

Development of Hazard and Risk Simulation Applications in Electrical Power Installation Workshops Based on Android in Vocational High Schools

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ABSTRACT

This study aims to: (1) develop a hazard and risk simulation application, (2) find out the function test, (3) find out the feasibility of the hazard and risk simulation application, and (4) determine the effectiveness of using the hazard and risk simulation application. This research uses the Research and Development method with the ADDIE development model, according to Lee and Owens. It consists of 5 stages, including analysis, design, development, implementation, and evaluation. The research subjects were 70 students in the Electrical Power Installation Engineering Expertise Package at SMK Negeri 2 Yogyakarta. Data collection used a questionnaire that had been validated by media experts and material experts, each with two validators. Data analysis using descriptive methods. The results of the study concluded that: (1) the development of hazard and risk simulation applications can be used to support learning in the subject of Basic Electromechanical Work for Class X students, Competence of Electrical Power Installation Engineering Expertise, (2) function tests of hazard and risk simulation applications are included in the category of "Very Good", (3) the feasibility of the hazard and risk simulation application is included in the "Very Eligible" category according to media experts, material experts, and user response, (4) Wilcoxon test known Asymp value. Sig. (2-tail) of 0.00 shows that there is a difference in value after using hazard and risk simulation learning media. The effectiveness of media applications is known to have increased learning outcomes and is included in the "Moderate" category with a gain value of 0.43. This shows that the media application of hazard and risk simulation applications is effectively used as a learning medium to improve student learning outcomes.

Keywords: simulation, application, hazard and risk, electrical installation, android.

INTRODUCTION

Human Resources (HR) has the main task as a determinant of development in a country [1]. Efforts to produce quality human resources by building strategies in the field of education, especially in Vocational High Schools (SMK). SMK aims to produce a mid-level skilled workforce to be ready to work according to their respective areas of expertise [2].

Improving students' skills cannot be separated from the availability of facilities and infrastructure in SMK. Facilities and infrastructure have a very important role in the learning process to create a comfortable and conducive learning process [3]. Supporting facilities and infrastructure are needed to facilitate the delivery of material by teachers to students [4]. Laboratories and workshops are used as learning facilities to improve students'

skills. Students in doing practice face-to-face with practical materials and tools that might cause danger. The hazards that arise come from the work done, the tools or objects used, and the workplace environment [5]. Hazards that can befall students in the work environment are in the form of biological, chemical, physical, mechanical, and psychological hazards [6].

International Labor Organization (ILO) conducts a survey of 337 million workplace accidents each year which causes around 2.3 million workers to lose their lives [7]. BPJS Ketenagakerjaan's annual report shows that in 2022, the number of work accidents was 265,334 cases [8]. Meanwhile, the Labor Social Security Company (Jamsostek) data shows that field workers who have had direct contact with machines have experienced work accidents. The majority of the workforce working in production areas are SMK graduates. From these facts, it can

be concluded that work accidents can occur among SMK graduates.

Implementing Occupational Health and Safety (OHS) in laboratories and workshops is urgently needed to anticipate and evaluate potential hazards. Occupational safety is needed to create a sense of security from various hazards and risks of work accidents in the work environment. Students must have full awareness of the importance of OSH when doing a practicum in workshops [9]. The objectives of implementing OSH in the workshop include: protecting workshop users from work risks, ensuring all equipment and materials are in a safe condition for use, maintaining all activities in the workshop, and creating a safe and comfortable work environment [10]. Increasing a safe atmosphere at work can increase work productivity [11].

The knowledge about OSH provided by the teacher is not just a theory but must be applied. But in reality, many students ignore the potential dangers that may occur and the use of Personal Protective Equipment (PPE) is not optimal. PPE is one way to prevent accidents, and technically PPE is not perfect for protecting the body, but it can reduce the severity of accidents that occur [12]. Students feel less practical when using PPE, so they underestimate things related to OSH. The lack of warning of danger in the workshop resulted in decreased awareness of the danger.

