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Development of Multimedia Based on Advanced Powerpoint and a Problem-Based Learning Model for Reading Workmanship Signs

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Abstract

This research aims to develop Advanced PowerPoint-based multimedia using the Problem-Based Learning (PBL) model and the ADDIE method. The material used in this research is workmanship signs. The objectives of this study are to: (1) test the feasibility of the developed multimedia based on Advanced PowerPoint and the Problem-Based Learning model, (2) evaluate the differences in learning outcomes between public and private vocational schools, and (3) Analyze the extent of improvement in learning outcomes among students who receive instruction using Advanced PowerPoint-based multimedia with the PBL model, compared to those who receive conventional instruction. Data were analyzed using one-way ANOVA, and the results showed a statistically significant difference between the tested groups. Furthermore, the LSD post hoc test revealed significant differences between pairs of groups, indicating that classes using Advanced PowerPoint-based multimedia with the PBL model achieved the highest learning outcomes. In contrast, private vocational school classes showed moderate N-Gain values. In conclusion, Advanced PowerPoint-based multimedia combined with the PBL model is effective in improving student learning outcomes in the topic of workmanship signs.

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INTRODUCTION

Learning in Vocational High Schools (SMK) carries a significant responsibility in preparing students to enter the dynamic and ever-evolving world of work. One of the main challenges is aligning the learning process with technological advancements, particularly in the subject of manufacturing drawing techniques. According to Jannah et al. (2022), education must keep pace with technological developments so that learning objectives can be fulfilled through an effective and efficient process. Pangestika et al. (2023) state that educators play a crucial role in integrating classroom learning with technology, especially in today's digital era, where conventional teaching methods without interactive digital media are considered less effective in achieving optimal learning outcomes. Aljazzaf (2020) explained that the use of information and communication technology in education can enhance learning skills and transform how teachers and students engage in the teaching and learning process. In the context of 21st-century education, Attwell and Gerrard (2019) emphasized the importance of digital learning resources in improving students' readiness to meet the demands of modern industry. In practice, real issues persist, especially in the manufacturing drawing subjects at SMKN 4 Semarang and SMK Texmaco, where student learning outcomes remain low. Observations show that many teachers still deliver the topic of workmanship signs using only static images, without incorporating interactive media that can attract students' attention. This results in boredom and low student engagement in the learning process. According to Mubarak et al. (2024), one factor contributing to low learning outcomes is the lack of student interest. Based on daily test data, more than 60% of students from both schools failed to meet the Minimum Completion Criteria (KKM). This aligns with the findings of Mubarak et al. (2024), who also highlight the lack of student interest as a contributing factor to low academic performance. Therefore, innovative learning media interventions are needed to help students better understand technical and abstract materials through visual and engaging methods.

The use of multimedia based on Advanced PowerPoint with the Problem-Based Learning (PBL) model is an alternative solution to improving learning quality, consistent with the findings of Backfish et al. (2021), who reported that integrating multimedia into learning can enhance student motivation, which in turn leads to better learning outcomes. Multimedia is designed to deliver learning materials dynamically through text, audio, video, animations, and interactive navigation buttons that encourage active learner engagement. It can enhance the speed and effectiveness of the learning process, thereby supporting the achievement of learning objectives (Makatuu R.A. et al., 2024). The implementation of the PBL approach in multimedia design encourages students to think critically and solve contextual problems relevant to the industrial world. It aligns with the research of Nugraheni et al. (2022), which found that the use of varied and appropriate learning media can significantly improve students' critical thinking skills. Furthermore, multimedia can minimize misunderstandings between teachers and students during the learning process (Mukhadik et al., 2023). This product was specifically developed for the workmanship signs topic and targeting grade XI students of the Mechanical Engineering program. The development assumes the availability of supporting infrastructure, such as computers, projectors, and the readiness of both teachers and students to actively utilize technology in the classroom. This study aims to develop and evaluate the feasibility and effectiveness of Advanced PowerPoint-based multimedia integrated with a PBL approach in improving student learning outcomes. The research objectives are to validate the media through expert judgment, assess its effectiveness in public and private vocational school contexts, and analyze the resulting improvement in learning outcomes. It is expected that this multimedia product will not only enhance cognitive understanding but also serve as a practical reference for teachers and schools in selecting learning strategies that meet students' needs and align with industrial demands. In addition to contributing theoretically to the development of educational media, this research

is expected to have a practical impact by promoting improvements in the quality of vocational education in Indonesia.

