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The Analysis of Safety Behavior in Construction Project

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ABSTRACT

The purpose of this study was to determine the effect of using videos and safety games packaged on mobile phones on work safety behavior. The quasi-experimental research method uses learning media through videos, safety games, and work experience. The dependent variable is work safety behavior, while age and education are covariates. Sampling as respondents using purposive sampling with a sample size of 60. This analysis uses ANOVA. The result of this research is that the learning media in the form of video significantly affects the perception of work safety (sig. < 0.05). Video is the best learning media between the combination of safety-game and video-safety-game in providing a perception of safety behavior with a mean = 3.494. The results of this study contribute to implementing safety training in the field. Video is a learning media that increases knowledge about work safety to reduce the incidence of work injuries.

Keywords: Media learning; Project management work; Safety behavior; Training

1. Introduction

Implementing construction projects limited by time, quality, and cost makes workers experience physical and psychological pressure to carry out their work. In addition, workers on construction projects in Indonesia have a primary and junior secondary education level of 79.68%. Lack of safety training, young age, and a stressful work environment make workers behave unsafely [1-3]. So, construction projects in the field have a high risk of work accidents. Dangerous behavior and conditions are the root causes of accidents [4]. Of the causes of accidents, 88%

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are dangerous behaviors, 10% are dangerous conditions, and 2% are preventable [5].

Work safety programs in the field on construction projects must be implemented. To succeed in the work safety program, work safety training is required. Effective training programs improve safety performance [6], and inadequate safety training contributes to construction project accident rates [7]. Safety training with communication through written and oral forms is less effective [8]. Work safety training with various learning media affects the understanding of workplace safety. Information and communication technology are essential in transferring knowledge in safety training. Previous research on learning media in occupational safety training is the use of learning media with video and television [9], multiuser virtual safety training system [5], three-dimensional visualization [10], immersive virtual reality [11], augmented reality panorama [12], and naturalistic injury simulation (NIS) [13]. Research results with various learning media can increase knowledge of work safety. Occupational safety training in Indonesia is generally carried out formally in high school and diploma education.

Meanwhile, there is still little non-formal training. For construction workers who like to use cell phones during their break, the role of cell phones is essential for learning media. Therefore, this study provides non-formal safety training using video and work safety games on mobile phones. So, learning media with interactive and learner-centered technology will improve training performance [5, 14]. The purpose of this study is to determine the effect of learning media in the form of videos and safety games on work safety attitudes carried out by workers on construction projects.

2. Materials and Methods

The learning media in this study used video and safety games. The two learning medias serve as treatment for workers in construction projects. Learning media contains work safety in construction projects.

Table 1. Experimental design block.

Work experience	Learning media			
	O	A	B	C
≤ 5 years	5	5	5	5
between 5 to 10 years	5	5	5	5
≥ 10 years	5	5	5	5

Note: O: No treatment**,** A: Video, B: Safety game, C: Video-safety game mix.

The research method uses a quasi-experimental approach. This experimental design was chosen because it was impossible to control all the related variables in a closed space. The treatments used in this study were learning media (video and safety games) and work experience (work experience < 5 years, five years to ten years work experience > 10 years) (Table 1). The independent variable in this study is the treatment of learning media and experience, while the dependent variable is work safety behavior. The variable measured in this study is the work safety behavior variable. The work safety behavior variable consists of 11 indicators (Table 2).

Table 2. Mean of safety behaviors.

