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Application of Android-Based Interactive Multimedia to Enhance Learning Outcomes in Understanding the Working Principles of SMAW Welding

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Abstract

Traditional learning media remain prevalent due to the limited utilization of Android-based platforms among students as an instructional tool, necessitating an update in information delivery methods. The integration of technology in teaching materials aims to address this gap. This study seeks to implement Android-based interactive multimedia using the Problem Based Learning model to enhance students learning outcomes in understanding the working principles of Shielded Metal Arc Welding (SMAW) in cognitive, affective, and psychomotor domains. The research follows the ADDIE development model, which includes Analysis, Design, Development, Implementation, and Evaluation. The study involved 72 tenth grade students from the Welding and Metal Fabrication Engineering program, divided into control and experimental groups. The findings indicate that the application of Android-based interactive multimedia significantly increased students learning interest, with an initial average score of 63.194 rising to 73.889. T-test results revealed a significant difference between pre-test and post-test scores, with a significance value (2-tailed) of $p = 0.00 < 0.05$ and a t-value of 6.504. The hypothesis testing confirms that the use of Android-based interactive multimedia positively influences the learning outcomes of tenth grade students in the Welding and Metal Fabrication Engineering program at SMK Negeri 1 Adiwerna. Based on these findings, it can be concluded that the implementation of Android-based interactive multimedia effectively enhances students understanding of SMAW welding principles.

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INTRODUCTION

Education is a fundamental component in developing high-quality human resources (Reinsini et al., 2021: 139). It plays a crucial and foundational role in producing high-quality individuals in Indonesia. The educational process is considered effective when all educational components are actively involved. Various factors influence the learning process, including teaching materials, methodologies, school facilities, administrative support, infrastructure, other resources, and the creation of a conducive learning environment (Istijarti et al., 2019: 906). Therefore, education serves as a means for individuals to improve their quality of life (Safriwardy et al., 2022: 136). Based on this perspective, education can be understood as a necessity and a conscious effort to enhance human life by providing access to quality learning experiences.

A learning environment emerges when three interconnected elements are present: teachers as educators, students as learners, and appropriate learning resources in the classroom. The presence of educators is essential in guiding the acquisition of knowledge, skills, attitudes, and self-confidence (Pramowardhani et al., 2023: 1). The success of learning can be measured by students ability to comprehend concepts. This level of understanding allows students to apply their knowledge further, moving beyond rote memorization to gain deeper insights into a subject. To achieve such comprehension, students must engage in exercises that enhance their intellectual capacity through various skill-development activities. One essential skill is problem-solving, which helps students gradually understand concepts and apply structured steps in addressing challenges (Niswah et al., 2024: 504).

Based on data from SMK Negeri 1 Adiwerna, the learning outcomes of tenth-grade students in the Welding and Metal Fabrication Engineering program regarding the working principles of SMAW welding remain below the expected standards. The minimum competency criterion (KKM) at SMK Negeri 1 Adiwerna for vocational subjects is set at 70. Initial learning assessments revealed that only 13 students (37.1%) met the required criteria, while 22 students (62.8%) did not meet the standard, indicating a low achievement rate. The researcher identified that the primary cause of low student performance is the lack of technology utilization in the learning process. The current teaching method predominantly relies on lectures, resulting in a one-way communication model where students passively listen to the teacher. However, not all students fully grasp the delivered material. The development of innovative and appropriate learning models, methods, and techniques significantly impacts learning success and the refinement of students knowledge and skills. One potential solution is integrating interactive multimedia based on Android using the Problem Based Learning model.

According to Nopriyanti and Sudira (2015: 224), interactive multimedia refers to multimedia designed to effectively convey information while allowing user interaction. This feature enables users to control the learning flow freely. Atmawarni (2011: 23) defines interactive multimedia as a medium that integrates text, video, graphics, sound, and animation to deliver messages and information through electronic devices such as computers and other digital tools. Interactive multimedia enhances clarity in subject matter, simplifies the learning process, directs attention, and fosters motivation, ultimately improving student learning outcomes. Furthermore, interactive multimedia transforms abstract concepts into concrete representations, encourages active participation, and provides students with real learning experiences. In developing interactive multimedia, researchers emphasize the importance of technology utilization. One practical approach is leveraging Android technology in the learning process.

