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Innovating OHS Learning Media Through Video Databases to Promote Eco-Friendly Construction Practices in MSMEs

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ABSTRAK

Latar Belakang: Rendahnya literasi Keselamatan dan Kesehatan Kerja (K3) pada sektor Usaha Mikro, Kecil, dan Menengah (UMKM) konstruksi masih menjadi tantangan karena berkontribusi terhadap meningkatnya risiko kecelakaan kerja serta rendahnya penerapan praktik konstruksi yang memperhatikan aspek lingkungan. Pengembangan media pembelajaran berbasis digital diharapkan mampu meningkatkan pemahaman pekerja mengenai K3 sekaligus mendorong penerapan konstruksi ramah lingkungan. Penelitian ini bertujuan menganalisis efektivitas media pembelajaran K3 menggunakan database video dalam meningkatkan literasi K3 pekerja UMKM konstruksi.

Metode: Penelitian ini menggunakan desain quasi-experimental dengan pendekatan *pretest-posttest control group design*. Penelitian melibatkan 60 responden yang terdiri atas 30 responden pada kelompok eksperimen dan 30 responden pada kelompok kontrol. Instrumen penelitian menggunakan skala Guttman yang telah memenuhi koefisien reproducibility >0,90. Analisis data dilakukan menggunakan uji nonparametrik Mann-Whitney U untuk membandingkan perubahan skor literasi K3 antar kelompok.

Hasil: Hasil penelitian menunjukkan terdapat perbedaan yang signifikan antara kelompok eksperimen dan kelompok kontrol setelah intervensi ($p=0,000$; $p<0,05$). Kelompok eksperimen mengalami peningkatan skor literasi K3 sebesar 24,2 poin, sedangkan kelompok kontrol hanya meningkat sebesar 4,2 poin. Peningkatan tersebut menunjukkan bahwa penggunaan media pembelajaran berbasis database video lebih efektif dibandingkan metode pembelajaran konvensional dalam meningkatkan pemahaman pekerja mengenai praktik K3 dan konstruksi ramah lingkungan.

Simpulan: Media pembelajaran K3 menggunakan database video terbukti efektif meningkatkan literasi K3 pekerja UMKM konstruksi serta mendukung penerapan praktik konstruksi yang lebih aman dan ramah lingkungan. Media digital interaktif berpotensi menjadi strategi pembelajaran berkelanjutan dalam meningkatkan budaya K3 di sektor konstruksi.

Kata kunci: konstruksi ramah lingkungan; UMKM konstruksi; literasi K3; media pembelajaran; database video

ABSTRACT

Background: Low Occupational Safety and Health (OSH) literacy among Micro, Small, and Medium Enterprises (MSMEs) in the construction sector remains a major challenge, contributing to an increased risk of occupational accidents and the limited implementation of environmentally sustainable construction practices. The development of digital learning media is expected to enhance workers' understanding of OSH while promoting environmentally friendly construction practices. This study aimed to evaluate the effectiveness of an OSH learning medium based on a video database in improving OSH literacy among construction MSME workers.

Methods: This study employed a quasi-experimental design using a pretest-posttest control group approach. A total of 60 respondents participated in the study, comprising 30 workers in the experimental group and 30 workers in the control group. The research instrument is developed using the Guttman scale and demonstrated a coefficient of reproducibility greater than 0.90. Data were analyzed using the nonparametric Mann-Whitney U test to compare changes in OSH literacy scores between the two groups.

Results: The findings revealed a statistically significant difference between the experimental and control groups after the intervention ($p<0.001$). The experimental group demonstrated an increase of 24.2 points in OSH literacy scores, whereas the control group showed an increase of only 4.2 points. These findings indicate that the video database-based learning medium was more effective than conventional learning methods in improving workers' understanding of occupational safety and health practices and environmentally sustainable construction.

Conclusion: The video database-based OSH learning medium was effective in improving OSH literacy among construction MSME workers and supporting the implementation of safer and more environmentally sustainable construction practices. Interactive digital learning media have the potential to serve as a sustainable educational strategy for strengthening the occupational safety culture in the construction sector.