Safety behaviour indicators	Mean	Standard Deviation	References
Using of personal protective equipment	4.07	0.70	[2, 19, 20]
Occupational safety communication	2.77	0.72	[8, 17]
Using of tools according to the procedure	2.40	0.99	[2, 21]
No kidding	2.93	1.22	[22]
Report unsafe situation	2.87	0.92	[13, 23]
Don't touch	2.80	0.63	[24]
Walking according to the specified path	3.60	0.74	[24, 25]
Concentration on work	3.20	0.68	[20, 22, 25]
Obey safety signs	2.07	0.88	[24, 26]
Don't play with work equipment	3.80	0.68	[22, 24]
It doesn't interfere with the operation of dangerous tools	3.73	0.88	[22, 25]

Data collection by questionnaire was done once per group. Covariates in experimental research are age and education level. The covariate variable serves to reduce noise (as a control variable). Age levels consist of ages < 36 years and ≥ 36 years. Meanwhile, the education level is below junior high school and high school. Sampling used purposive sampling, with the respondents being construction project workers. The number of objects for each treatment is 15 respondents, and the number of objects per group observed is five respondents, so the actual object as a total sample is 60 respondents. The experimental design in this study is shown in Table 1. The measurement scale uses a Likert scale of 1 to 5. The data collection uses a questionnaire, and the occupational safety behavior variable is formed with 11 indicators, as shown in Table 2. The eleven indicators consist of 13 questions (Appendix 1). Meanwhile, the assessment of work safety behavior variables is never = 1.00 - 1.8, seldom = 1.81 - 2.60, sometimes = 2.61 - 3.40, often = 3.41 - 4.2 = often and always = 4.21 - 5.00.

The analysis in this study uses a two-way analysis of variance (ANOVA) with SPSS (Statistical Package for the Social Sciences). The reason for using a two-way ANOVA is that it can determine the significance level of differences in the mean of sample groups or more with two influencing factors. The assumption used to analyze variance is that the data distribution follows a normal distribution. The variance of each treatment must be homogeneous, the data between replications in each treatment must be freely distributed, and each treatment must have repetition [15].

3. Results and Discussion

The profile of the workforce as research respondents totaling 60 respondents is high school education 28.33% and elementary school and junior high school 71.67%. Meanwhile, the profile of respondents based on the age of under thirty-six years is 86.67%, while the age of more than thirty-six years is 13.33%. Based on the education level of the respondents, most of whom are from elementary and junior high schools, the respondents have minimal knowledge about work safety in construction projects. Based on the age of the respondents, most of them are less than thirty-six years old; at that age is an early adult period full of psychological problems and high levels of emotional tension. The profile of education and age shows that workers in the construction sector are very susceptible to work accidents. Based on the profile of workers in construction projects, it is in line with the results of research which explains that low levels of education tend to have a high risk of work accidents [16].

This study consisted of 11 indicators of work safety, as shown in Table 2. Before treatment, there were six indicators with the criterion of sometimes being used (mean 2.61-3.4). A minor means of work safety indicators is work safety communication. Work safety communication in question is that workers rarely discuss safety with fellow friends or safety officers. In addition, workers seldom remind their friends when facing dangerous conditions. At the same time, safety communication is something significant [17]. Then, the indicator with the second-lowest mean value is the use of equipment that does not follow standard operating procedures (SOP). Violating work procedures is poor work safety behaviour and endangers the safety of workers [18]. The third lowest mean indicator is that workers pay less attention to safety signs and jokes while working, even though safety officers provide a briefing on work safety every day before work. The fourth lowest mean indicator is touching between friends at work. The next lowest indicator is not joking and not reporting unsafe conditions in the workplace. Reporting hazardous conditions to safety officers is an essential form of communication in reducing the risk of accidents. Emotions affect workers' behaviour; some workers who experience work pressure make jokes, making them unable to concentrate on their work [17]. These six

indicators (criteria sometimes) are work safety behaviours that must be considered because work safety behaviour is the cause of significant cause of workplace accidents [1].

In Table 3, there is a tendency to increase changes in perceptions of work safety behavior after being given training participants compared to before being given training. Video treatment, safety games, and a combination of both provide good changes to the perception of work safety. Dominant workers with primary and secondary education find it easier to understand work safety through videos with basic education levels. The treatment in the video had the highest total average compared to other treatments. After being given treatment, the perception of work safety behavior with less than five years of work experience tends to be higher than those of 5 to 10 years of work experience. Given the video treatment, the perception of work safety tends to decrease and increase work experience. On the other hand, by providing safety game treatment to workers, their perception of work safety tends to increase and increase work experience. Meanwhile, for work experience of fewer than five years, a combination of video treatment and safety games, the perception of work safety tends to be higher than work experience of more than five years.

