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EFFECTIVENESS OF YOUTUBE-BASED TUTORIALS IN SMAW WELDING PRACTICE LEARNING OUTCOMES

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Abstract

This study aims to analyze the effectiveness of YouTube-based video tutorial learning media in improving students' cognitive learning outcomes in Shielded Metal Arc Welding SMAW practice at SMK Negeri 4 Semarang. The background of this research is based on the limited use of contextual and engaging instructional media in vocational education, which leads to low conceptual understanding and applied skills among students. The research employed a quasi-experimental method with a pretest-posttest control group design. The sample consisted of 60 tenth-grade students from the Mechanical Engineering Expertise Program, selected through purposive sampling and divided into two groups: an experimental group that used YouTube-based instructional videos and a control group that applied conventional lecture methods. The research instrument comprised 20 validated multiple-choice questions. Data was analyzed using the Shapiro-Wilk normality test, Levene's homogeneity test, independent t-test, and N-Gain analysis to assess learning improvement. The results indicated a significant difference between the experimental and control groups $p < 0.001$, with the experimental group achieving an average post-test score of 84.50 and an N-Gain of 0.6100 high category. In contrast, the control group scored an average of 75.33 with an N-Gain of 0.4155 medium category. These findings suggest that using YouTube video tutorials as instructional media effectively enhances students' learning outcomes in welding practice while also creating a more contextual, visual, and student-centred learning process suited to the learning styles of vocational students.

Key Words: YouTube Video Tutorial, SMAW Welding, Learning Media, Student Outcomes, Vocational Education

INTRODUCTION

Vocational High Schools SMK in Indonesia are designed to equip students with vocational skills, especially in engineering and industrial fields such as welding. Initial observations show that SMAW learning is still dominated by lectures and direct demonstrations without adequate learning media support. This condition causes students to have difficulty understanding the material thoroughly and are less able to apply it in work practice.

Along with the development of technology, video-based teaching media, primarily through the YouTube platform, is considered relevant to the characteristics of today's digital generation. Several studies have also shown that the use of YouTube in engineering teaching can significantly improve student motivation, engagement and learning outcomes (Navarrete et al., 2023), (Gafur et al., 2023) and (De la Flor López et al., 2016). The study's results Navarrete et al (2023) show that the design of video learning that includes interactive features, learner activities such as play and pause, and instructional design principles contribute significantly to the effectiveness of YouTube-based video learning. The combination of audio and video can detect real-time weld.

Mayer (2024) confirms that combining audio and visual elements in learning media significantly improves comprehension and retention of material. This supports the choice of YouTube as a learning medium, particularly because its personalized algorithm helps tailor content to meet individual learning needs (Navarrete et al., 2023). Despite previous studies showing the effectiveness of multimedia learning, there is still a gap in understanding how the dynamic interaction of visual and audio content enhances explicitly student engagement and learning outcomes on widely accessible platforms such as YouTube.

Based on this urgency, this research activity aims to introduce Methods for developing and implementing YouTube-based teaching media in SMAW welding courses. Arkenback (2023) Although YouTube is widely used in vocational learning, most instructional videos still teach technical skills in isolation, without fully integrating real work contexts. The main objective of this research is to enhance media in learning innovation and foster a more engaging contextualized learning process than traditional learning (Heibel et al., 2023) and (Ahmad et al., 2024). Hopefully, this can contribute to increasing the competence of SMK graduates who are adaptive to the demands of the modern world of work.

METHODS

This research activity was conducted at SMK Negeri 4 Semarang in the 2024-2025 academic year. This program is aimed at class X Mechanical Engineering Program students, especially in SMAW Welding practice. This activity aims to introduce, implement, and evaluate YouTube video tutorial-based learning media to improve student learning outcomes in welding practice (Phulpoto, 2022).

The participants of the activity consisted of two groups, The experimental group used YouTube-based learning video media, and the control group used conventional lecture-based learning methods. Class X Mechanical Engineering 1 was designated as the experimental group, while Class X Mechanical Engineering 2 as the control group. The sample determination employed a purposive sampling technique, considering the curriculum's suitability, the availability of facilities, and the school's support.

The learning materials covered the basic competencies of SMAW welding, including the welding process, main welding components, auxiliary aids, and welding positions and techniques. YouTube video tutorials were selected as the learning media based on pedagogical criteria, such as good visual and audio quality and their alignment with the curriculum at SMK Negeri 4 Semarang. This choice is by Arkenback (2023), who showed that students in vocational education prefer YouTube videos because this approach makes them directly see practical learning. This method effectively supports their independent and observational learning style.

The tools and materials used in this activity include multimedia devices, LCD projectors, active speakers, welding practice devices, welding machines, electrodes, face shields, metal work materials, and evaluation instruments in the form of pre-test and post-test questions. The instrument consisted of 20 multiple-choice questions, which were validated by a panel of experts in welding education. The validation process consists of assessing the clarity, relevance, and difficulty level of the questions to ensure that the questions measure the learning indicators of SMAW welding material appropriately. The validated questions are then revised according to input from experts to ensure their suitability with the curriculum and learning objectives.