Keywords: Green Construction, Eco-Friendly Construction ; OSH literacy; learning media; database video

INTRODUCTION

Occupational Safety and Health (OSH) is a fundamental aspect of construction activities that not only concerns worker protection but also contributes to the development of sustainable and environmentally friendly construction practices. In the Micro, Small, and Medium Enterprises (MSME) sector, implementing OSH principles still faces various challenges, including low worker literacy, limited resources, and a lack of effective, context-specific learning materials. Data from the Ministry of Manpower in 2023 indicate that more than 35% of national occupational accident cases occurred in the construction sector, with the majority involving informal or MSME workers.¹ This condition not only poses safety risks but also leads to resource-intensive construction practices that have the potential to cause environmental pollution.

In the context of sustainable development, implementing Occupational Safety and Health (OSH) standards is a strategic means of supporting green construction. Sound safety practices have been proven to reduce material waste, minimize emissions, and create a more efficient, cleaner work environment². This emphasizes that the implementation of risk analysis and mitigation strategies in green construction projects significantly contributes to energy efficiency and construction waste management. Similar findings were reported by Lingard et al., who highlighted that a strong safety culture on construction sites not only protects workers but also enhances collaboration and productivity, forming the foundation of sustainable construction practices³.

For the MSME sector, integrating OSH principles with environmentally friendly construction practices remains a major challenge. Limited resources and restricted access to formal training have contributed to low OSH literacy among field workers. Therefore, a simple, engaging, and easily accessible learning approach is needed. Research by Safitri and Wahyuningsih showed that use of tutorial videos significantly improved workers' knowledge of safe behavior in the informal sector⁴. These results are consistent with the findings of Arsana, who developed OSH learning videos for engineering students and demonstrated their effectiveness in enhancing conceptual understanding and awareness of potential workplace hazards⁵.

Moreover, Arthur emphasized that animation-based video learning media can enhance participant engagement and improve OSH information retention by up to twice that of conventional text-based methods⁶. Similar findings were reported by Wahrini and Peng, who developed interactive OSH video-based media using the 4-D model for vocational high school students in the construction program. The media proved effective in conceptualizing safe work procedures through contextual simulations that closely resemble on-site situations⁷. Furthermore, Wahrini reinforced these findings through a follow-up study based on the ADDIE model, in which OSH video media not only enhanced conceptual understanding but also motivated participants to apply safety practices in their daily work activities.

From the perspective of construction education, Mendrova also demonstrated that instructional videos in introductory construction courses can enhance students' practical thinking skills and strengthen the connection between theoretical knowledge and field practice⁸. This indicates that visual-based media innovations have significant potential for application in OSH training for MSME construction workers, who tend to learn best through practical, hands-on experience.

Furthermore, an international study by Mohandes, along with recent research in China on factors influencing green construction practices, indicates that the successful implementation of sustainable construction depends heavily on workers' awareness and behavior regarding safety and environmental issues⁹. In other words, improving OSH literacy among grassroots workers is a crucial foundation for developing a greener and more competitive construction sector.

Based on these conditions and empirical findings, video-based OSH learning media is a strategic innovation that not only effective understanding and safe behavior among MSME workers but also has potential to strengthen the implementation of environmentally friendly construction practices. Therefore, this study aims to develop and test the effectiveness of database-driven video OSH learning media in promoting sustainable construction practices within the MSME sector. Through this approach, the research is expected to produce an interactive, efficient, and field-relevant learning model capable of supporting the enhancement of OSH culture while raising environmental sustainability awareness in small-scale construction.

MATERIALS AND METHODS

This study employed a quasi-experimental approach using a pretest-posttest control group design to examine the effectiveness of database-driven video OSH learning media in enhancing OSH literacy and promoting awareness of environmentally friendly construction practices among MSME construction workers. The research was conducted from June to September 2025 at several small construction project sites in the Tegal Regency, Central Java.