The use of technology facilitates the creation of an interactive learning application that includes instructional materials, animated videos, and assessments. This technological integration offers students a more engaging and effective learning experience. Additionally, it enables students to review lessons anytime and anywhere, enhancing their comprehension of the topics covered by teachers. According to Arief and Umniati (2012: 115), Android is an open-source operating system. Its diverse application development capabilities allow for the creation of

interactive learning media. By incorporating Android-based technology, learning experiences become more dynamic, incorporating audio, visual, and animation elements to simplify complex concepts.

Joyce and Weils describe a learning model as a conceptual framework that serves as a systematic guideline for instructional planning, incorporating syntactic structures, social systems, reaction principles, and support mechanisms. One widely recognized and highly regarded model in education is Problem Based Learning (PBL). PBL is a teaching model where students solve problems through scientific methods, enabling them to acquire relevant knowledge while simultaneously developing problem-solving skills (Syamsidah and Hamidah Suryani, 2018: 2).

Based on the aforementioned issues, an effective learning process requires innovation and adaptation. This study aims to (1) assess the feasibility of Android-based interactive multimedia in enhancing student learning outcomes related to the working principles of SMAW welding within the Welding and Metal Fabrication Engineering program, (2) evaluate the improvement in student learning outcomes after using Android-based interactive multimedia for understanding SMAW welding principles, and (3) analyze student responses to the use of Android-based interactive multimedia as a learning tool for SMAW welding principles.

METHODOLOGY

Research Location and Time

This study was conducted at SMK Negeri 1 Adiwerna, focusing on tenth-grade students in the Welding and Metal Fabrication Engineering program, specifically in the Basic Welding Techniques course. The research was carried out during the odd semester of the 2024/2025 academic year, following the stages outlined in Table 1.

Table 1. Research Timeline

Stage	Implementation Period	Deatails
Preparation	January - February 2024	• Preliminary research • Initial data collection • Title submission
Implementation	February – October 2024	• Proposal drafting • Proposal seminar • Instrument development • Validation by media and subject matter experts
Completion	October – December 2024	• Data analysis • Report preparation

Type of Research

This study employs a development research method, commonly known as Research and Development (R&D). The design of interactive multimedia in this research follows the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

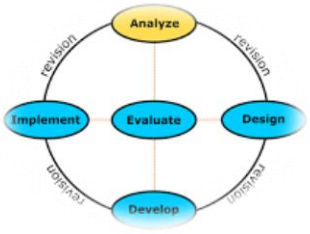

FIgure 1. The development framework

Research Subjects

The subjects of this study were tenth-grade students in the Welding and Metal Fabrication Engineering program at SMK Negeri 1 Adiwerna. The sample consisted of two classes: Class X TPFL 1 and Class X TPFL 2, with a total of 72 students. Class X TPFL 1, consisting of 36 students, was assigned as the experimental group, while Class X TPFL 2, also consisting of 36 students, was designated as the control group. The sampling technique used was Simple Random Sampling, meaning that samples were selected randomly from the population without considering stratification, ensuring that every member of the population had an equal opportunity to be included in the sample.

RESULTS AND DISCUSSION

Research Results

The field implementation stage involved applying interactive multimedia on the working principles of SMAW welding as a learning medium for SMAW welding material. This stage also included administering pre-tests, post-tests, and student response questionnaires.

The pre-test and post-test were given to tenth-grade students in the Welding and Metal Fabrication Engineering program, with a total of 36 students in the control class and 36 students in the experimental class.

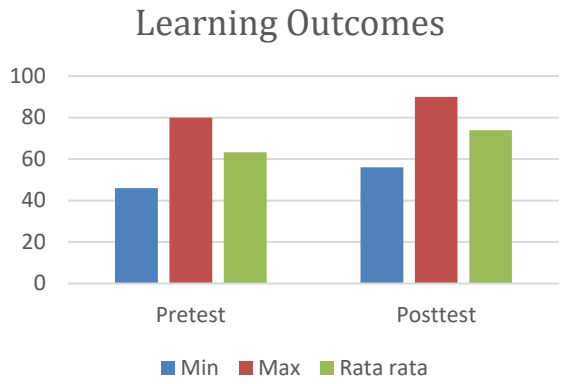

Figure 2. The pre-test and post-test scores

Based on the diagram above, the average pre-test score was 63.194, with a minimum score of 46 and a maximum score of 80. Meanwhile, the average post-test score was 73.889, with a minimum score of 56 and a maximum score of 90. Following the pre-test and post-test, the next stage involved evaluation. The data on student responses to the developed product were obtained from questionnaires filled out by 36 students who had used the interactive multimedia learning media. The results of the questionnaire analysis are presented in the following table:

