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Development of Android-Based Occupational Safety and Health Learning Media to Improve Understanding of Work Accidents for Vocational High School Students

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ABSTRACT

This research is based on the high risk of accidents faced by SMK students in the engineering and vocational fields, as well as the need to understand K3 principles before entering the world of work. This research aims to develop Android-based learning media to improve Vocational High School (SMK) students' understanding of occupational safety and health (OHS). This research is descriptive quantitative research using Research and Development (R&D) research design with the ADDIE development model, which consists of five stages namely analysis, design, development, implementation, and evaluation. The research subjects were 72 grade XI students at SMK Muhammadiyah 2 Tempel, selected based on their involvement in industrial work practices. Data were collected through observation, interviews, questionnaires, and tests, with instruments in the form of observation guidelines, interview guidelines, questionnaires, and test sheets. Data analysis was carried out descriptively and inferentially to assess the effectiveness of the media, with a t-test to determine the difference in students OHS understanding before and after using the media. The results showed that this Android-based media significantly improved students OHS understanding, indicated by an increase in the comprehension test score from 60% to 85%. As many as 92% of students felt that their understanding of OHS materials had improved, and 88% of students stated that this media was easy to use. The impact of this research contributes to improving the quality of vocational education, especially in preparing students for safety risks in the work environment, as well as improving students' digital literacy. The findings provide practical implications for the development of technology-based learning media relevant to industry needs and are expected to serve as a model for other educational institutions in improving students OHS understanding.

Keywords: Android-Based Occupational, Safety and Health, Learning Media, Improve understanding of Work Accidents, Automotive

INTRODUCTION

Occupational safety and health (OHS) is a key pillar in modern industry, especially in the context of vocational education at Vocational High Schools (SMK). Students in SMK, especially those involved in engineering and vocational fields, face a high risk of work-related accidents if they do not have adequate knowledge of OHS. According to Yadav et al. [1], the high incidence of accidents among the young workforce highlights the importance of a strong understanding of OHS principles. Research shows that effective OHS education can reduce the risk of accidents and increase safety awareness in the work environment [2][3]. Therefore, it is important to develop learning methods that can improve students' understanding of the risks they face in the world of work.

One promising approach is the development of Android-based learning media for OHS. Android-based media offers great flexibility and accessibility, allowing students to learn anytime and anywhere [4]. Mobile applications can provide relevant and up-to-date information on OHS procedures and display accident risk scenarios interactively. Research by Cahyono shows that the use of mobile applications in learning can increase student engagement, which leads to increased understanding of the material being taught [5]. By utilizing this technology, students are expected to more easily assimilate OHS knowledge and apply it in practice.

Android-based learning media also allows the integration of interactive features such as quizzes, simulations and case studies. These features not only help students receive information, but also practice and test their knowledge directly [6][7]. Through simulations, students can experience and understand real risks that may occur in the work environment, as well as learn how to identify and manage these risks. Research by Deng et al., [8] showed that this approach can sensitize students to potential hazards, as well as improve their readiness in dealing with risky situations. Therefore, the development of an Android-based OSH application is highly relevant in the context of education in vocational schools.

The importance of effective OHS learning is reflected in statistical data showing the high rate of work accidents in various industrial sectors. According to data from the International Labor Organization (ILO), approximately 2.78 million workers die each year due to occupational accidents and related diseases [9][10]. In addition, more than 374 million workers experience minor to serious occupational accidents. These figures indicate the need to improve OHS education and training among vocational students so that they are better prepared for the risky world of work. This is in line with the research findings, who emphasized the need for a more responsive and integrated OHS education program in the vocational curriculum [11][12].

The development of Android-based OHS learning media is expected to overcome the problem of students' lack of understanding of accident risks. By utilizing technology that is familiar to students, it is hoped that they will be more motivated to learn OHS independently. Some research results show that learning that utilizes technology tends to increase students' motivation and help them develop a proactive attitude towards safety [11][13]. Through this app, students can explore various aspects of OHS, including how to identify hazards, risk assessment and appropriate preventive measures. This is an important step towards building a safety culture among the younger generation.

The success of an Android-based OHS learning application is highly dependent on an attractive and easy-to-use interface design. Intuitive design in educational applications has an impact on students who do not feel burdened while learning [14]. A well-designed app can facilitate an enjoyable and effective learning process, allowing students to grasp OHS content more quickly. In addition, the immediate feedback feature in the app can help students evaluate their understanding in real-time. Therefore, the development of an Android-based OHS application must pay attention to the design and user interaction aspects as a whole [15][16].