Table 3 explains that the treatment of safety games through mobile phones gives the lowest mean value compared to other treatments. The literacy barrier is the challenge of using safety games with mobile phones in this experiment. Literacy barriers are caused by the dominant elementary and junior high school education levels [27]. Based on this analysis, worker safety behavior is influenced by education and work experience. The video treatment resulted in the most significant mean related to the perception of work safety behavior. Learning media with training videos can increase workplace safety awareness and improve worker safety behavior. Videos packaged on mobile phones are easily understood by workers [27, 28]. Workers' level of education can reduce human error, with a high level of education having a risk of death due to work accidents. Therefore, the level of education is controlled to prevent work accidents [30].

Table 3. Mean of safety behaviour variable.

Learn_med	Experience (year)	Mean	Total Mean
	Exp<5	2.923	
No Video_Safgame	5≤ Exp<10	2.883	3.013
	≥10	3.231	
	Exp<5	3.558	
Video	5≤ Exp<10	3.462	3.494
	≥10	3.462	
	Exp<5	3.077	
Safgame	5≤ Exp<10	3.077	3.090
	≥10	3.116	
	Exp<5	3.308	
Video_Safgame	5≤ Exp<10	3.099	3.195
	≥10	3.179	

The results of the questionnaire validity test for 13 questions had a sig value (2 tailed) < 0.05, while the results of the questionnaire reliability test value Cronbach's alpha = 0.621 > 0.6. Based on the test results, it is explained that the questionnaire has validity and reliability. Prerequisites before performing ANOVA analysis are normality test, homogeneity test, and independence test. The normality test uses the Kolmogorov-Smirnov test, the value of sig (2 tailed) = 0.200 > 0.05, and the significance value explains the measurement data of the normal distribution. Homogeneity test using Levene's trial, the value of sig = 0.139 > 0.05, then the information has homogeneous properties. While the independence test uses the Lagrange multiplier test method, the calculated value 2 = 9.72< χ^2 table (77.931), it

can be concluded that there is no correlation between the measurement data. Table 4 explains that the perception of work safety behaviour can be explained by the safety training model using learning media, experience (length of work), age, education, and learning-experience media interactions by 59.3% (sig < 0.05). Learning media treatment affects work safety behavior (sig. 0.045 < 0.05). Learning media (videos and safety games) packaged in mobile phones are interactive and easy-to-understand learning technologies. In addition, learning media with interactive technology that is human-centered satisfies its users [6, 14, 31]. The success of responding to learning is needed in the construction industry. Therefore, technology to access information about workplace safety is essential [32]. Generally, occupational safety training using slides and written handouts does not facilitate participants' emotions in acquiring new knowledge [8], so learning media has an essential role in increasing understanding of work safety. Age and education significantly affect the perception of work safety behavior (sig. < 0.05). Most construction workers are less than 36 years old and have a low level of education (primary and secondary), so appropriate learning media are needed. Workers with low education usually do not prioritize work safety [20, 33]. Skills and expertise are essential in influencing safety attitudes in the workplace. For workers with low levels of education, the curriculum does not contain learning about workplace safety, and workers who have never received safety training are at high risk of workplace accidents. Workers who drop out of school and have low levels of education are at high risk of injury due to work accidents [34]. Therefore, work safety knowledge is necessary to improve worker safety behaviour. Therefore, the importance of training with video media and safety games that are packaged interactively to increase understanding of work safety [13, 35, 36]. The increasing understanding of workplace safety affects workers' safety behavior because human factors are the leading cause of accidents on construction projects [37, 38]. Experience (length of work) of workers has no significant effect (sig.> 0.05) on perceptions of work safety during training. The interaction of learning media and workers' experience has no significant effect on the perception of work safety behavior (sig > 0.05). Workers with long tenure tend to be psychologically less enthusiastic about safety training, so understanding work safety behavior is not good, even though the learning media is easy and interactive. Therefore, the psychology of less enthusiastic workers about participating in the training has a very important role.

