

## Development of a Mobile Application for Occupational Health and Safety Education in Vocational High Schools: A Case Study in Construction and Housing Engineering

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### Abstract

Students need to have a good understanding of occupational health and safety to avoid accidents during practical activities and in the workplace. To help with this, digital technology can be used to create learning materials and media that aid in achieving learning objectives. This study aimed to develop a mobile application that could be used as a learning resource during practical activities in workshops. The research was carried out at the Department of Construction and Housing Engineering in a Vocational High School in Surakarta, using the Alessi & Trollip research method. The development process consisted of three stages: Planning, Designing, and Development. The study employed various techniques, such as questionnaires, interviews, observation, and documentation, to collect research data. The study used interactive models to analyze qualitative data and descriptive statistics to analyze quantitative data. As a result, the learning resource created has a material suitability level of 90% and media suitability of 100%. User testing has shown positive results, with individual test scores averaging 90% and class test scores averaging 90.35%, which is rated as "very good." This study aims to provide an appropriate learning resource that addresses the identified problems.

**Keywords:** mobile application, practicum learning, occupational health and safety, safety education, vocational high school

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### 1. Introduction

The features of education include the use of technology in the learning process, as well as interactions between teachers and students with the aid of a variety of media, techniques, and instructional materials (Firmadani, 2020). In the globalized era of education, information and technology are developing at an accelerating rate, requiring adaptation to improve the quality of education, particularly throughout the learning process (Haleem, Javaid, Qadri, & Suman, 2022).

Efforts to enhance learning involve using technology to optimize the learning process, resulting in improved performance and learning outcomes (Haleem et al., 2022). The Association for Educational Communications and Technology or abbreviated as AECT in 2018 explained Educational Technology as "the study and ethical application of theory, research, and best practices to advance knowledge as well as mediate and improve learning and performance through the strategic design, management and implementation of learning and instructional

processes and resources” (AECT, 2018). The use of this technology can provide students with learning experiences that develop their competencies and personal potential (Puspitasari, Opwora, & Kamis, 2024).

Technology has indeed become an important factor in facilitating student learning outcomes (Zamhari, Ridzaniyanto, & Kangkamano, 2021); (Lin, Chen, & Liu, 2017). Its utilization has been proven to have a significant impact on cognitive learning by enhancing the learning process and making it more engaging and interactive for student’s (Patricia Aguilera-Hermida, 2020); (Sulistiyanto et al., 2023). Recognizing the importance of instructional materials plays a critical role in facilitating the most effective learning experience and it has been proven that three-level representation helps students to relate better to their learning material (Sexton, 2017; Nugrahadi, 2019). This media offers flexibility in the learning process, which can be carried out without any limitations of time and space (Odewumi et al., 2019). This includes goal-setting, comprehending learning objectives, and monitoring their progress towards achieving learning objectives (Puspitasari et al., 2024).

One way technology can enhance learning is through the use of smartphones, which provide students with access to a wealth of information (Senge, 2023). The use of smartphones as a learning tool requires special attention to ensure its optimal usage. With the rapid advancement of technology and coupled with Indonesia's large number of mobile device users, it is one of the countries with the highest mobile penetration rates (Wirawan, Fajar, & Ibrahim, 2013), smartphones have features that can facilitate the distribution of teaching materials, access to learning resources, and interaction during the learning process (Wali & Omaid, 2020). However, the current situation shows that

many teachers have not yet made the most of this technology in their teaching process and still prefer conventional learning models (Rahayu & Sukardi, 2021).

There are several areas where schools need improvement, including the implementation of industrial work practices (Mulyana, 2013), for example, A preliminary study at a vocational school in Surakarta found that even though Occupational Health and Safety competencies were important in meeting work skills needs in industry, they had not been implemented optimally. As a result, students' knowledge of the importance of this material decreased, increasing the risk of dangers and accidents during practicum. Therefore, efforts need to be made to increase student awareness and knowledge of the importance of occupational health and safety (Latif, Situngkir, Susiani, Nugraha, & M. Yusuf, 2022). To achieve a high-quality learning process, particularly in practicum learning, vocational high school students require a connection and alignment between education and the industrial sector such as understanding occupational health and safety (Ali & Koehler, 2020).

According to a preliminary study conducted at vocational high schools in Surakarta, there are multiple challenges related to the implementation of Occupational Health and Safety (K3). Firstly, students lack awareness of studying and executing K3. Secondly, the learning process involves more independent inquiry activities and assignments, leading to limited interaction between teachers and students and ineffective learning. Thirdly, the media used by teachers for facilitating K3 learning is not yet optimal, with students feeling that teachers only give verbal directions without explaining the material in detail.

