JVCE 9 (2) (2024) : 171-177

Journal of Vocational Career Education

https://journal.unnes.ac.id/nju/index.php/jvce

The Implementation of Interactive Media to Improve Student Achievement in Lighting and Signaling Systems

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Article Info

Article History :
Received
June 2024
Accepted
September 2024
Published
December 2024

Keywords:
interactive learning media; web-based; lighting system; feasibility; effectiveness

Abstract

Students' limited understanding of lighting systems and signaling lamps is attributed to conventional teaching methods, insufficient practical tools, and the absence of interactive learning media. This study aimed to develop, assess the feasibility, and test the effectiveness of web-based interactive learning media on the subject. The method applied Research and Development (R&D) with the ADDIE development model. The research design adopted a Pretest-Posttest Control Group Design. The validation results indicated that the media was highly feasible for use, as shown by maximum eligibility scores. The effectiveness test, comparing the control and experimental groups, showed a significant difference. The improvement in students' learning outcomes fell into the moderate category. Therefore, this learning media was proven to be both feasible and effective in enhancing students' achievement on the topic of lighting systems and signaling lamps.

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p-ISSN 2339-0344
e-ISSN 2503-2305

INTRODUCTION

Education plays a crucial role in creating a qualified human resource in the global era. Educational value shapes strong character, ethics, and individual adaptation skills toward the job field (Sanga & Wangdra, 2023). Globalization demands that students not only have technical skills but also adaptive skills such as teamwork and problem-solving (Riza & Yoto, 2023). Technology provides an opportunity and also challenges in education. However, its utilization is not optimal (Lestari, 2018).

Vocational high school has the responsibility to prepare students with the skills and competencies needed for employment. Unfortunately, many teachers still use the lecture method, so that the students tend to be passive and face difficulty understanding the materials, such as the vehicle lighting system (Wedi, 2016). This material covered various technical concepts (Achmad & Muliatna, 2013); however, less learning interaction has led to a lack of student comprehension (Ismail et al., 2023). Furthermore, the lack of sufficient practice tools becomes an obstacle in practical learning (Rahmat & Kadir, 2022).

Developing web-based interactive learning media presents a practical and effective solution. This media provides current material, flexibility in its use, and supports self-learning (Vogel et al., 2025). However, the limited infrastructure and teacher competency in using learning media become a burden that needs to be solved through training (Sulistiani et al., 2021). Based on the problem above, this research aims to develop a web-based interactive learning media in the lighting system for the XI TKRO program at State Vocational High (SMK Negeri) 5 Semarang with a focus on its feasibility and effectiveness.

Myer et al. (2024) demonstrated that a web-based bracket contest system can enhance science communication, improve conceptual understanding, and support interdisciplinary biology education. Octavina & Susanti (2021) stated that Lectora Inspire android-based media, is feasible to use in the accounting subject, with a validation percentage achieve 81,30%, 84% for media experts, and students' responses gained 93,33%. Hamonangan (2021) elaborated that interactive CDs are feasible to use and effective in improving students' motivation and learning output. Rosalina & Suhardi (2020) stated that interactive multimedia is very needed to develop learning media at school. Kenny et al (2023) elaborated that the e-learning module is feasible based on the users' and experts' judgment. Furthermore, Aydin et al. (2015) supported the result that website sources and community are more effective for blended learning (PJJ), expand materials access, and support collaboration.

This research aimed to analyze the feasibility and effectiveness of interactive learning media in a web-based lighting system to improve students' learning achievement at a vocational high school (SMK).

METHODE

Development Model

This research adopted the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. This method was selected because it has simple steps, is flexible, and appropriate for developed products (Ginantara & Aguss, 2022). The analysis covered problem identification and planning. The design included a flowchart, storyboard, and evaluation instrument. Furthermore, the development stage covered media production, expert validation, and revision. Implementation included a test for the experimental class and conventional learning for the control class. Meanwhile, the evaluation was applied to gain feedback and assess students' achievement.

Research Design and Sample

This research conducted a pre-test and post-test control group, with research subjects consisting of two classes, namely the experiment class, which applied web-based interactive learning media, and the control class that used a conventional method. The two groups were given a pre-test and a post-test to determine the influence. Research subjects are students of XI TKRO at SMKN 5 Semarang, five material experts, and five media experts.

Data Collection Technique

The data collection technique used an expert assessment sheet and multiple-choice questions. Expert judgment consists of subject matter experts and media experts. The instrument covered curriculum aspects, content, language, delivery/ presentation, and benefits. Meanwhile, media assessment consisted of user-friendly, consistent language, graphics, interactivity, and web-based content. Multiple choice is also used to assess the improvement of learning achievement based on pre-test and post-test.

Data Analysis Technique

The feasibility analysis of the media was conducted through validity and reliability testing. Content validity was assessed using the i-CVI and calculated by the following formula: i-CVI = number of experts who rated the item as relevant/total number of experts. Reliability was evaluated using the Percent Agreement formula: Percent Agreement = (agreement / (agreement + disagreement)) × 100%. The effectiveness of the media was analyzed using the N-Gain test to measure the improvement from pretest to posttest scores, calculated using the formula: (Posttest Score – Pretest Score) / (Maximum Score – Pretest Score) × 100%. Subsequently, an independent sample t-test was conducted on the N-Gain scores using SPSS version 25 to determine the difference in learning outcomes between the experimental and control classes.

