

Ubiquitous learning in occupational health and safety for vocational education

Ketut Ima Ismara¹, Amin Suharjono², Didi Supriadi³

¹Department of Electrical Engineering Education, Univertas Negeri Yogyakarta, Indonesia

²Electrical Engineering Department, Politeknik Negeri Semarang, Indonesia

³Management Education, Universitas Sarjanawiyata Tamansiswa, Indonesia

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ABSTRACT

This research aimed to develop instructional media for occupational safety and health android-based for vocational schools. The second aim is to determine the feasibility of instructional media and student responses. The type of research is research and development (R&D) with the Analysis, Design, Development, Implementation, Evaluation (ADDIE) method, namely, analysis, design, development, implementation, and evaluation. The instrument used for data collection was a questionnaire with fourth scales. Data collection used an assessment questionnaire for two experts and 103 users. Research data analysis techniques used quantitative descriptive analysis. This study's results have produced products in the form of android-based instructional media for Occupational Safety and Health. In this study, we designed and developed an application called Zerosicks for mobile devices to help students learn occupational safety and health principles. The results of testing for all features and navigation work well and under their functions. The assessment results by content experts, media experts, and students as users indicate that this media has a very decent level of eligibility. Suggestions for product development are to add videos to the media, provide selected music, and add discussion forums for users.

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Corresponding Author:

Didi Supriadi

Management Education

Universitas Sarjanawiyata Tamansiswa

Jl. Kusumanegara 157 Yogyakarta, Indonesia

Email: didi.supriadi@ustjogja.ac.id

1. INTRODUCTION

Developing learning technology affects student mastery of learning material significantly. Students are required to be able to master the technology well so they can help enter the workforce. Vocational high schools' missions are defined as: preparing youth in education to life, upskill individuals with upgrade level competencies, providing workforce, and advancing knowledge, ability, and competency in the workforce [1]. Competency-based learning in vocational high school requires a learning medium to more easily understand the material being taught. Social competence refers to the teacher's capacity to serve as part of a community [2]. Vocational students will be directed to work in the industrial world. For this reason, vocational students are taught about occupational safety and health, which is used as a basis for practice.

Occupational safety and health are fundamental things and become mandatory things that must be taught to vocational students. Students equipped with occupational safety and health are important things to do in the work environment. However, in the work field there are not a few accident problems experienced by workers. The analysis by Grytnes, *et al.* [3] points to this difference in employment status as necessary for

their safety practices and also for the teachers' position to influence safety learning and practices during company-based training. An analysis of interview and survey data focusing on how vocational students enact safety 'knowings' across learning sites suggests how different forms of connectivity models in vocational school promote various safety learning forms among students. Successful vocational laboratory performance is assessed by environmental conditions and increasing work safety factors [4].

One method in analyzing an activity when working in industry or other places that require safety standards, which has several methods, is Zerosicks. This analysis can provide solutions to accidents that can occur with accident analysis explained by considering various aspects. The analysis that was examined was written based on the order of letters in Zerosicks [5]. By studying occupational safety and health (OHS) analysis, students are expected to understand more about hazards, work environment, workplace risks, OHS implementation, OHS culture, and legislation regarding OHS. The level of student activity is also low in following occupational safety and health material because the media used by the teacher are less innovative.

The observations of the learning process at SMK Yogyakarta, Indonesia, are teachers still using the printed module in teaching material. The modules provided are not available in full in one module but are fragmented. So, students get a different print module at each meeting. The teacher prints the modules separately, then students pay for each meeting. So students are not burdened with high module prices if the modules are printed in their entirety. Schools do not charge module printing fees at the beginning of the semester, so teachers must apply the module printing method for each meeting. This method is considered appropriate so that students are not burdened with large and concurrent expenses because, of course, not only one subject that requires modules. But some problems arise due to the use of this method. Students cannot learn before the material is discussed, and also students often ignore the print module at previous meetings because they feel that the module will not be discussed again at the next meeting. It was suggested that the teachers' awareness should be focused on the students' learning approaches to vocational school students' [6].