METHOD

The research method employed in this study is Research and Development (R&D). This method is appropriate for validating and developing specific educational products. It aligns with the research objectives, one of which is to assess the validity and reliability of the developed learning media. The R&D model adopted is the ADDIE model—Analysis, Design, Development, Implementation, and Evaluation (Agustien, 2020). The resulting product is multimedia learning material developed using Advanced PowerPoint, integrated with a Problem-Based Learning (PBL) model.

Picture 1. Stages of the ADDIE model

Stages of Addie Model Development

The ADDIE model is developed through the following five stages:

1. Analysis
   In this stage, field observations were carried out at two vocational schools to examine the learning conditions related to the *workmanship signs* material. The analysis focused on identifying existing problems, evaluating the content, formulating learning objectives, and designing multimedia content that covers the definition, benefits, and types of workmanship signs. The Problem-Based Learning (PBL) model was selected to enhance student engagement and comprehension.
2. Design
   This stage involves the development of interactive multimedia using Advanced PowerPoint, including the formulation of learning objectives, material preparation, and storyboard creation in line with PBL principles. The multimedia is enhanced with visual aids, videos, and practice questions to support student comprehension.
3. Development
   During this stage, media experts reviewed the multimedia through a validation process. Once the product was deemed valid and reliable, it was finalized and prepared for classroom implementation.
4. Implementation
   In the implementation stage, the developed multimedia was applied in real classroom settings to evaluate its effectiveness and impact on student learning outcomes. Feedback was collected to build future improvements and refinements at SMKN 4 Semarang and SMK Texmaco.
5. Evaluation
   In this final stage, student learning outcomes were analyzed by comparing results before and after the implementation of the multimedia to assess its effectiveness in the instructional process.

Research Subjects and Locations

The subjects in this study were Mechanical Engineering students from SMKN 4 Semarang and SMK Texmaco Semarang. The sample was selected using a random sampling technique. The sampling process was carried out by drawing lots from existing classes, where each selected class was assigned either as a control class or an experimental class. From each selected class, 30 students participated in the study. In total, 120 students were involved in the research, with the following distribution:

a. At SMKN 4 Semarang, the experimental class consisted of 30 students from class XI TM 1, while the control class consisted of 30 students from class XI TM 2.
b. At SMK Texmaco Semarang, the experimental class consisted of 30 students from class XI TP 1, and the control class consisted of 30 students from class XI TP 2.

Data Collection Techniques and Instruments

Data collection is a critical initial stage in the research process, where researchers apply various systematic methods to obtain relevant data that address the research questions and support the achievement of research objectives (Jailani, 2023). The data collection techniques used in this study include: (1) Observation and interviews, (2) Media feasibility and validation instruments, (3) Test sheets (pre-tests and post-tests).

RESEARCH RESULTS

Multimedia Feasibility Test and Test Instrument

The multimedia feasibility must be assessed to ensure it adequately reflects all relevant conceptual aspects, typically through expert judgment (Krieglstein et al., 2022). A Feasibility test of advanced PowerPoint-based multimedia using a problem-based learning model for workmanship signs was conducted by eight validators. The data were analyzed using the Content Validity Ratio (CVR) and Content Validity Index (CVI) formulas. These methods were selected as they are proven effective in measuring the level of agreement among raters regarding the relevance of specific items. Based on the calculations, the obtained validity score was 0.95. According to Lawshe (1975), with eight validators, a CVR score above 0.75 indicates the media is valid. After assessing content validity, the next step was testing media content reliability using the Percent Agreement method, which resulted in a 95% agreement score. According to Borich (1994), media are reliable if inter-rater agreement exceeds 75%, indicating strong consistency among assessors. The validity and reliability of the test instrument were analyzed using Aiken's validity and Intraclass Correlation Coefficient (ICC), with the evaluations conducted by eight expert validators. The validity value was ≥ 0.57, indicating the instrument is valid. ICC analysis, conducted using SPSS software, yielded an average measure of 0.558, suggesting a moderate level of agreement among experts.