Based on the results of observations, schools have not fully paid attention to OSH. This is indicated by the lack of OSH posters in the workshop, the lack of socialization regarding the importance of OSH, and the lack of assertiveness by teachers in following up on students who violate OSH regulations. The teacher focuses more attention on students who do not wear work clothes. Students are not allowed to take part in the practice if they are not wearing work clothes. This shows that awareness of OSH behavior is still lacking. Many students are not aware of OSH behavior, especially when they are in the workshop. Students practice without first looking at the theory, so their

knowledge is limited and does not know the correct work procedure. Research states that the magnitude of the relationship of OSH knowledge to OSH behavioral awareness is 23.21%, and the remaining 76.79% is determined by other variables [13].

The application of OSH is very important because it has a positive impact on vocational students as prospective workers [14]. Students are accustomed to always working in safe conditions because they comply with OSH procedures. This will be an advantage for the industry because it has a workforce that is aware of the importance of OSH, as well as enhancing the reputation of educational institutions capable of producing these graduates. OSH's performance of Electrical Power Installation Workshops in SMK can be seen from efforts to minimize hazard risks. The application of OSH aims to prevent or minimize the risks that occur from work carried out by humans.

Hazard identification needs to be done to minimize work accidents [15]. Hazard identification can reduce the chance of an accident because identification is related to the factors that cause accidents [16]. The potential hazards that occur in the Electrical Power Installation Workshop are numerous. Everything that is done when students do workshop practicum must have a risk. The need for students to understand the hazards and risks that can occur in the workshop. In order to minimize the number of work accidents, so as to create a healthy and safe working atmosphere.

This research is limited to developing hazard and risk simulation applications in Android-based Electric Power Installation Workshops for learning Electromechanical Basic Work in Vocational High Schools. The hazard and risk simulation application is an Android-based application to support the learning process for class X in the Electrical Installation Engineering Skills Competency. This simulation application can be a learning medium to broaden students' insights regarding occupational health and safety. The development of hazard and risk simulation applications for Android-based

Electric Power Installation Workshops is packaged with attractive animations. So that students can have an idea of the dangers and potential hazards that can occur when doing a practicum in the workshop. The simulation is packaged with interesting animations so that it can increase students' interest and motivation to learn [17]. The hazard and risk simulation application for Android-based Electric Power Installation Workshops were developed using Adobe Animate CC software.

METHODS

A. Development Model

Media development is carried out using the RnD (Research and Development) research and development model. The resulting product is a hazard and risk simulation application in the Electrical Power Installation Workshop on a smartphone with the Android operating system. The limitations of the material described in the learning media consist of occupational safety and health, hazards, risks, personal protective equipment, and hazard simulations. The effectiveness of using instructional media is known from the differences in pretest and posttest results. The development model used is the development model, according to Lee and Owens. The steps taken include analysis consisting of need assessment and front-end analysis, development, implementation, and evaluation [18], shown in Figure 1.

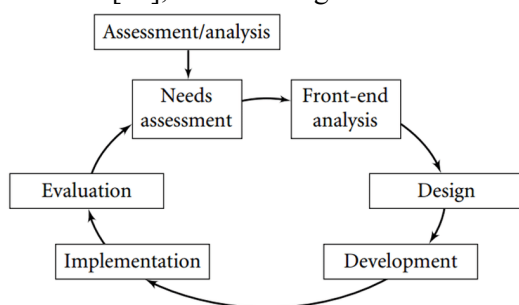


Figure 1. ADDIE Development Model Stages

B. Development Procedure

The steps in the ADDIE development model, according to Lee and Owens:

1) Analysis

The analysis stage consists of need

assessment and front-end analysis. Need assessment is a systematic process for setting goals, identifying actual conditions with conditions to be achieved, and setting priority actions to be taken [19]. The need assessment analysis carried out was conducting interviews and observations. Observations were carried out at the Electric Power Installation Engineering Skills Competency Workshop, while interviews were conducted with teachers supporting the Electromechanical Basic Work subject at SMK Negeri 2 Yogyakarta. Meanwhile, front-end analysis is an analysis conducted to obtain information about alternative solutions to be developed. Front-end analysis consists of student analysis, situation analysis, technology analysis, objective analysis, important event analysis, current issue analysis, task analysis, media analysis, existing data analysis, and cost analysis [19]. At this stage, the problems found in learning are examined to find out how to solve them [20].