Through the development of Android-based OHS learning media, it is expected that vocational students will be better prepared to face the risk of accidents in the work environment. Students not only gain theoretical knowledge, but also relevant practical skills to manage risks. Students' active involvement in the OHS learning process can improve their level of understanding [17][18]. In this context, Android-based applications serve not only as a source of information, but also as an interactive tool that supports a more in-depth learning process. By understanding and applying OHS principles, students are expected to be more confident and ready to enter the workforce.

In the current digital era, the use of application-based learning media that integrates simulation and real-time evaluation is expected to provide a more in-depth and interesting learning experience for students. The novelty of this research lies in the use of technology as a means to improve OHS awareness and skills effectively and efficiently, which has not been widely applied in the context of vocational education in Indonesia. Thus, the results of this study have the potential to become an innovative model for other educational institutions in improving occupational safety in the future and anticipating the need for a workforce that has a strong understanding of OHS [19][20].

The purpose of this research is to design and develop an application-based learning media that can increase OHS (Occupational Safety and Health) awareness and skills among SMK students, so that they have a better understanding of safety in the workplace. In addition, this research also

aims to measure the effectiveness of the application in influencing students' knowledge and attitude towards OHS. Some of the research questions to be answered are: (a) How effective is this app-based learning media in improving students' understanding and awareness of OSH? (b) Can this media improve students' skills in applying OSH principles in the school environment and the workplace? (c) How do students respond to the use of this app as a learning media? By answering these questions, it is hoped that this research will not only contribute to the development of effective OHS learning media, but also become a reference for other educational institutions that want to integrate OHS learning in a more interactive and innovative way.

RESEARCH METHOD

This research uses a Research and Development (R&D) approach with the ADDIE development model, which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen because it allows for a systematic and iterative development process, where the results of each stage are evaluated and used to improve the next stage. Each stage of the ADDIE model is applied sequentially with the aim of creating a product that meets the needs of students and applicable OHS standards.

The subjects of this study were grade XI students at Muhammadiyah 2 Tempel Vocational High School (SMK) majoring in automotive engineering with light vehicle expertise competence, totaling 72 students. The sample was purposively selected based on their involvement in industrial work practices. These students are expected to provide relevant input regarding OHS learning needs. The object of research is Android-based learning media developed for OHS learning. The development of this media is adjusted to the OHS standards applicable in the industry, to increase students' knowledge and awareness of the hazards they may face in the work environment.

Data were collected through several methods to obtain comprehensive information on the effectiveness of the learning media. The main data collection techniques in this study were observation, interview, questionnaire, and test. Observations were conducted to observe students' activities and responses while using the Android-based learning media. Interviews were conducted with teachers and students to gain deeper insights into the need for OHS in vocational learning. Questionnaires were distributed to students to evaluate their perception of the developed media, including interface and interactivity aspects. Tests were used to measure students' level of understanding of OHS materials before and after the use of learning media.

The instruments used in this study consisted of observation guidelines, interview guidelines, questionnaires, and test

sheets. The observation guideline was designed to record students' interaction with the learning media and their responses to the OHS content. Interview guidelines were developed to direct conversations with teachers and students, so that researchers could understand the specific needs of OHS in the context of vocational schools. The questionnaire contains a series of closed questions to measure students' perceptions related to interface, usability, and content quality aspects. The test sheet served as a cognitive evaluation instrument, where students answered OHS questions that focused on the basic principles of work safety.

The following are the grids for each of the research instruments used in this study, namely observation guidelines, interview guidelines, questionnaires, and test sheets. Each grid is organized based on the purpose of data collection and indicators relevant to the development of Android-based OHS learning media.

Table 1. Observation guide instrument grid

Indicator	Observed Aspects
Media Interface	Attractive and interactive display
Student Engagement	Level of student participation in media use
Understanding Instructions	Students' ability to follow instructions on media
Reactions to OHS Content	Student responses to OHS material
Ease of Navigation	Students' ability to navigate in media

Table 2. Interview guide instrument grid

Indicator	Objective	Information
OHS Learning Media Needs	Understanding OHS content needs	Interviews with teachers and students
Content Quality	Evaluating content relevant to OHS	Teachers and students as resources
Media Interactivity	Assessing interactive aspects in media	Information from teachers and students
Challenges of Media Usage	Identifying potential technical issues	User experience (teachers and students)
Impact of Media on Understanding	Assessing the effectiveness of media in understanding OHS	Can be compared with the results of the OHS understanding test

Table 3. Questionnaire instrument grid

Indicator	Statement	Information
Media View	This media display is interesting	Assessing media visuals and aesthetics
Content Quality	The information presented is clear and relevant	Assess the relevance of the OHS content presented
Ease of Use	Easy to use media	Assess the level of ease of navigation on media
Interest in Material	This media makes me more interested in OHS	Measuring the influence of media on students' learning interest in OHS
Increased Understanding	This media increases my understanding of OHS risks	Measuring students' perceptions of improving understanding of OHS
Media Interactivity	This media has interactive features that help learning.	Assessing interactive engagement in learning media