Interviews also included vocational students who received the printed modules used by the teacher during learning. Most students think that the print module is less effective; this print module is straight forward to lose because it is in the form of paper and is easily tucked. Then this print module is also easily damaged if frequently opened or folded. Teachers who use the lecture method in delivering teaching materials make students very bored and quickly get bored with ongoing lessons. Another disadvantage of the printed module is that the image displayed becomes less clear because this module is a photocopy, so the existing image is blurred. Students' capability also varies; some students once saw the live broadcast understand the material presented. Also, some students have not been able to understand with just one video display. It can affect student learning outcomes. Most students have reached the minimum completeness criteria, but the knowledge they get is only useful and not for the long term because they have forgotten what the teacher discussed at the meeting.

Learning does not always have to be fixed with printed modules in the form of books. Technology that continues to develop can help the learning process. One of them is with ubiquitous learning or learning any-where. The printed module makes students unable to learn if they do not bring the module. Students today carry smartphones more often than books or modules when going anywhere. A study by Yildiz, *et al.* [7] concludes that on Vocational High School students were a positive and significant relationship between social media attitudes and internet connection years and social media usage hours.

The teaching and learning process greatly influences the outcome of the learning objectives. A teacher must have a suitable method of delivering material to be interested in the teaching material being prepared. Currently, students have been allowed to bring smartphones to school. However, while waiting, students are busy with their respective smartphones and do not pay attention to the teacher receiving material in front of the class. Smartphones will be handy if used. This smartphone must be addressed wisely by restoring its negativity and adding other functions. If the smartphone is used as a teacher's media in the subject matter, of course, the smartphone's function will be better than students use it for less useful things. Bağcı [8] advised for today's that students to use digital courses accurately and effectively, new educational methods should be used, and students, parents, teachers, and administrators need to be trained to learn the adverse psychological and physical effects caused by digital addictions such as the internet and smartphones addictions.

Interactive learning media can be in the form of text, visuals, and simulations that can help students gain more knowledge, a more in-depth understanding of concepts, and know the application of knowledge learned [9]. Many interactive learning media types can take advantage of Android, including augmented reality, virtual reality, video learning, and android-based interactive learning media. Augmented reality learning media still needs books for scanning images, and then 3D visuals will appear from the image. However, if a student forgets to bring a book, he cannot use the augmented reality media. Virtual reality learning media requires other equipment such as virtual reality glass cameras or virtual reality headsets. If the school does not have a virtual reality headset, there will be difficulties when using virtual reality-based learning media. Learning media in the form of video still does not involve students in learning. Students are

still passive and only watch with-out taking part in the learning process. Therefore researchers used interactive learning media based on Android.

Ubiquitous learning is a new educational paradigm made possible in part by digital media's affordances [10]. Ubiquitous learning is very suitable for learning because it utilizes technological advances in the teaching and learning process. Technology can encourage learning processes, support communication settings, assess learning activities, manage resources, and create learning materials [11]. Technology can help advance learning in schools. Students will feel curious about the advanced media and use technology to deliver the material.

Ubiquitous learning technologies have been successfully applied to learning activities in various fields such as natural science, social science, and languages. The students' learning motives and interests have been raised, as well as good learning performance being presented. Moreover, they might not be able to link what they are learning to their previous knowledge learned in the class without proper guidance or instant supports. Consequently, it is essential to guide the students to focus on the correct learning targets and provide them with instant support when encountering problems during the ubiquitous learning process, particularly for those learning tasks that require frequent interactions with the learning targets [12]. In conjunction with support from the digital world, ubiquitous learning is recognized as a practical approach to positioning students in real-world learning environments [13].

Multimedia has proven its efficacy as computer-assisted tools in learning. Its courseware requires understanding design and learning theories during the pre-development process. It combines and integrates text, graphics, sound, animation, and video [14]. This Android-based learning media will attract more students' attention because it is more exciting and interactive with images, music that can be played, and practice questions on one product that is more attractive to learners' desires in learning. Android-based learning media is convenient because it can be learned by students any-where. This Android-based learning media can facilitate each student in learning so that what he learns is right with the level of ability and intelligence. The use of Android-based learning media has many benefits over other media. For example, it can add teaching materials to students in the classroom, add students' curiosity to the material being provided, and develop into independent learning materials for students without the teacher's need for guidance.