2) Design

The second stage that must be done is the design stage. The design stage is a design process that considers important factors in product development. Planning that can be done, among others: determine media concept, display concept, material concept, flowchart creation, user experience creation in the form of storyboards and application wireframes, and user interface creation. Storyboards are used to assist developers in compiling step-by-step application designs [21]. Wireframes are used to facilitate the preparation of content and user experience [22]. User Interface (UI) refers to a system and a user interacting with each other through commands or techniques to operate the system, input data, and use the contents. User Experience (UX) refers to the overall experience related to the perception (emotion and thought), reaction, and behavior that a user feels and thinks through his or her direct or indirect use of a system, product, content, or service [23]. UI/UX is an interface through which a person can interact with a system or application in a computer and communication environment, which is classified

into a software interface and a hardware interface [24]. Creating a user interface and user experience using Adobe XD software. Adobe XD is software that focuses on design for the user interface and user experience. Users can design simple application interfaces and then create interactive prototypes that can be distributed and viewed by users [25].

3) Development

The purpose of this stage is to produce products and validate learning resources that have been loaded into learning media. The development stage includes product production, feasibility testing, revising, and testing. The product manufacturing stage was developed using Adobe Animate CC software. Adobe Animate is a multimedia software that is useful for creating animations. The formats that can be published are HTML5, WebGL, Scalable Vector Graphics (SVG) animation and Sprite Sheets, Flash Player Format (SWF), and Adobe AIR.

The project development is also distributed to Android, iOS, Windows Desktops, and MacOS [26]. Functional testing is obtained from the results of the function test assessment. Product revision based on the results of input analysis and suggestions from media and material experts.

4) Implementation

The implementation phase is carried out by implementing products developed in the school environment involving teachers and students. At this stage, a questionnaire will be distributed, which is used to evaluate the learning media. This researcher can find out the responses or opinions of students regarding the learning media developed.

5) Evaluation

This evaluation stage is carried out to measure the level of effectiveness of the learning media developed. Increased student knowledge can be seen by comparing the pretest and posttest results.

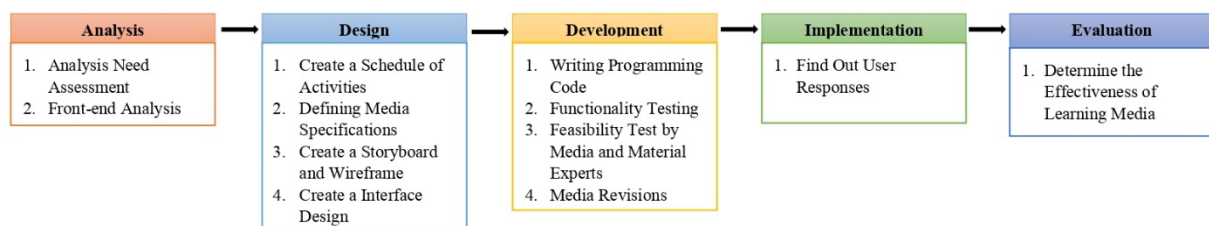


Figure 2. Schematic of Research and Development Hazard and Risk Simulation Application

C. Research Subject

Subjects in the study include: (1) Nine students of the Department of Electrical Engineering Education, Faculty of Engineering, Yogyakarta State University as function test examiners; (2) Two media experts are Lecturers of the Department of Electrical Engineering Education, Faculty of Engineering, Yogyakarta State University; (3) Two material experts are one Lecturer of the Department of Electrical Engineering Education, Faculty of Engineering, Yogyakarta State University and one teacher of the Electromechanical Basic Work subject of the TITL expertise program at SMK Negeri 2 Yogyakarta; and (4) Class X students majoring in TITL at SMK Negeri 2 Yogyakarta totaling 70

students, with details: 35 students as a control class and 35 students as an experimental class.