RESEARCH RESULT AND DISCUSSION

Research Result

A feasibility test result was conducted by five material and media experts to determine the feasibility of web-based interactive learning media. The analysis applied CVR and CVI; the data showed a validation indicator (score ≥ 0.99), and the material was declared to be feasible. Reliability based on agreement percentage, which gained 100%, or it can be said as reliable since it passed the minimum score 80%. Furthermore, assessments by five media experts also revealed that all indicators achieved high validity scores (≥ 0.99), demonstrating that the media is valid and feasible for use. With a reliability score of 100%, the instrument meets the criteria for a dependable measurement tool.

The improvement in learning outcomes was analyzed using the N-Gain. In the control class, the N-Gain score gained 0.21 – 0.81 (average of 0.5), whereas in the experimental class, the scores ranged from 0.33 to 1.00, with an average of 0.6. A pre-test was conducted before the participants took a multiple-choice test. The result of the independent sample t-test showed that the mean score of the control class was 48.83, while that of the experimental class was 59. Levene's Test indicated that the data variances were homogeneous (Sig. = 0.136 > 0.05). The t-test result (Sig. 2-tailed = 0.08 > 0.05) revealed no significant difference between the two groups, suggesting that both classes had comparable initial abilities.

The average posttest score of the control class was 74.51, while that of the experimental class was 83.39. The Kolmogorov–Smirnov normality test indicated that the data were normally distributed (Sig. > 0.05). The researcher applied a homogeneity test using Levene's Statistic, which shows homogeneity (Sig. > 0.05). N-Gain analysis depicted an average control class of 0.5056, and the experimental class gained 0.6074. The independent sample t-test on the N-Gain scores revealed a statistically significant difference (Sig. = 0.007 < 0.05), with the experimental class achieving higher results. This finding demonstrates that web-based interactive media is more effective in improving learning outcomes on the topic of lighting and signaling systems. Based on expert judgement, developed media is feasible based on CVR, CVI, and agreement percentage. All indicators gained maximum score (CVR and CVI = 1; agreement percentage = 100%) and all indicators were declared valid and reliable.

The instructional material was deemed appropriate as it fulfilled the following aspects: (1) curriculum alignment, (2) content quality, (3) language use, (4) presentation, and (5) relevance or usefulness. The media was also considered highly feasible, meeting the criteria of: (1) ease of use, (2) consistency, (3) linguistic clarity, (4) graphic quality, (5) interactivity, and (6) web-based accessibility.

Discussion

This research is in line with Huda and Widjanarko (2020), who developed E-modul and E-jobsheet of the lighting system subject. The developed learning media was feasible based on the material and media experts, and it can improve students' achievement based on the difference between pre-test and post-test scores. Setyadi (2018) developed an interactive learning medium in the form of a teaching aid for the lighting system. The validation results indicated that the media was highly feasible, and its implementation significantly increased the number of students who passed the competency test. An interactive learning media created by Iskandar et al (2023) gained a very high score from experts, practical to use, and effective in supporting the learning process.

Octavia and Susanti (2021) demonstrated that the Lectora Inspire web-based interactive media used in accounting education was highly feasible and received positive responses from students. Huang and Macgilchrist (2024) found that IVR-based learning with virtual map class was effective in improving students' writing quality if compared to the conventional method. Myer et al. (2024) concluded that web-based bracket contest media can advance science communication, students' understanding, and support interdisciplinary biology education. Knaus (2023) emphasized the importance of learning media that align with real life because it can build competency and advance students' social skills. Suyitno (2018) developed learning tools and media that proved as feasible and had a positive impact on increasing the number of students who passed the competency test.

The effectiveness result in this study showed that there is a significant difference between the control and experimental groups. It proved that web-based interactive learning media can improve students' learning achievement in the topic of lighting and signaling systems. Frimaula and Putra (2023) stated that interactive learning media must meet valid criteria, practice, and be effective. Learning media should be aligned with the characteristics of the subject matter and students' needs, particularly for theoretical content that is typically delivered solely through textbooks. The developed tools in this study integrated texts, pictures, videos, and animations, which help the students conquer difficult material through challenging and interesting activities.

Okagbue et al. (2023) elaborated web-based learning system boosts students' engagement in the learning process, stimulates competency, and builds students' confidence in gaining knowledge and skills. Liu and Yu (2023) added that this learning system can increase learning quality and help to conquer learning challenges in this global era. Wardana and Dinasti (2024) tested learning media with supply power, involving both students and media experts. The result showed that the media is very feasible and increases students' interaction and learning effectiveness. Sibley et al. (2024) stated that technology provided asynchronous learning that can stimulate students to be active and have a positive effect on students' social behavior.

Satria et al (2023) elaborated that learning media reinforced learning flexibility and maintained students' and teachers' interaction, and it can be developed to be more interesting and interactive. Mardiana and Hadromi (2020) found that interactive media in a conventional fulfilling system improved learning output effectively through visual presentation and active learning experiences.

CONCLUSION

This result showed that web-based interactive learning media on lighting system materials and signs are feasible and effective to be used. The feasibility was confirmed through expert validation, yielding a Content Validity Index (CVI) score of 1.00 and an agreement rate of 100%. The effectiveness test employed the N-Gain analysis, while the Independent Samples t-test confirmed that the data met the assumptions of normality and homogeneity. Furthermore, the pre-test average score for the experiment class was 59.08 and increased to 83.39 at the post-test, with N-Gain achieved 0.6074 (medium category). It means that the developed media significantly improved students' learning achievement.

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