Li, Chiu, and Tseng [15] showed that contextualized resources could better improve learners' learning achievement and efficiency and improve their self-learning efficiency while reducing their cognitive load. Learners thought the ubiquitous learning system which provided contextualized resources was more useful. Today, when information technologies are evolving rapidly, digital platforms such as computers, the internet, social media, and smartphones have become essential parts of our lives. People of a variety of ages intensely use these digital platforms. Students mostly use digital platforms to communicate, navigate social media, and play online and offline games. The digital platforms used for those diverse aims influence our lives and especially create an addiction for students. In this context, vocational schools' students may be negatively influenced by the intense usage of digital platforms [8].

This study describes a new learning paradigm, known as ubiquitous learning or u-learning, supported by ubiquitous computing technologies [16]. A media development is needed as a practical teacher teaching material; students do not incur additional costs for printing teaching material and are flexible, which can be used as learning both when the teacher is there. Students, namely android-based learning media, are used independently, which is equipped with music and practice questions and final scores obtained by students to find out how far students can understand the material in the media. With the development of this Android-based learning media, it is expected to make students more interested in the material being discussed by the teacher and can help educators to add teaching material and help the learning process. To solve one of these problems, it can use the Android-based occupational safety and health learning media.

2. RESEARCH METHOD

2.1. Types of research

This type of research is research and development (R&D) with Analysis, Design, Development, Implementation, Evaluation (ADDIE) as a method of development. Research and development (R&D) is a term used to describe the activities carried out by other entities such as corporations and individual entrepreneurs to create something new [17]. It has improved products and processes. This type of research is research and development (R&D), a research focus on researching and testing the development of products there before. The method used in this study using a model of the development of ADDIE by Robert Maribe Branch; there are five stages in the technique of ADDIE, namely analysis, design, development, implementation, and evaluation.

2.2. Time and place of research

This study was conducted on October 30 and November 1, 2019 in vocational high school in Yogyakarta, Indonesia.

2.3. Subject research

This research employed two experts consist of media experts and subject matter experts. The experts are a lecturer in the Department of Electrical Engineering Education, State University of Yogyakarta, and the 10th-grade student of Industrial Automation Engineering Department of Vocational High School Yogyakarta as instructional media users. Work Safety health based on Android. There were 103 students as respondents from 2nd Vocational State Depok Sleman, 2nd Vocational State Yogyakarta, and 3rd Vocational State Yogyakarta. The sample selection technique used purposive sampling. The sample criteria are schools that are willing to report activities by sending photos of accidents, hazard photos, or photos of conditions that are considered dangerous in practice places or workshops.

2.4. Research procedure

Research procedures conduct following the ADDIE approach. ADDIE Model is a term used to describe a systematic approach to learning, virtually identical to the development of learning systems [18]. In the analysis, the phase analyzes potential and existing problems to be solved with the right solution. A review of the environment are conditions, the learning process, student under-standing, learning support facilities, and the matter at this stage. Furthermore, researchers analyzed the existing problems on these aspects to be addressed. Researchers develop Android-based media as a medium of learning to solve existing problems. The second phase is the design. The design was made by adjusting the needs of various parties and made as attractive as possible to attract student interest. This stage's results from the initial sketches of media design and media applications and working diagrams were created.

The next stage is the development and manufacture of products to realize that the supervisor has validated the previous design. Products made in the form of instructional media Work Safety and Health Android based at Vocational High School Yogyakarta. After the media is complete further testing the feasibility of the products in terms of several aspects: media and material aspects, implementation phase conducted after the product are made and tested by the experts of media and subject matter experts. Implementation of health and safety instructional media work done in 10th-grade Vocational High School Yogyakarta. The application done by the researchers is to study the response of the learner as the media created. Product evaluation as a learning medium performed after the implementation phase.