Table 4. Test sheet instrument grid

Indicator	Type of Questions	Information
OHS Basics	Multiple choice	General understanding of OHS
Accident Risk	Short Essay	Understanding the types of OHS risks
Personal Protective Equipment (PPE)	Multiple choice	Understanding the use of PPE
Emergency measures	Multiple choice	Basic understanding of emergency procedures
Implementation of OHS in the Workplace	Short Essay	Students' reasoning on the importance of OHS
Hazard Identification	Short Essay	Students' ability to identify and assess

The data obtained were analyzed descriptively and inferentially. Data from observations and interviews were analyzed descriptively qualitatively to describe student responses to learning media and OHS needs in the context of vocational learning. The questionnaire results were analyzed descriptively to determine the level of student satisfaction and perception of the developed media. Data from the test were analyzed inferentially with t test to determine the difference in students' understanding of OHS before and after using Android-based learning media. This data analysis aims to evaluate the effectiveness of learning media in improving students' understanding of OHS, as well as identifying areas that need to be improved in the developed product.

RESULT AND DISCUSSION

Analysis Stage

At the analysis stage, identification of occupational safety and health (OHS) learning needs was carried out for vocational high school students. The results of interviews and observations with teachers and students showed that most students had limited knowledge about the risk of accidents in the work environment. The following are the results of the needs analysis:

Table 5. Percentage of students who agree

OHS Learning Needs	Percentage of Students
Understanding the risks of accidents in the workplace	78%
Use of personal protective equipment (PPE)	82%
Skills in handling emergency situations	65%

This table shows that the majority of students (78%) feel the need to improve their understanding of workplace accident risks, while 82% of students consider it important to learn about the use of personal protective equipment (PPE). However, skills in handling emergency situations are at a lower percentage, namely 65%, indicating that students have less than optimal knowledge in this area. These results emphasize the need for OHS learning media that can increase awareness of PPE and emergency skills, which are important in the work environment. This data is the basis for designing features in the Android-based learning media that will be developed.

Design Stage

In the design stage, interactive Android-based learning media content and features are designed to improve students' understanding of OHS. The features designed include interactive video modules, evaluation quizzes, simulations of PPE use, and safety procedures. The following is a media design table:

Table 6. Main features of the learning media designed

Media Features	Description
Interactive Video Module	Showing videos about accident risks
Evaluation Quiz	Providing practice questions related to OHS material
Simulation of Use of PPE	Interactive to understand the use of PPE
Safety Procedures	Instructions for workplace safety measures

This table describes the main features of the learning media designed based on the needs found in the analysis stage. Each feature has a specific function to improve students' understanding of OHS: Interactive video modules and evaluation quizzes aim to provide a theoretical understanding of occupational risks and safety. The PPE use simulation feature provides virtual practical experience, which is expected to improve students' ability to use PPE correctly. With safety procedures, this media helps students practice safety steps in the workplace, strengthening their readiness when they are in a real work environment.

Development Stage

In the development stage, Android-based learning media is developed according to the design. The development process involves creating video modules, creating evaluation quizzes, and animation-based simulations. The following are the results of the media trial in terms of feature completeness and content quality:

Table 7. The results of the media trial in terms of feature completeness and content quality

Aspect	Expert Assessment (Scale 1-5)	Information
Completeness of OHS Materials	4.5	The material covers the basics of OHS
Interactivity	4.7	Interactive features such as PPE simulations
Ease of Navigation	4.3	Easy access between modules
Visual Display	4.6	Attractive and simple appearance

Expert assessment in this table shows that the developed learning media has good quality in four main aspects: completeness of materials, interactivity, ease of navigation, and visual appearance. The high score level in the interactivity aspect (4.7) shows that the PPE simulation and quiz features are able to attract students' interest and provide an in-depth learning experience. The visual appearance rated 4.6 also indicates that this media is designed with an attractive and user-friendly design, so that it can facilitate students' understanding of the OHS material. Overall, the results of this assessment show that the media meets the quality standards as an interactive learning tool and can be implemented in the next stage.

Implementation Stage

Learning media is implemented in learning sessions at SMK. A total of 30 grade XI students were tested using this media for two weeks, with the aim of improving understanding of OHS. The following are the results of the student understanding test before and after using the media:

Table 8. The results of the student understanding test before and after using the media

OHS Understanding Test	Before Using Media	After Using Media
Basic Understanding of OHS	60%	85%
Use of PPE	58%	88%
Emergency measures	55%	82%

The data in this table shows an increase in students' understanding of three main aspects of OHS after using Android-based learning media. Basic understanding of OHS increased from 60% to 85%, understanding of the use of PPE increased from 58% to 88%, and emergency action skills increased from 55% to 82%. This increase indicates that Android-based OHS learning media is effective in improving students' understanding of OHS. The aspects of the use of PPE and emergency actions, which were previously considered difficult, experienced the greatest increase, indicating that this media succeeded in closing the knowledge gap found at the analysis stage.