Data collection techniques were done by giving pre-tests before treatment and post-tests after treatment in both groups. The data that were collected were analyzed using both descriptive and inferential statistics. Normality and homogeneity tests were performed to ensure that the data met the necessary assumptions for analysis. The data met the requirements. An independent t-test was then performed to assess significant differences between the two groups. Furthermore, the N-Gain test was utilized to evaluate the effectiveness of learning media in enhancing student outcomes. To illustrate the procedure for carrying out activities in a systematic and structured manner, the following is a flow chart of this research, as seen in Figure 1.

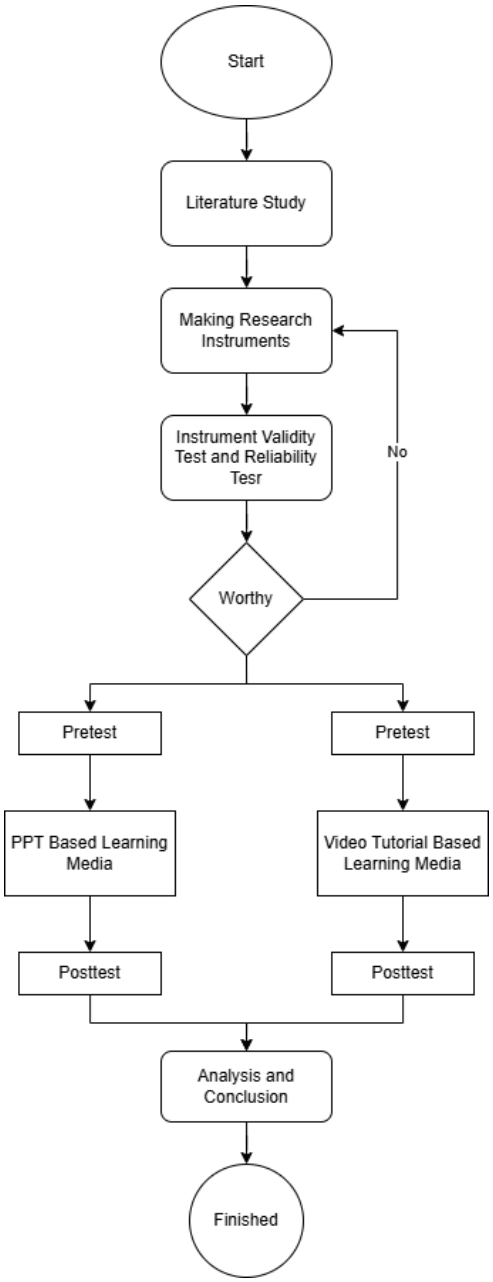

Figure 1. Flow of the research implementation cycle

RESULTS AND DISCUSSION

This research was conducted at SMK 4 Semarang using a pseudo-experimental design with 60 students divided evenly into the control and experimental groups. Both groups had pre-test and post-test questions to measure the effectiveness of YouTube-based learning media. The paired t-test results on the pre-test score show significance, as seen in Table 1.

Table 1. Independent Samples Test

	Equal Variances Assumed	Equal Variances Not Assumed
Sig. (2-tailed)	.097	.098
Mean Difference	3.000	3.000
Snd. Error Difference	1.781	1.781

After conducting learning interventions, a post-test was conducted to measure the level of student understanding, and there was a significant increase in the experimental group. The average post-test score for the experimental group was 84.50, and for the control group was 75.33. The data processing can be seen in Table 2.

Table 2. Descriptive Statistics of Post-test Scores

	Experimental	Control
N	30	30
Mean	84.50	75.33
Std. Deviation	8.025	7.303

The Shapiro-Wilk test, which was conducted after the statistical test of The normality test, conducted after the descriptive statistical test of the post-test scores, showed significance values of 0.054 control group and 0.265 experimental group, both of which had values greater than 0.05, indicating that the distribution of data in the groups was normal (Table 3).

Table 3. Post-test data normality test

	Saphiro – Wilk	
	Control	Experimental
Statistic	.932	.957
Df	30	30
Sig.	.054	.265

Using the Shapiro-Wilk test, the Levene test was conducted after the normality test. Levene's test was conducted to determine the homogeneity of data variance. In this test, a significance value of 0.670 p>0.05 was obtained (Table 4), so the line "variances are assumed to be equal" was used in the t-test.

Table 4. Homogeneity of Post-test Data

Levene's Test for Equality of Variances	Equal variances assumed
f	0.183
sig	0.670

After the post-test, an independent test was conducted to assess the differences in significant values between the control and experimental groups. The results indicated that p<0.001, meaning that the scores of the experimental group showed a significantly greater improvement than those of the control group (Table 5).

