem-solving score of the control group increased from 56.15 to 68.81. Critical thinking skills, the experimental group showed a pre-test mean score of 49.04, which increased substantially to 79.59 in the post-test. In contrast, the mean critical thinking score of the control group increased from 33.74 to 65.67.

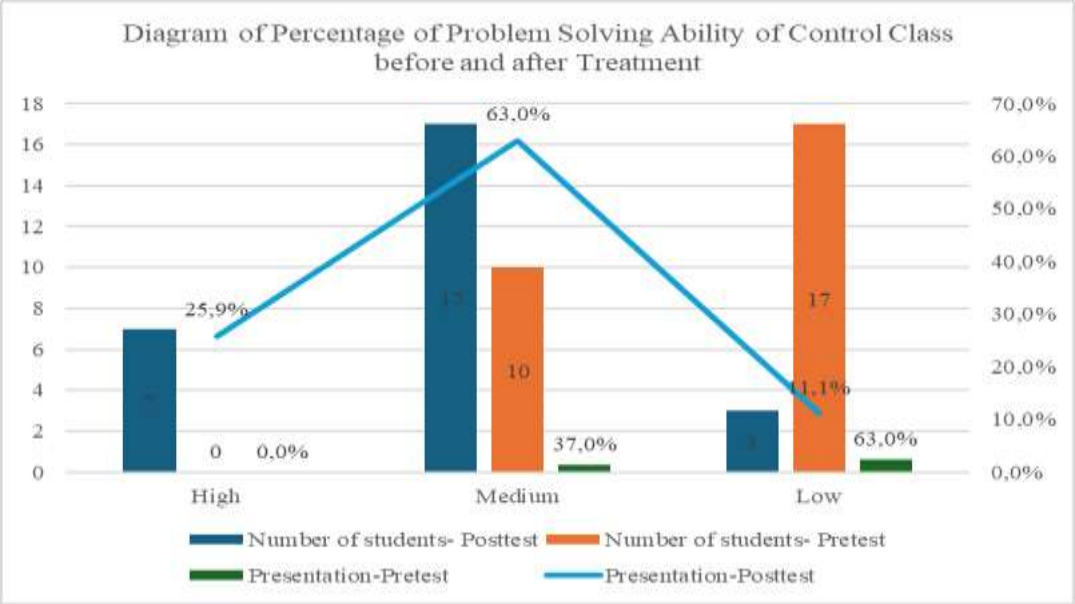
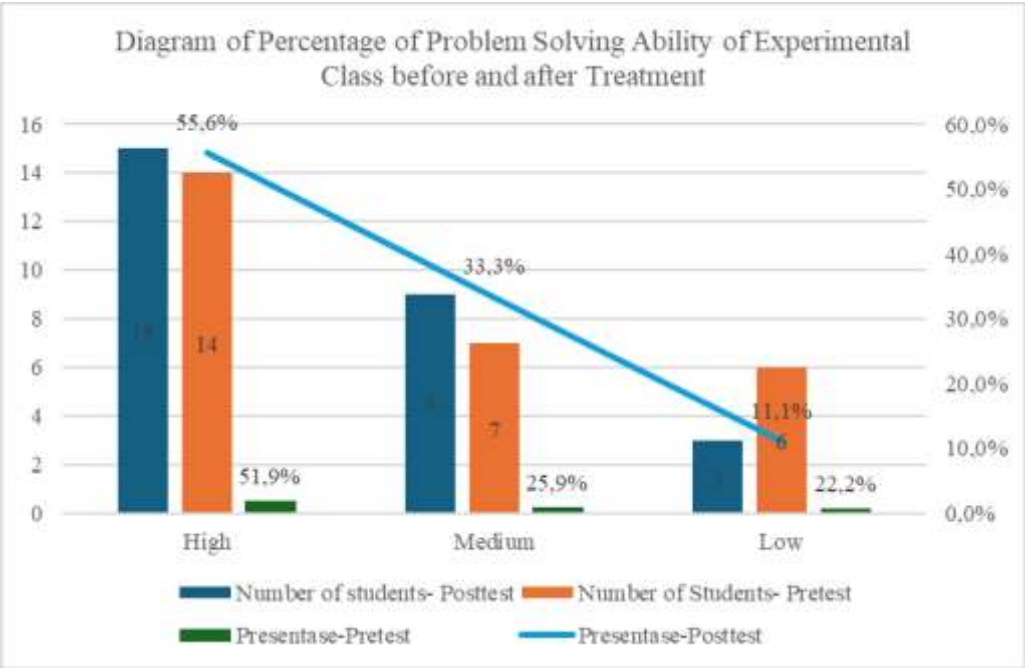