The study population consisted of all workers involved in MSME construction activities in the area. The inclusion criteria were: (1) actively working for at least six months, (2) willing to participate in the program and evaluations, and (3) able to read and write. Based on the minimum sample size calculation and considering

resource limitations, a total of 60 respondents were selected as the study sample. Participants were randomly assigned to two groups: the experimental group (n = 30) and the control group (n = 30).

The study variables comprised two main components. First, the independent variable was the use of database-based video OSH learning media containing materials on safety procedures, resource efficiency, construction waste management, and the application of green construction principles. Second, the dependent variables were workers' OSH literacy and environmental awareness, measured through tests assessing knowledge and understanding of safety procedures, the use of personal protective equipment, hazard identification, and the implementation of green construction concepts on-site.

The research instrument used a Guttman-scale questionnaire that had undergone content validity assessment by OSH and environmental experts, as well as reliability testing, yielding a reproducibility coefficient (CR) > 0.90, indicating excellent reliability. Data collection was carried out in three stages: (1) a pre-test to assess baseline OSH literacy and environmental awareness before the intervention, (2) an intervention in which the experimental group received two weeks of learning using the database-based video media presenting educational content on workplace safety and sustainable construction practices, and (3) a post-test to evaluate changes in knowledge and awareness after the intervention. The control group received only conventional instruction through lectures and OSH leaflets without environmental content.

Data analysis was conducted both descriptively and inferentially. Normality tests using Shapiro-Wilk and Kolmogorov-Smirnov tests indicated that the data were not normally distributed ($p < 0.05$); therefore, a nonparametric analysis using the Mann-Whitney U test was applied to compare the differences in change scores between the experimental and control groups.

This study obtained ethical clearance from the Research Ethics Committee of Universitas Bhamada Slawi (letter No. 011/KEPK-UBS/I/2025), confirming that all research procedures complied with ethical principles for human subjects' research.

RESULTS AND DISCUSSION

This study aims to evaluate the effectiveness of database-driven video OSH learning media in improving the occupational safety and health (OSH) literacy of MSME construction workers. The evaluation focuses on how video-based instructional materials, supported by a structured database system, influence workers' understanding of workplace hazards and safe work practices. In addition, the study examines whether exposure to these learning media is associated with higher levels of environmental awareness, particularly regarding waste management and sustainable construction behavior. The findings are expected to provide insights in how digital learning interventions can enhance safety culture in small-scale construction settings. Overall, this study highlights the potential of accessible technology-based media to strengthen OSH competence among workers who often have limited access to formal safety training.

Results

This study aimed to evaluate the effectiveness of an innovative database-driven video learning media in enhancing Occupational Safety and Health (OSH) literacy and environmental awareness among Micro, Small, and Medium Enterprise (MSME) workers in the construction sector. Before analyzing the intervention effects, the characteristics of the respondents were examined to ensure comparability between the experimental and control groups. Table 1 presents the demographic and occupational profiles of the 60 participants, including age, gender, education level, and years of work experience. Understanding these characteristics is important to interpret the results and ensure that any observed differences are not due to demographic disparities.

Table 1. Respondent Characteristics

Characteristic	Experimental Group (n = 30)	Control Group (n = 30)
Age (years), Mean $\pm$ SD	32.4 $\pm$ 5.1	31.9 $\pm$ 4.8
Education Level		
Primary	10	11
Secondary	15	14
Tertiary	5	5
Work Experience (years), Mean $\pm$ SD	7.2 $\pm$ 3.4	6.9 $\pm$ 3.2

Before the intervention, pre-test results indicated that OSH literacy and environmental awareness levels were relatively similar between the two groups, with mean scores of 58.2 for the experimental group and 57.9 for the control group. This equivalence demonstrates that the initial capabilities of both groups were homogeneous, making them suitable for comparison in assessing the effectiveness of the developed learning media. After a two-week intervention using the database-driven platform that integrated OSH concepts with environmentally friendly construction practices, the experimental group showed substantial improvement. The post-test results indicated an average score increase to 82.4, with a gain (Δ) of +24.2 points. In contrast, the control group, which received conventional learning methods, showed only a slight improvement, with an average post-test score of 62.1 and a Δ of +4.2 points.