D. Data Collection Technique

Data collection techniques used in this study include:

1) Observation

Observations were made to obtain data used for product development needs. Data in the form of syllabus, available learning media, and student participation in participating in Electromechanical Basic Work lessons. The observation was carried out directly to find out the situation that occurred when the learning took place in the Electrical Power Installation Workshop.

2) Interview

Interviews were conducted to collect in-depth information through conversations and questions and answers to informants who were directed to achieve the research objectives. The purpose of the interviews was to gather information regarding the hazards and risks at the Electrical Installation Workshop, the teaching and learning process, student behavior, and the use of learning media at SMK Negeri 2 Yogyakarta. The resource person for this interview activity was one of the teachers supporting the Basic Electromechanical Work subject.

3) Questionnaire

The questionnaire functions as an instrument for collecting research data. The accumulation of research data was obtained from the assessment of function tests, due diligence questionnaires, and respondent test questionnaires. The function test assessment is obtained from the function test assessment results. The due diligence questionnaire is a questionnaire for media and material experts. The respondent test questionnaire is a questionnaire that is distributed to students in Vocational High Schools.

E. Data Analysis Technique

The research data was obtained from the feasibility test questionnaire and the respondent test questionnaire. The feasibility test questionnaire is a questionnaire for media and material experts, while the respondent test questionnaire is a questionnaire that is distributed to students at SMK. The scale used is a likert scale with an alternative of four answer choices. The likert scale is some negative and positive statements regarding an object of attitude [27], shown in Table 1.

Table 1. Likert Scale

No	Percentage	Category
1	Strongly agree	4
2	Agree	3
3	Simply Agree	2
4	Disagree	1

Rating categories were determined using the normal distribution intervals shown in Table 2 [28].

Table 2. Feasibility Category Criteria

No	Score Intervals	Category
1	$(Mn + 1,50 SBn) < M \leq (Mn + 3,0 SBn)$	Strongly agree.
2	$(Mn) < M \leq (Mn + 1,50 SBn)$	Agree
3	$(Mn - 1,50 SBn) < M \leq (Mn)$	Simply Agree
4	$(Mn - 3,0 SBn) < M \leq (Mn - 1,50 SBn)$	Disagree

Description:

Mn = nominal average value
 $= \frac{1}{2} \times (\text{ideal highest score} + \text{ideal lowest score})$

SDn = nominal standard deviation
 $= \frac{1}{6} \times (\text{ideal highest score} - \text{ideal lowest score})$

The test of the effectiveness of the users of the developed media was carried out by quasi-experimentation using a pretest-posttest control group design model. The design of the experiment involves two groups of classes, namely the experimental class and the control class. Control classes are classes that are given learning using hazard and risk simulation applications, while control classes are given learning without using hazard and risk simulation applications [29]. The design of the experiment is shown in Table 3.

Table 3. Pretest-Posttest Control Group Design Experiment Design

No	Class	Pre-test	Treatment	Post-test
1	Experiment	O ₁	X	O ₂
2	Control	O ₃	-	O ₄

Description:

O1 = pretest results for the experimental class
 O2 = posttest results for the experimental class

X = treatment with hazard and risk simulation applications

O3 = pretest results for the experimental class
 O4 = posttest results for the experimental class

The results of the pretest and posttest of the experimental class and the control class were analyzed by the Mann-Whitney U test. Equation (1) and (2) in the analysis of nonparametric hypothesis testing using Mann-Whitney is [30]:

$$U_1 = n_1.n_2 + \frac{1}{2} \{n_1(n_1+1)\} - R_1 \quad (1)$$

$$U_2 = n_1.n_2 + \frac{1}{2} \{n_2(n_1+1)\} - R_2 \quad (2)$$

Description:

n = number of samples 1 and 2

U = sum of ranks 1 and 2

R = number of ranks in samples n_1 and n_2

Testing the increase in learning outcomes of the experimental class used the Wilcoxon test from the post-test results. The Wilcoxon test serves to test differences between paired data, test comparisons between observations before and after being given treatment, and determine the effectiveness of a treatment [31].