Learning Outcomes

Data on learning outcomes in this study were collected through the pretest and post-test sessions. Pretests were conducted in each class to assess students' initial abilities. After that, each class received different instructional treatments, and the learning process concluded with a post-test to evaluate the effectiveness of the respective approaches.

Analysis of pretest data

The pretest results were analyzed using a one-way ANOVA test with the assistance of SPSS software. The purpose of the one-way ANOVA is to determine whether there are significant differences before and after the treatment (Gunasti & Ardiansyah, 2024). The following are the results of the one-way ANOVA test conducted in this study.

Table 1. One-way ANOVA test of pretest results

Anova					
Learning outcomes	Sum of Squares	df	Mean Square	F	Sig
Between Groups	1862.292	3	620.764	7.286	0.55
Within Groups	9882.500	116	85.194		
Total	11744.792	119			

Based on the table above, the significance value is 0.055, which is greater than the threshold of 0.05 (0.055 > 0.05). This result indicates that there is no statistically significant difference in scores between the classes that received different treatments.

Post-test data analysis

The analysis began with prerequisite tests, including normality and homogeneity tests, conducted using SPSS software. The normality test was applied using the Shapiro-Wilk method, and the results showed that all classes had normally distributed data, as the significance values were higher than 0.05 (SMK Negeri

experimental class: 0.115; SMK Negeri control class: 0.134; private experimental class: 0.083; private control class: 0.080). The post-test data were also tested for homogeneity, and the results indicated homogeneity with a significance value of 0.78 (> 0.05). Since it was normally distributed and homogeneous, the analysis proceeded with a one-way ANOVA test on the post-test scores using SPSS software.

Table 2. One-way ANOVA test of post-test results

Anova					
Learning Outcomes	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1234. 315	3	411.438	10.209	<.001
Within Groups	4674.852	116	40.300		
Total	5909.167	119			

Based on the table above, the significance value is 0.001, which is less than 0.05 (0.001 < 0.05). It indicates that the results are statistically significant, and in conclusion, there is a difference in the average post-test scores among the classes.

Post Hoc LSD

Post hoc testing using the Least Significant Difference (LSD) method was conducted to identify the modest significant differences between each group (Salsabila B.T. et al., 2024). The analysis was carried out using SPSS software, and the results are presented in the following table.

Table 3. LSD Post Hoc Test

Multiple Comparison						
Dependent variable: Learning outcomes LSD						
(I) Class	(J) Class	Mean Difference (I-J)	Std.Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control class of State SMK	Experiment class of state SMK	-5.247*	1.653	.002	-8.52	-1.97
	Control class of state SMK	3.715*	1.640	.025	.47	6.96
	Experiment class of private SMK	-.580*	1.653	.726	-3.85	2.69
Experimental class of State SMK	Control class of state SMK	5.247*	1.653	.002	1.97	8.52
	Control class of private SMK	8.962*	1.626	<.001	5.74	12.18
	Experiment class of private SMK	4.667*	1.639	.005	1.42	7.91
Private vocational control class	Control class of state SMK	-3.715*	1.640	.025	-6.96	-.47
	Experiment class of state SMK	-8.962*	1.626	<.001	-12.18	-5.74
	Experiment class of private SMK	-4.296*	1.626	.009	-7.52	-1.08
Experimental class, Private vocational school	Control class of state SMK	.580*	1.653	.726	-2.69	3.85
	Experiment class of state SMK	-4.667*	1.639	.005	-7.91	-1.42
	Control class of private SMK	4.296*	1.626	.009	1.08	7.52

Based on the table above, a statistically significant difference in the average post-test scores was found between the control class and the experimental class at the public vocational school (State SMK), as indicated by a p-value of 0.02 (0.02 < 0.05). A significant difference was observed between the control class at the public vocational school and the control class at the private vocational school, with a p-value of 0.025 (0.025 < 0.05). In contrast, no significant difference was found between the experimental class at the public vocational school and the

control class at the private vocational school, as evidenced by a p-value of 0.726 (0.726 > 0.05).