The study also revealed that conventional teaching methods used at these schools are

monotonous and not contextual to the teaching material. This results in a lack of awareness of occupational health and safety, which can increase the risk of danger during the practicum learning process. Therefore, it is crucial to take the necessary steps to improve students' awareness and knowledge of occupational health and safety.

The potential solution to this problem is to use smartphones as learning media to facilitate learning and achieve learning goals (Nunuk Suryani, Achmad Setiawan, 2019). The objective of this research is to create a mobile application-based learning medium that digitalizes the Occupational Health and Safety teaching materials and Interactive learning media that is based on mobile devices can effectively combine visual and interactive elements to enhance the learning experience (Saputri, Sukirno, Kurniawan, & Probowasito, 2020). The development of this medium will enable students to utilize their smartphones optimally as a learning tool to access resources before practicums (Triluqman, Mulyoto, & Sutimin, 2018). In order to help students achieve their learning goals, smartphones can be utilized more effectively (Gultom, Baharuddin, Ampera, Fibriasari, & Sembiring, 2022).

Numerous studies are at your disposal to tackle the aforementioned concerns. One such example is the research conducted by Andi Darussalam, which discovered a 15% boost in motivation and learning awareness through the implementation of mobile application-based learning media (Darussalam, 2015). Furthermore, Morris et al., (2016: 7) study titled "Mobile Technology: Students' Perceived Benefits of Apps for Learning Neuroanatomy" showcases a substantial enhancement in performance or learning outcomes when mobile applications are utilized in educational activities.

Upon thorough examination of pertinent research and contextual information, it has been determined that the development of learning tools through mobile applications can serve as a viable means of promoting seamless teaching and learning (Chotib, 2018). Mobile applications can be structured in a way that suits the learning needs of Occupational Health and Safety by integrating learning resources based on practical needs (Abikenova, Oshakbayeva, Bekmagambetov, & Sarybayeva, 2023). This can help students understand theoretical material before practical learning (Sulistyanto et al., 2023). Optimizing this form of media can enhance awareness and understanding of occupational health and safety, all while achieving desired learning outcomes (Widianto, dkk, 2021).

## **2. Method**

The type of research used in this study is Development Research, also known as Research and Development (R&D). Development Research involves a process of creating and testing the validity of a product. The engineering process, which is based on various stages called design, is used to produce the product (Borg & Gall, 2003). This study employs the Alessi & Trollip model, and is divided into three stages: planning, designing, and development (Allesi & Trollip, 2001).

Observations were conducted in the Construction and Housing Engineering Department at the Vocational High School in Surakarta to analyze its media needs and development. Data was collected through interviews and questionnaires with practitioners and 30 students from the construction and housing engineering department. To analyze the media's suitability level, media experts, material experts and practitioners were consulted (Karmasin & Voci, 2021). Descriptive statistics were used to describe the

implementation of media during learning and the level of appropriateness of the media (Ibrahim, Muhammad Buchori, 2023). The media's feasibility was measured based on the percentage of eligibility using a specific formula (Balaka, 2020); (Sugiyono, 2011).

$$\text{Percentage} = \frac{\text{Score}}{\text{expectedscore}} \times 100\%$$

The following table presents an interpretation of the calculation results into feasibility categories:

**Table 1. Media Eligibility Category**

Category	Percentage (%)
Very qualified	82 – 100
Qualified	63 – 81
Not eligible	44 – 62
Very unqualified	25 – 43

It can be concluded that if the expert's assessment of the mobile application-based learning media development process is equal to or greater than 63%, then the product is considered feasible. The process of developing the learning media continues to the revision stage to produce a better product that meets the development objectives.

### 3. **Result and Discussion**

#### a. **Planning Stage**

Before proceeding to the design stage, it is essential to conduct a preliminary study to gather information on the following aspects: (1) The functioning of the learning process in schools, (2) Students' awareness of the importance of occupational health and safety, and (3) The requirements of teachers and students for effective learning resources. The present data is founded on the framework of e-learning developmental theory, which is aimed at identifying the conditions of learn-

ing, student attributes, initial knowledge of students, and significant learning events that necessitate renewal (Syarifah, 2010).