2.5. Data, instruments, and data collection techniques

Data were collected using research instruments. The research instrument applied first validated using the expert judgment technique. The data used is the number of data obtained from the expert assessment and then converted into descriptive categories of eligibility. The instrument used for data collection is a questionnaire with four alternative answers, among which 4 (Strong Agree), 3 (Agree), 2 (Less Agree), 1 (Disagree). Data collection is done by giving questionnaires to expert and user ratings. Experts and users are asked to fill in the answers to the tick mark on the appropriate selection of alternative solutions and opinions or votes, respectively. Notice in the form of suggestions for improvement regarding diction media inserted in the comments and ideas that have been provided at the end of the questionnaire

2.6. Data analysis technique

The data analysis techniques used in this research is quantitative descriptive analysis. Quantitative descriptive analysis characterizes the world or a phenomenon by identifying patterns in data to answer questions about who, what, where, when, and to what extent [19]. Descriptive analysis simplifies assessment to transform them into numbers. Descriptive analysis assessing the feasibility level of media seen from the study of questionnaire data.

The Likert scale consists of a series of four or more item Likert-type combined into one score/variable combination during the data analysis process [20]. Researchers used a scale with a range of 1-4. They consist of a very worthy choice, decent, less fit, and very unfit. Cronbach Alpha is used to obtain some information on the subject and should have some similarities, consistency indicator measurement values obtained from repeated measurements in the same situation. Cronbach Alpha coefficient measures the average standard variation obtained by dividing the total k items in the scale, all common variants [21].

In all situations involving the testers, it is important to estimate inter-rater reliability, such as the value of important implications for the validity of research results. If two examiners cannot be shown to assess an individual reliably based on observed behavior, then any subsequent analysis of the ratings given by the examiners would produce false results [22]. Thus it is necessary for inter-rater reliability testing to

determine the ratings of the two examiners. The rule of thumb of inter-rater reliability are: >0.9-0.8 (Extraordinary), >0.8-0.7 (Good), >0.7-0.6 (Acceptable), >0.6-0.5 (Questionable), >0.5-0.4 (Bad), and <0.5 (Unacceptable).

3. RESULTS AND DISCUSSION

3.1. Results

This study indicates that the product has been produced by instructional media work safety and health based on Android. The product research is Zerosicks application that shown in Figure 1. Based on test results, all the features and navigation work well and following its function. Results of the assessment conducted by subject matter experts, media experts, and students as users indicate that this media has a very decent level of eligibility. Rating by subject matter experts obtained a mean value of 94% is included in the category of very decent-presentation of data in the form of a bar chart as presented in Figure 2.



Figure 1. Display of Zerosicks

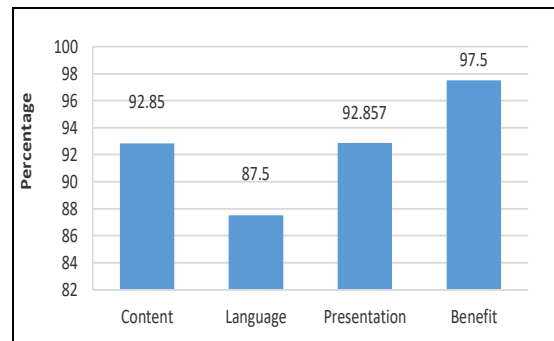


Figure 2. Graph of expert assessment

Figure 2 shows the percentage of the content aspect of 92.857%, the language aspect of 87.5%, the presentation aspect of 92.857% and the beneficial aspect of 97.5%. Assessment by media experts obtained a mean value of 90.5%, which belongs to the category of very decent. Presentation of data in the form of a bar chart, as in Figure 3.

Figure 3 reveals graph presentation aspect percentage of 87.5%, the aspects of ease 92.187%, the consistency aspect of 94.642%, and the aspect graph of 84.375%. The user's assessment obtained a mean value of 88.982% that fall into the category very well. Figure 4 presents the results of the assessment by the user is presented in the form of a bar chart. Percentage on display aspects of 88.214%, the material element of 88.428%, aspect of language by 90%, the component of expediency of 91.071, and the visual aspect as much as 88.982.