Improvement Test Result

The N-gain test is used to measure the effectiveness of increasing learning outcomes (Wati et al., 2024). The results of the N-Gain test calculation in each class can be seen in the following table:

Table 4. N-Gain Test

Class	Average Pre test Result	Average Post test Result	N-Gain	Improvement Criteria
Public School Experiment Class	51,83	87,83	74,73	High
Private school Experiment Class	45,00	83,17	69,4	Medium
Public School Control class	53,83	82,59	62,2	Medium
Private School control class	45,17	78,87	61,4	Medium

Based on the data, the public experimental class had an average pretest of 51.83% and a post-test of 87.83% with an N-Gain of 74.7% (high category). The private experimental class obtained an average pretest of 45.00 and a posttest of 83.17 with an N-Gain of 69.4% (medium category). The public control class showed an average pretest of 53.83% and a posttest of 82.59% with an N-Gain of 62.2% (medium category). On the other hand, the private control class had an average pretest of 45.17% and a post-test of 78.87% with an N-Gain of 61.4% (medium category). These results indicate that the experimental class that used multimedia based on advanced PowerPoint with the PBL method experienced a higher improvement in learning outcomes.

Discussion

Multimedia based on advanced PowerPoint combined with the Problem-Based Learning (PBL) model for the working mark material was evaluated by eight experts and received a 95% eligibility score, indicating that the multimedia is feasible, effective, and meets the standards for content, design, and functionality in learning. The test instrument used to measure student understanding after multimedia implementation also received strong agreement from 8 experts, confirming that the instrument was valid and appropriate for this study. According to Ramadhan et al. (2024), an instrument is considered good if it is valid and reliable.

Advanced PowerPoint-based multimedia with the PBL model has proven to be more effective than conventional learning methods, supporting the findings of Shen and Yu (2023), who stated that multimedia teaching has many advantages over traditional methods. Pre-tests were conducted to measure students' initial knowledge of working with mark material. Data analysis using One-Way ANOVA showed a significance value greater than 0.05, indicating no significant difference between control and experimental classes in public and private vocational schools. It depicted that the initial abilities were relatively equivalent before treatment. Post-test results after applying advanced PowerPoint-based multimedia with the PBL model showed increased average scores in the experimental classes of public vocational schools (87%) and private vocational schools (83%), compared to control classes (82% and 78%, respectively). It demonstrates the positive impact of multimedia on learning outcomes. After confirming normality and homogeneity, post-test results were analyzed using one-way ANOVA, which showed a significance value of

0.055 (>0.05), indicating no significant difference overall.

However, the Post-Hoc LSD test revealed significant differences between the control and experimental classes in public vocational schools (p = 0.02) and between control classes of public and private vocational schools (p = 0.025). No significant difference was found between the control class of public vocational schools and the experimental class of private vocational schools (p = 0.726). Further analysis using the N-Gain test showed that the experimental class in public vocational schools achieved an N-Gain of 0.747 (high category), while the private vocational school experimental class reached 0.694 (medium category). The control classes in public and private vocational schools had N-Gain scores of 0.622 and 0.614, respectively (both medium category). These results confirm that advanced PowerPoint-based multimedia combined with the PBL model provides higher improvement in learning outcomes than traditional methods, consistent with Kassa et al. (2024), who found that multimedia use in learning enhances student achievement.

CLOSING

Learning multimedia based on advanced PowerPoint combined with the Problem-Based Learning (PBL) model is declared valid and reliable for teaching working marks material. The results of the ANOVA analysis indicate a significant difference in average post-test scores between classes, particularly between the experimental and control groups in the public and private vocational schools.

The multimedia usage has proven effective in improving student learning outcomes. A higher improvement was observed in the experiment class of the Public Vocational High School , categorized as "high" based on the N-Gain score, while the other classes showed moderate improvements. These findings demonstrate that applying advanced PowerPoint-based multimedia with a Problem-Based Learning approach positively influences student learning achievement.

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