The Wilcoxon sign rank test formula is as follows [32]:

$$Z = \frac{T - \mu T}{\sigma T} \quad (3)$$

Description:

T = number of ranks with the smallest sign

The basis for decision-making to accept or reject the hypothesis on the Wilcoxon sign rank test is as follows: If the probability (Asymp.Sig) < 0.05, then H_0 is rejected, meaning there is a difference, whereas if the probability (Asymp.Sig) > 0.05 then H_0 is accepted meaning there is no difference.

The gain test is used to determine the effectiveness of using learning media. Equation (4) is the formula for calculating the gain value by category according to Table 4 [33], as follows:

$$g = \frac{T'1 - T1}{T_{maks} - T1} \quad (4)$$

Description:

g = score gain

T'1 = score posttest

T1 = score pretest

T_{maks} = maximum score

Table 4. Gain Value Classification

Gains Score	Category
0.71 – 1.00	High
0.31 – 0.70	Medium
0.00 – 0.30	Low

RESULT AND DISCUSSION

The product results in this development research are hazard and risk simulation applications in Android-based Electric Power Installation Workshops. The product developed contains occupational health and safety material in the Electromechanical Basic Work subject. The application can be used as a learning medium in the Electromechanical Basic Work subject. The development model used is the development model, according to Lee and Owens. An explanation of each stage of development is described as follows:

A. Analysis Stage

This research begins with an analysis phase which is divided into two, namely need assessment analysis and front-end analysis. From the results of observations and interviews, it is known that teachers do not vary learning media in teaching and learning activities. The use of monotonous learning media makes students less interested and less active in participating in the learning process. This can result in the inability of students to understand the knowledge conveyed by the teacher. Finally, it has an impact on low student learning outcomes, so that learning objectives cannot be achieved. Delivering material can be mastered by students optimally with the application of more fun and innovative learning media. Utilization of technology and information can be utilized in the world of education, for example, through the development of learning media. One alternative learning media that can be developed is a hazard and risk simulation application at an Android-based Electric Power Installation Workshop. This learning media can be used in the learning process and can increase students' interest in participating in the learning process because the

appearance of the design is made attractive, and the material is adjusted to competency standards so that it can support the teaching and learning process.

B. Design Stage

The design phase is carried out by referring to the need assessment analysis that has been carried out. Product design carried out includes:

- 1) Determine the media concept, display concept, and material concept.

This application contains materials, simulations, and evaluations compiled using Adobe Animate CC software. The material explains material on occupational health and safety, hazards, and personal protective equipment. The hazard and risk simulations contained in the application are hazards that often occur when carrying out electrical installation practicums. Evaluation questions make questions related to the material contained in the application. This application is named Hazard and Risk Simulation. The display concept of this application product is designed according to the storyboard, which is then compiled into an interface design using Adobe XD software. This application is dominated by green and white colors. The interface design that has been made is then realized in Adobe Animate CC software through the Actionscript 3.0 programming language. The material concept refers to Basic Competency 3.1 applying OSH

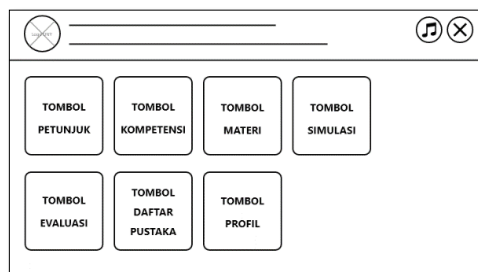


Figure 3. Storyboard Menu Page

according to the standard operating procedure manual in the field of electromechanical work and 4.1 Using OSH according to the standard operating manual in the electromechanical work field. The preparation of the material in this application was developed based on the syllabus of the Basic Electromechanical Work subject at SMK Negeri 2 Yogyakarta.