Table 2. Percentage Analysis of Student Responses

Response	Percentage (%)
Highly Suitable	58.10%
Suitable	23.88%
Moderately Suitable	0.55%
Less Suitable	0.09%
Not Suitable	0%

Based on the analysis of student responses, the obtained percentage was 82.62%. This result falls under the category of Highly Suitable for use. The pre-test and post-test scores from both the experimental and control classes were tested for normality using the Kolmogorov-Smirnov (K-S) test in SPSS. The results showed significance values of 0.058, 0.085, 0.052, and 0.052. Since all four values were greater than 0.05, the data residuals were considered normally distributed.

Once normality was confirmed, the next step was a homogeneity test. The homogeneity test results using SPSS indicated that data is considered homogeneous if the significance value is greater than 0.050. The homogeneity significance value, based on the mean, was 0.065. Since 0.065 is greater than 0.050, the data distribution was considered homogeneous. The parametric statistical requirements were met as the data were normally distributed and had homogeneous variance, allowing for an independent samples t-test.

After confirming homogeneity, an independent samples t-test was conducted using SPSS. The results are as follows:

Table 3. Independent Samples T-Test Statistics

Group Statistics

	Class	N	Mean	Std. Deviation	Std. Error Mean
Learning Outcomes	Post-Test Experimental Class	6	0.22	6.311	1.052
	Post-Test Control Class	6	8.58	8.686	1.448

Table 4. Independent Samples T-Test Results

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
Learning Outcomes	Equal variances assumed	5.463	.022	6.504	70	.000	11.639	1.790	8.070	15.208
	Equal variances not assumed			6.504	63.901	.000	11.639	1.790	8.064	15.214

Based on the table above, the mean score for the experimental class was 80.22, which was higher than the control class mean score of 68.58. The correlation value between the two post-test mean scores was 6.504, with a significance value of 0.000. This indicates a strong and significant correlation between the post-test mean scores of both groups. The next step was conducting an N-Gain test. The results are presented in the following tables:

Table 5. N-Gain Test Results

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Class	N	Percent	N	Percent	N	Percent
N_GainPersen	Experimental Class	36	100.0%	0	0.0%	36	100.0%
	Control Class	36	100.0%	0	0.0%	36	100.0%

Table 6. Descriptive Statistics N-Gain Control

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	36	8	66	.2212	14.496
Valid N (listwise)	36				

Table 7. Descriptive Statistics N-Gain Experimental

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	36	0	71	.3832	20.689
Valid N (listwise)	36				

Based on the N-Gain test results, the average N-Gain score for the control class was 0.2212, while the average N-Gain score for the experimental class was 0.3832. According to the N-Gain classification table, the experimental class fell into the "Moderate" category, whereas the control class fell into the "Low" category.

The data on student responses to the developed product were obtained from questionnaires filled out by 36 students who had used the interactive multimedia learning media. The responses of students regarding the final product, which was implemented using Android-based interactive multimedia to improve learning outcomes in understanding SMAW welding principles, resulted in a percentage of 82.62%. This outcome is categorized as "Highly Suitable" for use as a learning medium.

Discussion

Table 9. Analysis results after using the application

No.	Analysis	Stages
1.	Needs	a. The delivery of learning materials is facilitated through the SMAW APP, an educational application containing SMAW welding materials. This application also includes animations, videos, audio, and images that engage students and enhance their learning motivation. b. The learning materials cover processes such as assessment, evaluation, and identification of strengths and weaknesses in the instructional content used in the learning process.
2.	Problem	a. Utilizing Android as a learning medium and implementing problem-based learning has proven to be highly beneficial, as it enables students to comprehend, study, and develop problem-solving skills related to the principles of SMAW (Shielded Metal Arc Welding). Consequently, learning outcomes in SMAW welding have improved. b. The learning environment encompasses various factors that influence student learning experiences. The current instructional approach at the school still relies on conventional teaching methods, highlighting the need for an innovative learning model that can enhance student engagement in the learning process.