Table 2. Comparison of OSH Literacy and Environmental Awareness Scores between Experimental and Control Groups

Group	Pre-test (Mean $\pm$ SD)	Post-test (Mean $\pm$ SD)	Delta (Mean)
Experimental (n=30)	58.2 $\pm$ 6.5	82.4 $\pm$ 5.8	+24.2
Control (n=30)	57.9 $\pm$ 6.2	62.1 $\pm$ 6.0	+4.2

Table 2 shows that the pre-test mean scores of the experimental group (58.2 $\pm$ 6.5) and the control group (57.9 $\pm$ 6.2) were comparable. Following the intervention, the experimental group achieved a higher post-test mean score (82.4 $\pm$ 5.8) than the control group (62.1 $\pm$ 6.0). The overall literacy score increased by 24.2 points in the experimental group, whereas the control group showed an increase of only 4.2 points.

The questionnaire measured overall Occupational Safety and Health (OSH) literacy and environmental awareness through several domains, including safety procedures, personal protective equipment (PPE), hazard identification, and environmentally friendly construction practices. The results presented in Table 2 represent the overall literacy score across all assessed domains.

Normality tests using Shapiro–Wilk and Kolmogorov–Smirnov indicated that the data were not normally distributed ($p < 0.05$). Therefore, the nonparametric Mann–Whitney U test was used to compare the change scores (Δ) between the groups.

Table 3. Mann–Whitney U Test Results for Differences in Δ Scores of OSH Literacy and Environmental Awareness

Null Hypothesis	Test Type	Sig. (p-value)	Decision
The distribution of Δ is the same for both groups	Mann–Whitney U (Independent Sample)	0.000	Reject H_0

A p-value of 0.000 (< 0.05) indicates a significant difference between the experimental and control groups. Thus, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, meaning that the use of database-driven video learning media significantly improved OSH literacy and environmental awareness among MSME construction workers.

Discussion

1. Effectiveness of Video-Based Learning Media on OSH Literacy

The significant improvement observed in the experimental group indicates using database-driven video media effectively enhances learners’ understanding of occupational safety principles. This media also strengthens awareness of the importance of sustainable environmental management in workplace settings. These outcomes align with Lingard and Pink’s findings, which highlight the effectiveness of participatory video approaches and digital pedagogy in promoting collaborative learning cultures. Their studies further demonstrate that digital media can substantially increase OSH awareness on-site by encouraging workers to engage more actively with safety-related content.¹¹

Similar conclusions were reported by Kassem, who found that virtual environments and interactive videos help workers visualize workplace risks more clearly, thereby improving engagement in safety learning. Research by Wahrini and Hasbi at the secondary education level also showed that instructional videos significantly boost learning motivation among vocational high school students. These results reinforce the notion that video-based media is highly engaging and enhances knowledge retention across diverse learner groups. Together, these studies demonstrate that video instruction is not only attractive but also pedagogically effective in enhancing learning outcomes^{13,14}.

Further support comes from Ahn and Seo, who revealed that interactive elements in video-based safety training and immersive virtual reality (VR) environments can enhance construction workers’ personal competencies. Their findings suggest that higher levels of interactivity promote deeper cognitive processing and more effective learning transfer. Yusuf’s research also confirmed that multimedia- and computer-vision-based learning models significantly improve conceptual understanding and practical performance in construction engineering education. In line with this, Prima Putra reported very high validity and reliability ($R^2 \geq 0.7$) in the interactive video learning

media developed for OSH subjects at SMK Negeri 1 Batipuh, indicating its suitability for strengthening OSH-related behavior.

2. Strengthening Environmental Awareness through Digital Media

The integration of video content showcasing green construction practices such as waste management, energy efficiency, and environmentally friendly PPE helps shape workers' perceptions of the connection between safety and environmental sustainability. Research by Alherimi et al. shows that employees' pro-environmental behaviors increase significantly when organizations provide interactive and contextually relevant training¹⁵. Similar findings were reported by Wu et al., who found that environmental awareness training can strengthen green innovation performance through mechanisms of knowledge sharing and the habituation of sustainable behaviors^{16,17}.