Figure 1. Diagram of the Percentage of Problem-Solving Ability of Control Class before and after Treatment



. **Figure 2. Diagram of Percentage of Problem-Solving Ability of Experimental Class before and after Treatment**

he problem-solving abilities of students in comprehending vernier caliper usage reveal interesting dynamics between the control and experimental groups. As illustrated in Figures 1 and 2, a substantial portion of the experimental group (X TSM 2) in the

pre-test already demonstrated high problem-solving capabilities (51.9%). This contrasts sharply with the control group (X TSM 1), where the majority scored in the low (63.0%) and medium (37.0%) categories, with no students achieving a high criterion. Following the intervention of Problem-Based Learning (PBL) with Worksheets (WS), the experimental group's post-test results showed an increase in the high (55.56%) and medium (33.33%) categories, alongside a significant decrease in the low category (down to 11.11%). While the control group also exhibited an improvement in the high (25.9%) and medium (63.0%) categories without specific treatment, this comparison suggests that the PBL with WS intervention likely played an effective role in enhancing students' problem-solving skills. Nevertheless, the notable improvement in the control group indicates potential influence from other factors, such as natural student development or intrinsic motivation, necessitating further statistical analysis (t-test) to validate the treatment's specific efficacy.

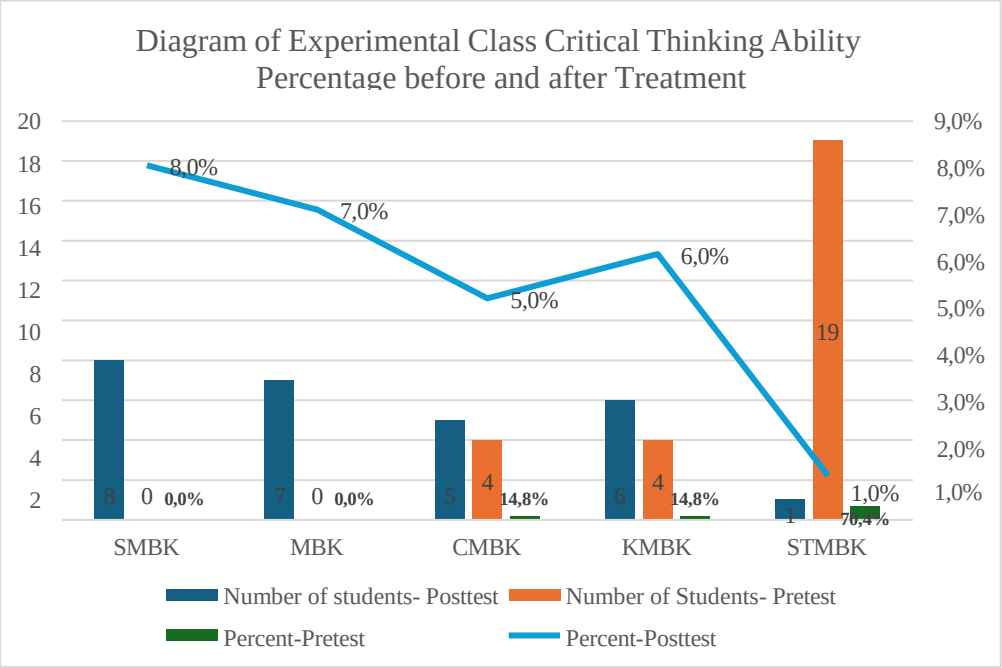


Figure 3. Experimental Class Critical Thinking Ability Percentage Diagram Before and After Treatment