Table 5. Right-tailed t-test Post-test Scores

	Equal variances assumed	Equal variances not assumed
Sig. (2-tailed)	<.001	<.001
Mean Difference	9.167	9.167
Std. Error Difference	1.981	1.981
T	4.627	4.627
df	58	57.492

After conducting an independent t-test, conduct an N-Gain analysis to measure the effectiveness of learning and compare between the control and experimental groups. The N-Gain analysis showed that the experimental group had an N-Gain of 0.6100 high category, while the control group had an average N-Gain of 0.4155 medium category (Tables 6 and 7).

Table 6. Descriptive Statistics of N-Gain Scores Control Group

	Control Group		
	Ngain	Pretest Score	Posttest Score
N	30	30	30
Min	.17	50	65
Max	.78	70	90
Mean	.4155	57.17	75.33
Std. Deviation	.18885	5.826	7.303

Table 7. Descriptive Statistics of N-Gain Scores Experimental Group

	Experimental Group		
	Ngain	Pretest Score	Posttest Score
N	30	30	30
Min	.33	50	70
Max	1.00	75	100
Mean	.6100	60.17	84.50
Std. Deviation	84.50	7.822	8.025

This study concluded that YouTube-based video tutorial learning media improved students' cognitive learning outcomes in vocational education (Phulpoto, 2022). The absence of significant differences in pre-test scores indicated that both groups had balanced initial abilities, thus strengthening the internal validity of the research design. After the intervention, the experimental group demonstrated greater understanding than the control group. This is by the findings of Khubayi & Mtshali (2024), which showed that students who learned through YouTube videos achieved significantly higher scores than those taught through traditional lecture methods $p < 0.05$. In contrast, studies by (Iftikhar, 2019) and Tudy, which focused mainly on theoretical learning, showed that this study highlights the effectiveness of video media in improving understanding of more complex practical concepts.

The average improvement of 9.17 points and an N-Gain of 0.6100 further support the effectiveness of YouTube-based video learning medium in delivering material more effectively. Additionally, research by Rahmawati et al (2024), Hafis et al (2023), and Abubakar & Muhammed (2023) similarly indicated that YouTube-based video media improved performance and learning outcomes in welding tasks, as compared to conventional lecture-based methods. The integration of YouTube video media in this study enabled students to understand better and apply key welding principles, such as current strength and safety procedures, in alignment with national vocational competencies (C2-C3). Moreover, the method proved effective in improving skills related to application, analysis, and evaluation (C3-C5). These findings align with the work of Striuk et al (2018) who emphasized the importance of adaptive and contextualized learning in vocational education.

What differentiates this study from previous research is the application of YouTube-based video learning media in a vocational context, which addresses both conceptual and methodological aspects. This study demonstrates that YouTube-based media contributes to a more engaging and collaborative learning environment in vocational education, facilitating mistake identification and skill improvement through re-viewing, as suggested by (Galatsopoulou et al., 2022) and (El-Ariss et al., 2021). By incorporating competency assessment into the YouTube-based learning process, the researcher aims to contribute to the literature by demonstrating improvements in students' academic performance, work readiness, and understanding, making it a valuable tool for vocational education.

CONCLUSIONS

Based on the results of research conducted at SMK Negeri 4 Semarang on sixty students of Class X Mechanical Engineering, with the experimental group using YouTube videos and the control group using conventional methods, it was concluded that YouTube-based video learning media was effective in improving students' cognitive learning outcomes in SMAW welding practice material. This is evidenced by a significant increase in post-test scores, with the experimental group scoring an average of 84.50 compared to the control group at 75.33, reflecting a 9.17-point difference $p < 0.001$. Additionally, the experimental group achieved an N-Gain of 0.6100, categorized as high, much higher than the control group, which had a medium category N-Gain of 0.4155. The normality test Shapiro-Wilk conducted on samples under 50 showed that the data were normally distributed with a significance of 0.054 for the control group and 0.265 for the experimental group. The homogeneity test Levene's test indicated no significant difference in variance between the two groups, with a value of 0.670 $p > 0.05$. These findings support the effectiveness of using YouTube video media to improve learning outcomes. YouTube-based learning in education aligns with the characteristics of vocational learning and learning styles preferred by vocational education students. This learning helps improve understanding of more visual, contextual, and practical concepts. Based on previous studies also support the combination of learning videos with vocational education because these learning videos can improve skill mastery and better prepare students for the demands of the workforce. However, this study has limitations regarding its small sample size and only focuses on one institution. It is hoped that future researchers can explore the use of YouTube-based learning media in various vocational schools or investigate its effectiveness for other vocational education

subjects. In addition, it is also hoped that subsequent researchers can research how to combine YouTube with other interactive technologies to improve learning outcomes in vocational education.

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