According to the results of the needs analysis, further to the information shared earlier, there were a few barriers that impeded the progress of developing learning materials. Firstly, the learning media utilized did not meet the eligibility criteria for use, as several students found it challenging to operate. Secondly, many students lacked comprehension of the significance of studying Occupational Health and Safety material. on the other hand, information was also found that only 10.4% of the students use multimedia, while the other 79.6% rely on material summaries through PowerPoint, PDFs, and discussions via WhatsApp during their practicum learning process. The study found that all respondents owned smartphones, and 96.3% of them used smartphones as their learning medium.

This observation shows that there is a potential for developing mobile applications that can integrate teaching materials, modules, learning videos, and practice questions into one mobile application to answer the problems stated above (Sulistyanto et al., 2023). During the advanced analysis stage, it was found that both teachers and students require efficient and effective learning media. They referred to mobile applications as a preferable option for learning due to several reasons such as interactive and fun learning media can help students learn independently. Teachers can present teaching materials in an engaging way by combining audio, video, and animation in the application. This approach can raise awareness about the importance of occupational health and safety.

Efficient and effective learning requires the availability of suitable and adaptable learning resources that can be accessed by learners at any time and place (Darmawan,

2016). A medium can be categorized as a learning medium if the tools or techniques used can convey information or messages from educators to students during the learning process (Morris et al., 2016). A mobile application is a type of learning media that satisfies several criteria. It can serve as both a medium and a resource for students (Tresnawati & Fauzi, 2015), offering learning materials, modules, videos, practice questions with feedback, games or illustrations, and contextual material (Listiaji, Widianingrum, Saputri, & Rahman, 2022).

**b. Designing Stage**

After conducting a preliminary study and needs analysis, it was found that students require a mobile application that can combine various learning sources such as text, audio, video and simulations to learn about Occupational Health and Safety before beginning practicum activities. All elements in the application should prioritize student characteristics to display media that can maintain student motivation and concentration levels (De Pace, Manuri, Sanna, & Zappia, 2019). Using this information, the application specifications were formulated during the design stage of the mobile application.

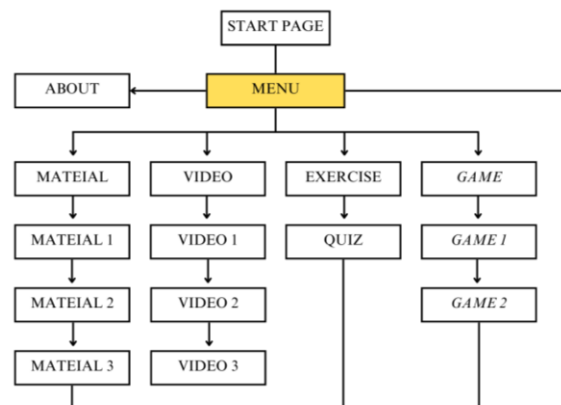
**Table 2. Product Specifications**

Media Component	Format
Navigation	Start button, home, back, sound configuration
Menu	Learning material, module, video, task, game
Video	MP4
Audio	MP3
Figure	JPEG, PNG
Document	PDF, HTML

Mobile applications can be developed using the Smart Apps Creator 3 software. This desktop application allows users to create interactive multimedia content with a

simple design and layout that is easy to use (Rambe, Erni, & Simanulang, 2022). The application results in APK, .exe, and HTML5 format files, which are compatible with different devices such as computers, laptops, and smartphones (Li, Lee, Wong, Yau, & Wong, 2018).

During the development stage, the first step is to formulate general media concepts and teaching material concepts. The media concept is created by making flowcharts and storyboards to design the content (figure 1 & attachment 1). Then, for the formulation of teaching materials, they are arranged based on basic competencies and indicators sourced from SKKNI KEMNAKER No. 38 of 2019 which covers the basics of Occupational Health and Safety and the potential and prevention of hazards in workshops.



**Figure 1. Flowchart**

To enhance the effectiveness and efficiency of learning materials, it is recommended that they are transformed into learning media devices (Triluqman et al., 2018). The digitalization of learning 4.0 has necessitated an increased demand for e-learning oriented learning media (Surahman & Alfindasari, 2017). Additionally, the widespread use and rapid development of smartphone technology have made it possible for students to use their devices as a learning tool, allowing them to learn inde-



pendently (Zainal, Asriati, & Syahrudin, 2019).

### c. Development Stage

The mobile application development consists of five main menus. The first menu is the home page that displays an explanation of the application, navigation for use, and the personal data of the application developer. The second menu is the material page, which contains a selection of materials related to Occupational Health and Safety. The material includes theoretical explanations in the form of text and images. The third menu is the video page, which contains learning videos that include infographics and simulations. The fourth menu is the practice page, which contains several questions to evaluate student learning. Lastly, the fifth menu is the game page, which contains gamification features related to Occupational Health and Safety signs.