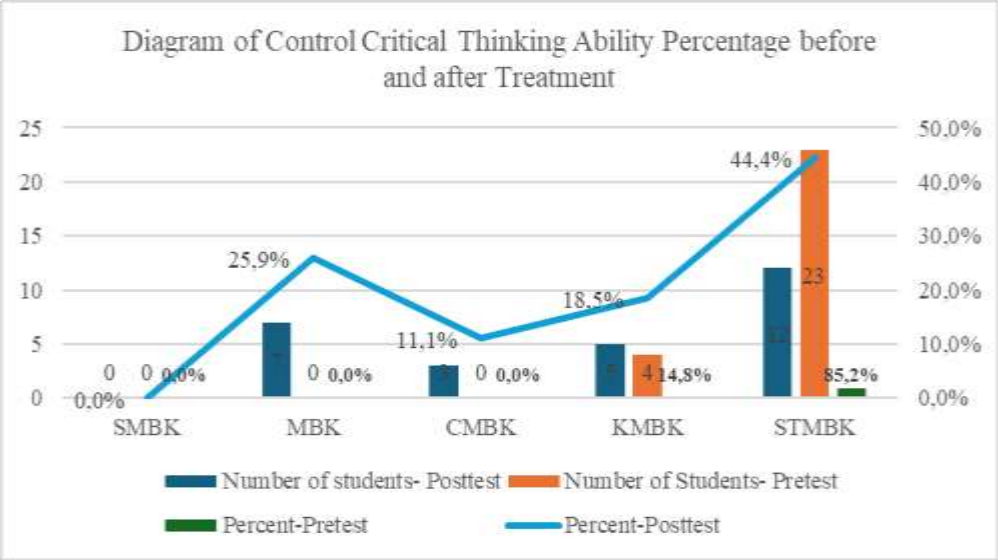


Figure 4. Percentage Diagram of Control Critical Thinking Ability Before and After Treatment

Furthermore, the analysis of students' critical thinking abilities (Figures 3 and 4) robustly supports the effectiveness of the PBL with WS intervention. In the pre-test, both the experimental and control groups were in a similar initial state, with the majority of students falling into the "Sangat Tidak Mampu Berpikir Kritis" (STMBK - Very Unable to Think Critically) category; specifically, 70.4% in the experimental group and 85.19% in the control group. However, the experimental group's post-test results demonstrated a markedly superior improvement compared to the control group. The percentage of STMBK students in the experimental group drastically reduced to merely 1%, whereas in the control group, it remained at 44.4%. More strikingly, the experimental group

successfully had 8 students (8.00%) achieve the "Sangat Mampu Berpikir Kritis" (SMBK - Very Capable of Critical Thinking) category and 7 students (7.0%) reach the "Mampu Berpikir Kritis" (MBK - Capable of Critical Thinking) category—an achievement not observed in the control group. While the control group also showed improvement with a shift from STMBK to MBK and "Cukup Mampu Berpikir Kritis" (CMBK - Moderately Capable of Critical Thinking), the absence of students in the SMBK category and the persistently high proportion of STMBK students underscore that the PBL with WS treatment in the experimental class was highly effective in advancing students' critical thinking skills to the highest level. This preliminary conclusion will be further substantiated through subsequent statistical tests to confirm the significance of the differences between the two groups.

To determine the statistical significance of the differences between the groups, independent samples t-tests were conducted on the post-test scores. The analysis for problem-solving skills yielded a significance value (2-tailed) of 0.013, which is less than 0.05 ($p < 0.05$). For critical thinking skills, the independent samples t-test revealed a significance value (2-tailed) of 0.000 ($p < 0.001$). These results indicate a statistically significant difference in both problem-solving and critical thinking skills between the experimental and control groups after the intervention.

Table 3. Independent Sample T-Test Results

Group Statistics

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Kem_Mem_Masalah	Kelas Eksperimen	27	75.3333	9.94987	1.91485
	Kelas Kontrol	27	68.8148	8.62928	1.66070
Kem_Ber_Kritis	Kelas Eksperimen	27	79.5926	11.44639	2.20286
	Kelas Kontrol	27	65.6667	13.00000	2.50185

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Kem_Mem_Masalah	Equal variances assumed	.015	.904	2.572	52	.013	6.51852	2.53468	1.43231	11.60473
	Equal variances not assumed			2.572	50.980	.013	6.51852	2.53468	1.42989	11.60715
Kem_Ber_Kritis	Equal variances assumed	1.212	.276	4.178	52	.000	13.92593	3.33344	7.23688	20.61497
	Equal variances not assumed			4.178	51.180	.000	13.92593	3.33344	7.23433	20.61752

B. DISCUSSION

The findings of this study provide compelling evidence that the Problem-Based Learning (PBL) model integrated with the Window Shopping (WS) method significantly enhances both problem-solving and critical thinking skills among vocational high school students. The notable increase in post-test scores for the experimental group, as supported by the independent samples t-test results, strongly indicates the effectiveness of the PBL with WS intervention compared to conventional learning.