- 2) Creating a Flowchart

The flowchart will be a guideline for how one screen is related to another screen in a hazard and risk simulation application. The contents of the screen that will be loaded in the media to be developed include a splash screen page, start page, main menu, instructions page, competency menu, basic competency page, material achievement indicator page, material menu, material page, simulation menu, page simulation, evaluation menu, evaluation page, evaluation results page, bibliography page, profile page, and exit page.

- 3) Creating User Experience (Storyboard and Application Wireframe)

Storyboards are used as a reference, an overview of the display that will appear in the hazard and risk simulation application. This storyboard contains the display design and various navigation buttons (Figure 3 and Figure 4). Wireframe contains a framework that can provide a rough description of each page contained in an application before entering the visual stage (Figure 5).

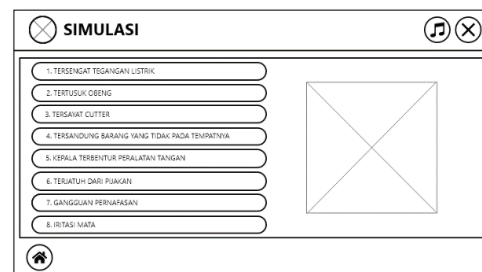


Figure 4. Storyboard Menu Simulation

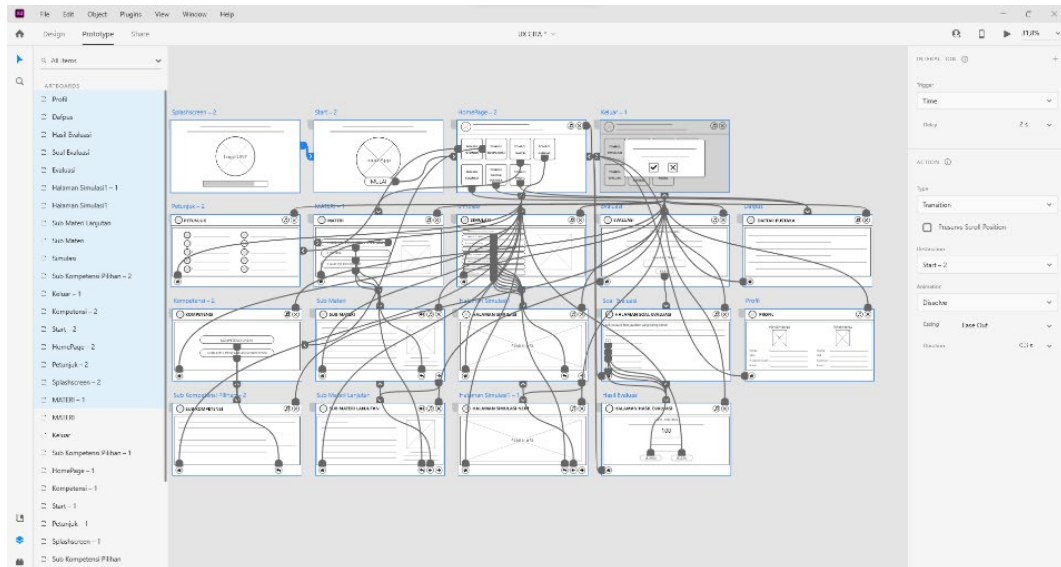


Figure 5. Design User Experience

4) Creating a User Interface

Creating a user interface using Adobe XD software (Figure 6). The design includes the

creation and arrangement of icon elements and materials.