Furthermore, Silvestru et al. demonstrated that sustainability has a direct impact on the competitiveness of construction workforce¹⁸. Meanwhile, Eid found a strong relationship between environmental awareness and the implementation of total quality management in construction companies¹⁹.

The relationship between digital learning and the development of a safety-sustainability culture was also examined by Addy, who highlighted that the integration of technologies such as virtual reality into safety training can enhance workers' risk perception and environmental awareness²⁰.

Further, Alshammari et al. demonstrated that managers' perceptions of safety and environmental issues strongly influence workers' safe behavior by enhancing their awareness and competencies²¹. Thus, human factors and organizational support are key elements in strengthening the impact of digital learning media.

3. Implications for the MSME Construction Sector

Practically, this study demonstrates that database-driven video OSH learning media has significant potential for implementation in safety and environmental training programs within the small-scale construction sector.

The use of digital media enables interactive, flexible, and contextualized learning an essential need for MSMEs, which generally face resource constraints. This aligns with Baek's findings, which highlighted a skills gap in sustainability between the construction industry and educational institutions.²² This aligns with Baek's findings, which highlighted a skills gap in sustainability between the construction industry and educational institutions.²² Additionally, Bashir et al. emphasized the importance of sustainable social practices as part of building a resilient construction sector²³.

Furthermore, several recent studies reinforce the urgency of developing digital media for OSH learning. Wahrini & Chua found that video learning media for OSH subjects in vocational high schools achieved a very high feasibility rate (approximately 89%), making it an effective instructional tool. Shamsudin & Majid, through a meta-analysis, demonstrated that virtual reality-based learning environments are significantly more effective than conventional methods in identifying construction hazards²⁴. Putriwardani & Susilawati emphasized that digital technology plays a crucial role in ensuring construction safety in Indonesia, particularly in supporting national OSH policies²⁵. Faisal & Fansuri also concluded that digital transformation offers significant opportunities for implementing data-driven construction safety technologies in Indonesia²⁶. Meanwhile, Weimintoro et al. demonstrated that OSH outreach and training programs in vocational high schools can enhance awareness and the implementation of OSH practices within the vocational education environment²⁷.

CONCLUSION

This study concludes that the innovative database-driven video learning media for Occupational Safety and Health (OSH) is proven effective not only in enhancing OSH literacy but also in promoting environmental awareness and the application of green construction principles among MSME construction workers. Based on the Mann-Whitney U test results ($p = 0.000 < 0.05$), there was a significant difference between the experimental and control groups in the improvement of OSH literacy and environmental awareness scores. Workers who participated in the video database learning experienced an average score increase of +24.2 points, substantially higher than the control group, which showed an improvement of only +4.2 points.

These findings indicate that integrating OSH content with topics in resource efficiency, waste management, and green construction practices within video-based media can strengthen understanding, knowledge retention, and foster safer and more environmentally conscious work behaviors.

Overall, this study confirms that the application of digital technology through video-based learning can serve as an innovative solution to the limitations of conventional training in the MSME construction sector. In addition to enhancing workplace safety literacy, database-driven video learning media can drive a transformation toward a safe, efficient, and sustainable work culture. Therefore, the results of this study are expected to provide a foundation for developing digital training models that support environmentally friendly construction practices in small- and medium-sized enterprises.

CONCLUSION

This study concludes that the database-driven video learning media is effective in improving Occupational Safety and Health (OSH) literacy and environmental awareness among construction workers in Micro, Small, and Medium Enterprises (MSMEs). The intervention resulted in a significantly greater increase in overall literacy scores in the experimental group than in the control group, indicating that digital video-based learning is more

effective than conventional instructional methods. Furthermore, integrating OSH materials with environmentally friendly construction concepts, including resource efficiency, waste management, and green construction practices, supports workers' understanding of safer and more sustainable construction practices. These findings suggest that database-driven video learning media can serve as an innovative and sustainable educational strategy to strengthen OSH culture and promote environmentally responsible construction practices in the MSME sector.

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