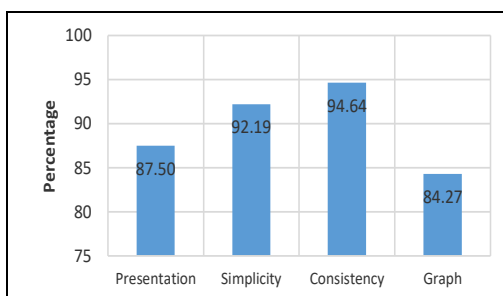


Figure 3. Graph media expert validation results

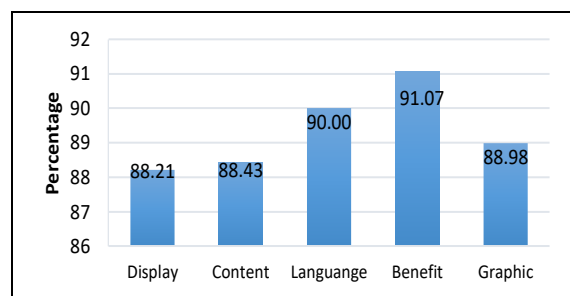


Figure 4. Graph of rating respondents

3.2. Discussion

The advantage of mobile android-based technology, where learners create multimodal representations outside the classroom and then discuss their well-founded experiences with peers and educators, has helped link learning to formal and more informal and personalized learning environments [23].

Figure 2 about diagram matter expert assessment that the graph shows the percentage of the content aspect of 92.85%, this is because the material according to the needs of students, following the essential competencies that exist in the syllabus, the contents are complete and coherent, the material is derived from an accurate source is a book of safety and health in the field of electricity by Ketut Ima Ismara and Eko Prianto. Further development can be added to other materials besides Zerosicks, e.g., personal protective equipment (PPE) and how to install.

A new trend in e-learning is known as mobile learning, the use of portable media such as smartphones. This research is in line with Kurniawan, *et al.* [24] that the students enjoy using mobile learning. It can be concluded that the use of mobile learning applications can make the learning process more flexible. By installing Zerosicks on their mobile phones, students can learn about the safety and health of their work on the mobile phone screen. This paper, therefore, provides an opportunity for developers to create ubiquitous learning environments that combine real-world and digital world resources [25]. It brings theoretical and practical ideas to the implementation of ubiquitous learning contexts. While paying attention to the development of both individual and collective learning, the reader is also interested in going further [26].

Percentage on the language aspect of 87.5%, this is because the sentences are easy to read, the information on the media is clear, the information on the matter following the contents Zerosicks, but the language developers use is still a little difficult to understand for students. For further development, the developer can then use language that is more easily understood by vocational students. The progress of online media is made so that learning can be accessed anywhere to learn more efficiently and flexibly. The development of online media provides a positive response that can increase student motivation [27].

Percentage aspects of the presentation of 92.857%, this is because the purpose of the media is clear, according to the Core Competence and Based Competence and listed on the medium of learning, learning media usage instructions are straightforward and easy to understand, presenting coherent and systematic writing cohesive material. For further development, the developer can then add the student's information, such as a list of books that can be accessed by students on occupational safety and health.

The percentage of the beneficial aspects of 97.5% is that the media help facilitate the learning process, students' interest, clarify the delivery of materials, and assist teachers in the learning process. For further development, the developer can then add audio materials, not just text. It is in line with Sunarto, *et al.* research [28], which states that a Mobile Learning application has been successfully increased learning outcomes.

The data can be seen in Figure 3 inform the graph presentation aspect percentage of 87.5% and this may be due to the selection of typeface and font size is right, the color composition with good media background and text, layout, and images corresponding letter. For further development, developers can then make media more attractive again, for example, by adding features and more different color selection on learning media. These technologies help students learn self-extracting information while actively using the cognitive structures of memory, thinking, and imagination [29].