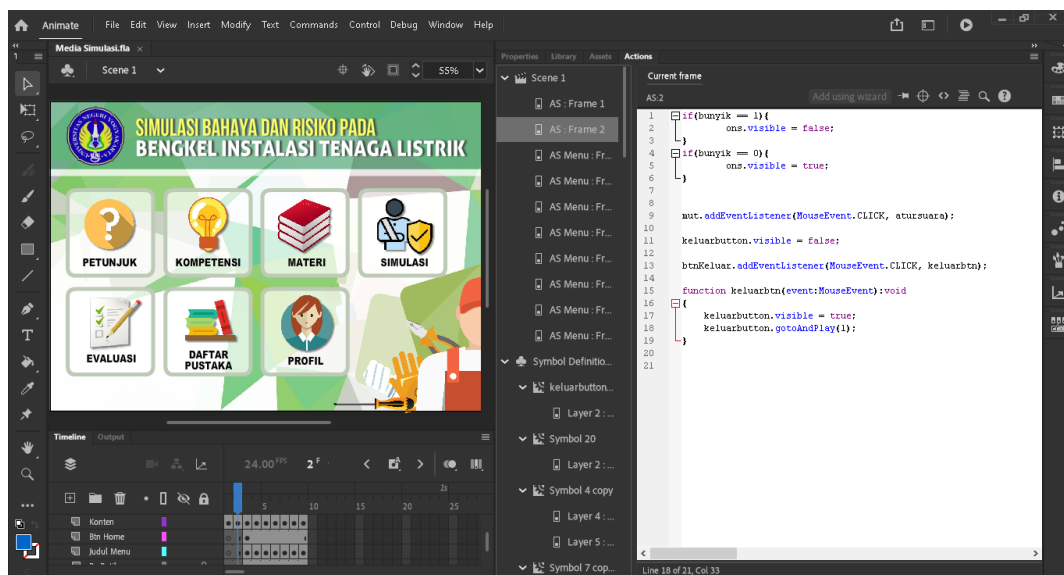


Figure 6. Desain User Interface

C. Development Stage

The development stage is carried out by realizing the concept of interface design and material design in Adobe Animate CC software (Figure 7), which is then integrated into an Android device. After this is realized, the media

is then tested for application functionality and validation by material experts and media experts to determine the feasibility level of the application (Figure 8). The results of the testing and validation are then revised so that the product is ready to be tested on students.

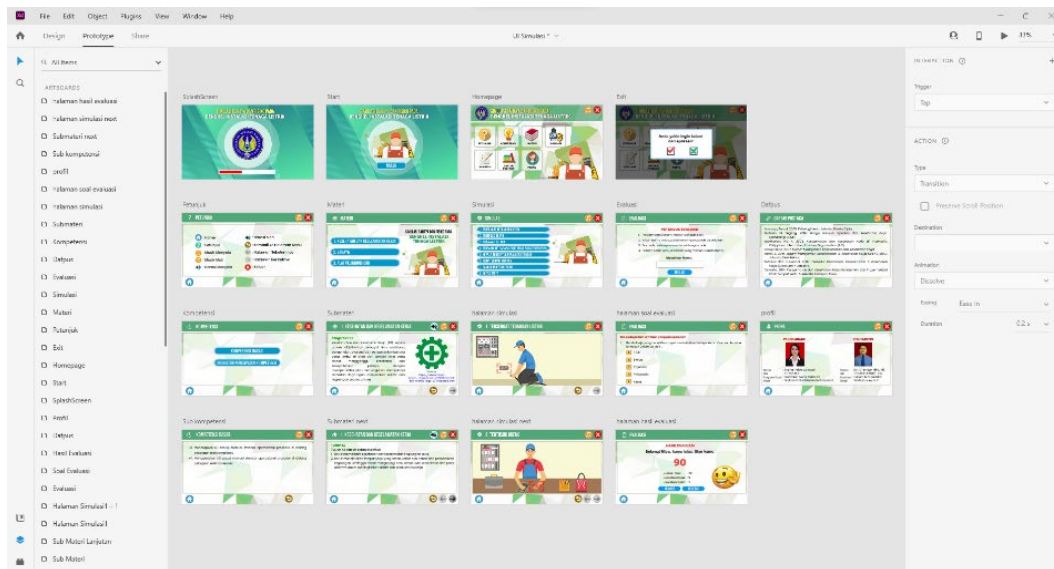


Figure 7. The Process of Creating Media in Adobe Animate



Figure 8. Application Development Results

1) Function Test

The function test aims to see the functioning of the functions created. The focus of this function test is the application installation and application operation. Function tests were carried out with various smartphone devices, namely: Oppo, Asus, Huawei, Samsung, Realme, and Xiaomi. Functional tests have shown that the system is able to work as expected. Function test testing is carried out using a questionnaire with a total of 40 items. The assessment questionnaire is divided into two aspects, namely: 2 aspects of application installation and 38 aspects of application operation. The results of the functional test on the application installation aspect obtained an average score of 2, and a large percentage of

eligibility was 100% included in the "Very Good" category. The operational aspect of the application obtains an average score of 38, and a large percentage of eligibility is 100% included in the "Very Good" category. The results of the function test of the hazard and risk simulation application are shown in Figure 9.