Specifically, for problem-solving skills, the experimental group demonstrated a more substantial improvement than the control group. This outcome aligns with previous research highlighting PBL's efficacy in fostering active learning and developing higher-order thinking (Nariman & Chrispeels, 2016). The integration of Window Shopping likely played a crucial role by providing students with additional opportunities for peer observation, comparative analysis of solutions, and reflective learning, which are vital for internalizing problem-solving strategies. This interactive approach encourages students to not only derive solutions independently but also to critically evaluate diverse approaches, thus strengthening their analytical capabilities in real-world contexts.

Similarly, the significant gains in critical thinking skills observed in the experimental group further underscore the potent combination of PBL and WS. Critical thinking involves analyzing information, evaluating arguments, and making reasoned judgments (Nurlailiya, 2013). The structured problem-solving scenarios within PBL, coupled with the exposure to varied solutions through Window Shopping, appear to have stimulated students' abilities to dissect complex problems, identify underlying assumptions, and formulate well-reasoned conclusions. This finding corroborates broader educational research indicating that active, student-centered pedagogies are more effective than traditional methods in developing critical thinking (Hattie, 2009; Prince & Felder, 2006).

The present study contributes to the growing body of literature on innovative pedagogical approaches in vocational education. It provides empirical support for the implementation of PBL with WS as an effective strategy to equip vocational students with essential 21st-century skills beyond mere technical proficiency. This is particularly relevant given the evolving demands of the modern workforce, which increasingly require adaptable and analytical professionals. The results imply that educators in vocational settings should consider adopting or refining PBL strategies with interactive components like Window

Shopping to foster deeper learning and critical competencies.

Limitations and Future Research: Despite these significant findings, this study has several limitations. First, the sample size was relatively small (n=54) and confined to students within a single vocational high school's Motorcycle Engineering program, which may limit the generalizability of the findings to other contexts or vocational fields. Second, the study's duration of three months, while allowing for consistent measurement, might not fully capture long -term impacts or sustained skill development. Future research could expand the sample size, include multiple institutions or vocational specializations, and explore the longitudinal effects of this learning model. Additionally, qualitative methods could be incorporated to gain a deeper understanding of the mechanisms through which PBL with WS influences student motivation and learning processes.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the research conducted, it is concluded that the implementation of the Problem-Based Learning (PBL) model integrated with the Window Shopping (WS) approach significantly impacts the enhancement of problem-solving and critical thinking skills among 10th-grade Motorcycle Engineering students at **SMK Negeri 1 Rongga**. Statistical analysis, particularly the independent samples t-test results, revealed significant differences between the group applying PBL with WS and the control group using conventional learning methods.

The application of PBL with WS not only improved students' technical skills in using mechanical measuring tools but also strengthened their abilities in critically analyzing and solving problems. These findings align with existing research indicating that PBL can enhance students' critical thinking skills across various disciplines. Consequently, adopting this method represents a strategic step in preparing vocational students to face increasingly complex challenges in the professional world.

Based on the findings of this study, several recommendations are proposed to enhance the effectiveness of implementing the Problem-Based Learning (PBL) model with Window Shopping (WS) at **SMK Negeri 1 Rongga** and other educational institutions:

1. **For Educators:** It is recommended that educators actively implement the PBL with WS method in the learning process, particularly in subjects related to automotive engineering. This approach will not only improve technical skills but also equip students with essential critical thinking abilities crucial for the workforce.
2. **For Schools/Institutions:** Educational institutions should provide greater support for teachers' professional development in implementing innovative learning methods. This can be achieved through targeted training and workshops focused on active learning strategies.
3. **For Future Research:** This study can serve as a valuable reference for other researchers interested in further exploring the application of PBL with WS within vocational education contexts. Through continued research, new avenues for improving educational quality and preparing students for a better future can hopefully be discovered.

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