Based on the learning outcomes in the basic SMAW welding component, students have demonstrated an understanding of the concepts, the ability to explain, identify, analyze, and conduct practical applications of SMAW welding. The evaluation results indicate that the use of Android-based interactive multimedia for teaching the principles of SMAW welding in the Welding and Metal Fabrication Engineering program is "effective". This conclusion is supported by the significant difference between the pre-test and post-test mean scores in the experimental class, as evidenced by the t-test significance value of 0.000. Furthermore, the improvement in student learning achievement in the experimental class falls within the "Moderate" category, with an N-Gain score of 0.3832.

This finding aligns with Handaru (2020), who states that the use of Android-based interactive multimedia can enhance learning outcomes. The integration of Android technology in education makes learning more engaging and interactive. Additionally, Asmianto (2022) highlights that the effectiveness of interactive learning media can be observed in students cognitive and psychomotor learning outcomes. Cognitive structures refer to an individuals thought processes used to understand, manage, and process information from their environment.

This study is consistent with research by Diana et al. (2024), which developed an Android-based interactive multimedia model using problem-based learning. Their findings indicate that this approach is valid and effective in improving students problem-solving abilities. In relation to teaching SMAW welding principles, educators should consider the following strategies: (1) avoiding monotonous teaching methods that may cause students to lose interest, (2) providing rewards to students, such as praise, material incentives, or other forms of recognition, and (3) engaging students who do not actively participate in the learning process to encourage their involvement.

The findings of this study also align with Mantoviana et al. (2023), who found that the implementation of Android-based interactive multimedia increased students motivation in learning chemistry, significantly impacting their academic performance. Achievement motivation has a partial but significant positive influence on students learning outcomes. Additionally, the study highlights the significant effects of the learning environment and students readiness on academic success.

Similarly, Hastuti et al. (2023) found that e-learning approaches, similar to interactive multimedia, effectively enhance students motivation and overall academic performance. This is further supported by Huang et al. (2018), who reported that the use of Android-based interactive learning media increases students motivation and interest in learning. Students tend to be more engaged and involved in the learning process when using familiar technology.

Student feedback on the final product was collected from 36 students who participated in the experimental class using Android-based interactive multimedia. The results show an approval rating of 82.62%, categorizing the media as "Highly Suitable" for the learning process. The questionnaire responses highlighted students affective domain, demonstrating that the interactive multimedia encouraged greater interest in learning. Changes in student behavior were observed through new responses to their learning environment, including improvements in skills, attitudes, competencies, emotions, knowledge, and social interactions.

This study is in line with Khabibah (2020), who found that learning materials were deemed suitable and that cognitive learning outcomes improved. The interest level in learning among students in the control class had an average score of 63.19, whereas the experimental class had an average score of 65.50. Students learning interest increased because they found Android-based multimedia learning more engaging. However, the difference in motivation between students exposed to conventional learning methods and those using interactive multimedia was not statistically significant. Although the graphical representation did not indicate a large difference, there was a noticeable trend of improvement in both control and experimental class pre-test and post-test scores.

This is further supported by Saputra et al. (2025), who found that using the Problem-Based Learning (PBL) model for SMAW welding material resulted in significant differences between pre-test and post-test scores after the intervention. This suggests that interactive multimedia positively influences students cognitive, affective, and psychomotor learning outcomes.

Additionally, Krimadinata et al. (2022) concluded that the developed learning media were suitable for educational use. Their findings showed that student responses, gathered from 34 students across 10 questions, yielded an average approval rating of 88%, categorizing the Android-based interactive multimedia as Highly Effective and Engaging. This suggests that the developed learning media meet high standards and serve as an effective tool for classroom instruction in chemistry for tenth-grade students during the first semester.

CONCLUSION

Based on the results and discussion regarding Android-based interactive multimedia as a learning medium in the Basic SMAW Welding course, it can be concluded that this learning media effectively supports both students and teachers in the learning process, leading to improved student learning outcomes. The analysis indicates that this media is suitable for independent learning, as it includes several features such as subject-related information and assessment tools. Android-based interactive multimedia serves as an effective learning medium that also enhances student creativity. The research findings show that before the intervention, student learning outcomes were 68.58%, whereas after the intervention, the outcomes improved to 80.22%.

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