Evaluation Stage

At the evaluation stage, the level of satisfaction and effectiveness of the media was measured through questionnaires and interviews. The results of the questionnaire showed that students felt helped by this media and expressed high enthusiasm in participating in learning. The following are the results of the student satisfaction evaluation:

Table 9. The results of the student satisfaction evaluation

Evaluation Aspects	Percentage of Students
Attractive Media Display	90%
Easy to Use Media	88%
Improving OHS Understanding	92%
Helpful Interactive Features	87%

This table indicates the evaluation results from the user experience side. Most students (90%) felt that the appearance of this media was attractive, and 88% of students stated that the media was easy to use, indicating that the appearance and user interface were well designed. As many as 92% of students stated that this media improved their understanding of OHS, which confirmed the effectiveness of the media as a learning tool. Interactive features, such as the simulation of using PPE, were considered useful by 87% of students. These results confirm that this learning media is not only easy to access and use, but also effective in improving understanding and awareness of OHS.

The results of this study support that Android-based learning media is effective in improving SMK students' understanding of OHS. This is driven by the interactive nature of digital media that can facilitate the

understanding of abstract concepts to be more concrete, as experienced in OHS learning. The use of simulations and visualizations in this media helps students visualize real risks in the workplace, improving their ability to recognize and understand risks effectively. According to previous research, the use of technology in learning does have a positive effect on students' understanding, especially in improving critical and analytical thinking skills [21][23].

In addition, attractive visual displays and easy-to-navigate interface designs also play a role in increasing student engagement during learning. Research shows that attractive visual displays increase student retention of the information presented, and intuitive interface interactions allow students to engage longer in the learning process . The use of attractively designed digital media can also increase student learning motivation, because they are more interested in using applications that have intuitive interfaces and attractive displays [24][25].

This motivational enhancement is an important aspect in OHS learning, because students who are motivated to learn will be more interested in studying the material and retaining the information obtained longer. Interactive digital platforms can trigger students' intrinsic motivation which in turn has a positive impact on learning achievement. In addition, this motivation encourages students to explore more deeply the occupational safety and health risks they face in industrial environments [26][28].

The interactivity aspects in this media, such as the quiz and simulation features, also proved very useful for students to test their understanding independently. These features serve as assessment tools that allow students to get immediate feedback on their understanding of OHS. The immediate feedback from the digital learning media helps students to immediately identify mistakes and improve their understanding. This is in line with constructivist learning theory, where students learn actively through interaction and direct experience, so that the knowledge gained is stronger and longer lasting [19][29][30].

In addition to being effective in improving understanding, the use of Android-based OHS learning media also supports students' technological skills that are important in facing the challenges of the digital era. It allows students to be familiar with technology and improve their digital literacy, which is one of the important skills expected in the world of work. Good digital literacy in students also allows them to be more adaptive to technological developments in the industrial environment, including the use of technological devices in work safety operational standards [31][33].

In addition, Android-based learning media also allows higher accessibility for students, given that many of them have access to Android devices. Research states that the availability of personal devices such as

smartphones makes it easier for students to learn anytime and anywhere, thus increasing flexibility in the teaching and learning process. This flexibility allows students to access OHS materials outside of class and repeat the materials if needed, thus strengthening their understanding of the materials presented [34][36].

The use of digital-based media in OHS learning in this study is in line with research results showing that students tend to have a better understanding when they learn with the help of technology, especially in terms of understanding high-risk content such as OHS. This is also relevant to the results of the study which stated that technology-based media provides a more in-depth learning experience and increases students' interest in learning that requires practical understanding such as OHS [37][39].

In addition to its effectiveness on student understanding, this media provides practical implications for vocational education. The availability of Android-based learning media is expected to improve the quality of vocational education as a whole, considering that current industry standards require a workforce that not only understands the material but also has good digital literacy. Therefore, the development of digital-based media like this is a strategic step in connecting learning in vocational schools with the increasingly complex needs of the industrial world [40].

CONCLUSION

This study concludes that Android-based OHS learning media is effective in improving vocational students' understanding of occupational safety and health risks. With interactive features such as simulations and quizzes, this media makes it easier for students to understand potential hazards in the work environment, while increasing their motivation and technological skills. This digital-based media is relevant to the needs of industries that require a safety-savvy workforce as well as digital literacy, making it a strategy that supports students' work readiness. The findings are expected to serve as a reference for vocational education in integrating digital technology into the OHS learning curriculum.

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