The design of the five menus refers to ideal aspects of learning media, such as ease of use, the accuracy of the information, completeness of material, layout, and colors used, supporting illustrations, and game menus as an effort to maintain students' enthusiasm for learning (De Pace et al., 2019). The entire development process is related to efforts to improve learning objectives (Garber, 2017).

After the prototype is produced, product testing (alpha testing) can begin after validation and assessment from material expert, media expert and practitioners to determine the suitability of the mobile application (Terhorst et al., 2020). Their expert assessment produces recommendations that serve as a reference for improvements during the product development stage (Davalbhakta et al., 2020). The results of the application development can be seen at following figure.

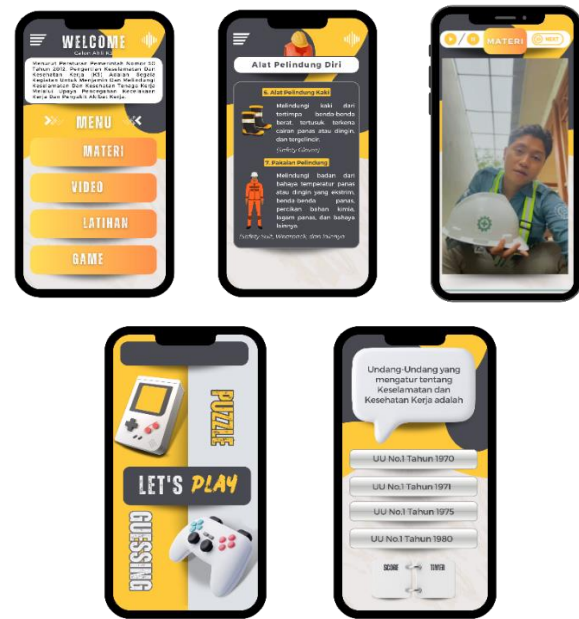


Figure 2. Mobile Application Interface

### d. Alpha Test

An alpha test is an initial evaluation conducted by experts to assess various aspects such as content, user-friendliness, and product suitability. The primary objective of this test is to identify and mitigate any potential errors in the product before it is made available to students. Additionally, it can also help determine if the product can function optimally.

The table below presents the results of the media expert's assessment of the product.

Table 3. Media Expert Assessment

Media Component	Percentage (%)
Visual Communication	100
Illustration	100
Advantage	100
<b>Average Value</b>	<b>100</b>

The questionnaire is designed to evaluate the suitability of learning media products based on aspects of visual communication, illustrations, and benefits (Rameshbhai Patel & Joseph, 2016). To determine the effectiveness of visual communication, the questionnaire assesses the suitability of image selec-

tion, color, font selection, and layout. In terms of illustration, the questionnaire evaluates the ease of use, instrument arrangement, material presentation, appearance, and image proportions (Artaya, 2018).

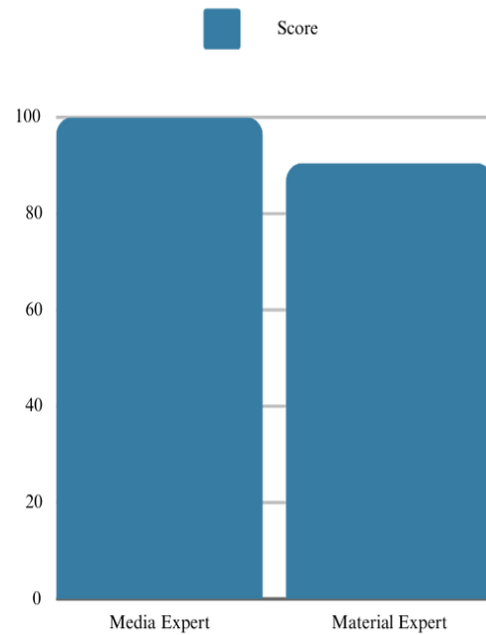
The questionnaire also includes indicators to assess the benefits of mobile applications, based on their ability to minimize misperceptions and make it easier for teachers to deliver material (Yuan, J., Wang, C., Skibniewski, M. J., & Li, 2012). The average score obtained from the assessment of these aspects was 100%, indicating that the product is “very feasible”.

Expert assessments of mobile applications are based on two aspects: material content and material benefits. The content of the material is evaluated based on its suitability with basic competencies, concept correctness, image illustrations’ suitability and clarity of the material’s meaning and function (Arrasyid et al., 2024). On the other hand, the benefits of the material are evaluated based on the indicators that the media can be used as a learning supplement, minimize misconceptions of the material, and facilitate teachers in delivering teaching material (An et al., 2018). The results of the material expert’s assessment of mobile application products as learning media are as follows.