Percentage of the aspects of ease of 92.187%, this is because the media is easy to use, clear presentation of the material, which is presented clearly and buttons work fine following its function, a language that is easy to understand, there are clear instructions for using the media, and the media do not confuse students. The next developer's further development does not need to remove the existing scroller on the media for a novice user, no difficulties when using the media. Ubiquitous learning takes advantage of digital content, physical surroundings, mobile devices, pervasive components, and wireless communication to deliver teaching-learning experiences to users anytime, anywhere, and anyway. Ubiquitous learning can transform traditional education provided at the classroom level and by e-learning. The students of diverse academic levels experience real and authentic settings, are immersed in dual reality sceneries, benefit from context-aware support, and interact with different devices and technologies in a blended fashion [30].

Percentage on the consistency aspect of 94.642% is because the fonts used are consistent, consistent font size, display a uniform, consistent navigation button layout, and consistent navigation essential functions. For further development, the developer can then add the next button on the matter so that before the next key is pressed, then the matter will not move to the next question. Percentage in the aspect graph of 84.375%, this is because the color is used appropriately, the picture presented is clear and not broken, and the design of the display accordingly. For further development, the next developer can add content to the media image of learning so that students are increasingly interested in learning media.

The last one in Figure 4 about diagram rating respondents obtained that percentage on display aspects of 88.214% this is due to attract media appearance and color are used accordingly. The developer's further development can change the colors blend better and use a contrasting color and firm but still comfortable viewing by the user. Percentage on the material aspects of 88.428% this is because of the purpose of the media listed on the medium, clear usage instructions, the material presented coherently, as well as easy to understand the information presented. In further development of the developer can change the

order of material offerings to be more coherent, can also use the numbering on the material to indicate the order of material that can be read by the user.

Percentage on aspects of language by 90% this is because the writing is easy to understand and read clearly, the information is presented clearly, and the language used is clear. In a further development, the developer can add a glossary on the media, making it easier for students to understand the meaning of the term is challenging. Percentage in the aspect of suitability of 91.071% is because the media simplify the explanation of the matter, helps the learning process and clarifies the delivery of content. In further development of the developer can add instructional videos regarding the use of PPE.

Percentage on the graphic aspect as much as 88.982% this is because the colors are presented right, presented a good image, design appropriate display, and music can be played well. In the further development of the developer can add other music so that students can choose the music you want to play, then improve image quality on the learning media and create a design that reveals the content of such material icon replaced with a hammer, helmet, and more. It can rightly say that modern education is increasingly taking place in a multimedia environment and relying on multimedia teaching and learning. The multimedia display provides a better understanding and understanding of teaching content that can be presented in many ways and which gives a higher educational value [31].

It is also necessary to directly engage the students in a dialogue about how they would like to see the use of technology to help them learn more effectively. At the same time, it is important for the teacher to be aware that customization is central to the definition of technology for students. It is something that adapts to their needs, not something that requires them to change. The incoming students will have significant expectations regarding the use of technology to support learning, but those expectations are tied to teacher and their ability to use technology correctly [32]. The use of interactive learning media based on Android can combine with blended learning implementation. It can help improve students' learning and also increase student's achievement [33].

4. CONCLUSION

The application called Zerosicks for mobile devices to help students learn the principles of occupational safety and health has been successfully developed for vocational high school students and has been evaluated with the results: 1) The level feasibility study media android based K3 is included in the category of "Very Decent." Test validation is performed based on the aspect of material and media aspects, each aspect examined by two experts. Based on the analysis of data validation test, a score is an average score of subject matter experts by 94% with the test inter-rater of 0.848 while the average scores of media experts amounted to 90.5% with the test inter-rater 0.821, both in the category of "Very Decent" and otherwise reliable; 2) Analysis of the responses to get an average score of 88.98% with a Cronbach Alpha test for 0.823. Suggestions from the development of this product include adding a video to the media, providing a selection of music for users and add a discussion forum for users.

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