Subsequent analysis using the Tukey test, as shown in Table 5, explains the difference in the mean of video treatment with no treatment by-0.550, while the difference in the mean of video-safety games combination without treatment is -0.248. The minus sign explains that the presence of video treatment and the combination of video-safety games significantly increases the understanding of the perception of work safety behavior (sig.<0.05). At the same time, the safety-game treatment did not significantly increase the perception of work safety behavior (sig > 0.05).

Table 4. Tests of between-subjects effects.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.416[a]	13	.263	5.157	.000
Intercept	31.066	1	31.066	609.657	.000
Age	.30	1	.300	5.895	.019
Education	.546	1	.546	10.706	.002
Learn_med	0.444	3	.148	2.902	.045
Experience	.114	2	.057	1.118	.336
Learn_med * Experience	.292	6	.049	0.955	.466
Error	2.344	46	.051		
Total	610.255	60			

Corrected Total	5.760	59	

a. R Squared = .593 (Adjusted R Squared = .478)

Table 5. The results of paired mean comparison of learning media.

Learn med (I)	Learn med (J)	Mean Difference (I-J)	Standard Error	Sig
No Video Safgame	Video	-.550*	.0885	.000
	Safgame	-.150*	.0885	.335
	Video Safgame	-.248*	.0885	.035
Video	No Video Safgame	.550*	.0885	.000
	Safgame	.400*	.0885	.000
	Video Safgame	.303*	.0885	.006
Safgame	No Video Safgame	.150*	.0885	.335
	Video	-.400*	.0885	.000
	Video Safgame	-.098	.0885	.690
Video Safgame	No Video Safgame	.248*	.0885	.035
	Video	-.303*	.0885	.006
	Safgame	.098	.0885	.690

Description: The asterisk (*) denotes statistically significant differences in means at the 0.05 level.

In Table 5, the learning media in the form of safety and video safety games had no difference in perception results using the Tukey test. The perception of the two treatments, namely safety and video safety game, does not have a significant difference; this is because workers find it difficult (not used to using cellphones) to operate cellphones as a game medium, so workers' perceptions are less focused on understanding work safety material. Apart from that, workers also prefer to avoid playing games on cell phones.

The difference in the mean of video treatment with other treatments is positive. The video treatment significantly impacts perceptions of work safety behavior (sig. < 0.05) or is the best among other treatments. The video treatment in this experiment is because workers with low education easily understand the video. Workers with low levels of education have less ability to analyze work safety. Based on this analysis, it is explained that learning media in occupational safety training has a significant role in increasing perceptions of work safety behavior. Because most construction workers have low education, workers prefer learning media that make it easier to understand work safety. Therefore, the challenge in communicating work safety is caused by literacy barriers [14]. The project manager must be able to motivate workers to continue learning that work safety is a mandatory requirement. The success of implementing safety training depends on the participants' motivation. In addition, the use of videos in safety training must be designed with exciting materials, and also the management must support and prepare the training [39].

4. Conclusion

Based on the results of the discussion in this research, safety training on construction projects using learning media using videos packaged on cell phones provides the best understanding of work safety behavior compared to safety games packaged on cell phones and a combination of both.

The weakness of this research is the need for a larger sample size and grouping of respondents based on age and education level as treatment objects in experimental research. Suggestions for further research include adding non-formal education variables like cellphone-based work safety training and workers' length of work (experience) as independent variables. Apart from that, other work safety indicators need to be added as dependent variables.

Suggestions for further research include adding non-formal education variables in the form of cellphone-based work safety training and workers' length of work (experience) as independent variables. Apart from that, other work safety indicators need to be added as dependent variables.

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