**Table 4. Material Expert Assessment**

Media Component	Percentage (%)
Contents of Teaching Materials	89,28
Benefits of Teaching Materials	91,6
<b>Average Value</b>	<b>90,47</b>

The average expert assessment of the material of the product was 90.47%. This value indicates that the developed mobile application is “highly feasible” in terms of material aspects. The results expert’s assesment shown in Figure 3.



**Figure 3. Expert’s Assesment**

In addition to expert validation, three teachers from a vocational high school program for Construction and Housing Engineering carried out practitioner validation. This testing was done to confirm the quality of the media and materials used for learning. According to the assessments from the practitioners, the learning media was rated as "very decent/good" with an average score of 92.5%.

**e. Alpha Test**

This testing is the stage of fully testing a product for students. The results of this testing are an assessment of the function and feedback from students or product users. Once the product is approved by media expert, materials experts, and practiccioner it undergoes testing on users, specifically, students of Surakarta Vocational High School. The testing was conducted on 3 students selected in clusters to represent different ability levels (high, medium, low) in practical learning (Verbraken, Bravo, Weber, & Baesens, 2014). The results of the user test are presented in the table below.

**Table 5. User Test Results**

Media Component	Percentage (%)
Recognizing How to Use Media	93
Media Interface	90
Presentation of Teaching Materials	87.5
Ease of Using the Application	92
Reaching Learning Objectives	87.5
<b>Average Value</b>	<b>90</b>

Based on user testing, the mobile application has been rated "very feasible" with an average score of 90%. The application has received positive feedback from media experts, material experts, practitioner and users. Therefore, it can be used effectively for learning Occupational Health and Safety during practicums (Puspitasari et al., 2024). This effort aims to facilitate optimal student learning. The data paints a positive picture of students' perception of the application under development. Additionally, research indicates that this media has the potential to foster the attainment of learning objectives (Duryan, Smyth, Roberts, Rowlinson, & Sherratt, 2020) and promote awareness of occupational health and safety (Gultom et al., 2022). Moreover, the media should offer information that enables students to equip themselves for the workforce, including work safety guidelines, management, and culture within the industry (Du & Zhao, 2011).

After testing was carried out on users in categories based on ability level, testing was also carried out on one class to obtain information about various aspects of the media, such as ease of understanding and use, presentation of media and material, ease of use, and achievement of deeper learning objectives. This trial involved 28 students from Construction and Housing Engineering at State Vocational School 2 Surakarta. The test results obtained a score of 90.35% which

placed it in the "Very Decent/Good" category.

The findings of the alpha and beta testing conducted at Surakarta Vocational High Schools have exhibited positive outcomes in the development of application-based learning media. These learning tools have been designed to facilitate the acquisition of knowledge in the domain of occupational health and safety. The results of the testing indicate that application-based learning media can be an effective aid in enhancing the learning experience of students while augmenting their understanding of safety protocols and measures in the workplace.

#### 4. Conclusion

Learning through mobile applications is an effective and convenient choice in Indonesia due to the widespread use of mobile devices among Indonesian students. Researchers discovered that all respondents had smartphones, and 96.3% of them actively used their smartphones as a learning medium. This indicates the potential for developing application-based learning media on smartphones. However, the current learning carried out by teachers is still not optimal since 79.6% of students stated that teachers only provide conventional media during practical learning. This type of learning process is less effective and impacts student performance and achievement in practical learning.

The final product developed for learning media is a mobile application that integrates various types of teaching materials such as text-based e-modules, learning videos, audio-video explanations, and gamification in a single media. Expert assessment and users trial indicate that the Occupational Health and Safety mobile application is an excellent media for practical learning. According to media experts, the media has received a



score of 100, indicating high suitability. Similarly, material experts rated it as very relevant to teaching materials, giving it a score of 92.5. Individual testing resulted in a score of 90 (Very Good), while in-class testing resulted in a slightly higher score of 90.35 (Very Good). This data serves as a reference for developing mobile applications that teachers can use and adapt to achieve learning goals (Kusuma, Suryani, & Sumaryati, 2022). According to recent research studies (Saputri et al., 2020); (Sulistyanto et al., 2023), incorporating validation tests and due diligence is essential in the development of effective learning media. These studies have shown that Application Mobile-based learning media are more effective than traditional models in facilitating the learning process.

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