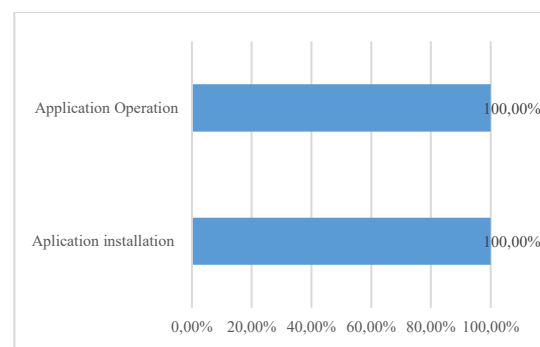


Figure 9. Functional Test Results Assessment Graph

2) Media Feasibility Test

Media feasibility testing by media experts has 5 aspects, namely: text, graphics, color, animation, and audio [34]. The media feasibility test used a questionnaire instrument with a total of 31 statement items. There are 6 text aspects, 9 graphic aspects, 6 color aspects, 6 animation aspects, and 4 audio aspects. The results of the assessment by media experts on the text aspect obtained an average score of 21.5 and an eligibility percentage of 89.58% in the "Very Eligible" eligibility category. The graphical aspect obtained an average score of 31.5 and an eligibility percentage of 87.50% in the "Very Eligible" feasibility category. The color aspect obtained an average score of 21 and an eligibility percentage of 87.50% in the "Very Eligible" feasibility category. The animation aspect gets an average score of 21 and a feasibility percentage of 87, 50%, with the "Very Eligible" category of eligibility. The audio aspect obtains an average score of 10.5 and a feasibility percentage of 65.63% with the "Decent" eligibility category. The results of the feasibility assessment of hazard and risk simulation application media by experts are shown in Figure 10.

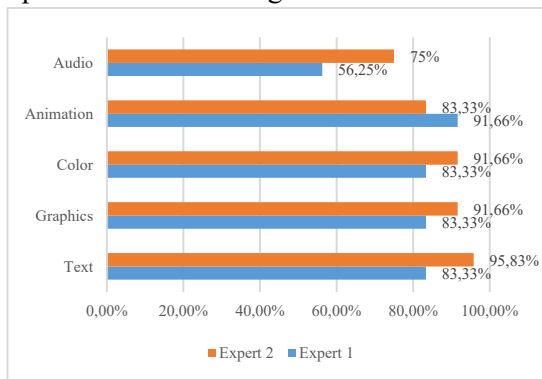


Figure 10. Assessment of Media Feasibility Results Graph

3) Material Feasibility Test

Material feasibility testing by material experts has four aspects, namely: accuracy of the material, usefulness, user friendly, and attracting motivation [35]. The material feasibility test uses a questionnaire instrument with a total of 29 statement items. Aspects of the actuality of the material, as many as 10 items; aspects of

usefulness, as many as 6 items; aspects of user convenience, as many as 8 items; and aspects of attracting motivation, as many as 5 items. The results of the assessment by material experts on the aspect of the accuracy of the material obtained an average score of 32 and a percentage of 80.00% with the "Decent" feasibility category. The usefulness aspect gets an average score of 17 and a percentage of 70.83% in the "Decent" feasibility category. The user-friendliness aspect obtained an average score of 30.5 and an eligibility percentage of 95.31% in the "Very Eligible" feasibility category. Interesting aspects of motivation get an average score of 17, 5, and the percentage of eligibility is 87.50% with the category of "Very Eligible". The results of the feasibility assessment of hazard and risk simulation application materials by media experts are shown in Figure 11.

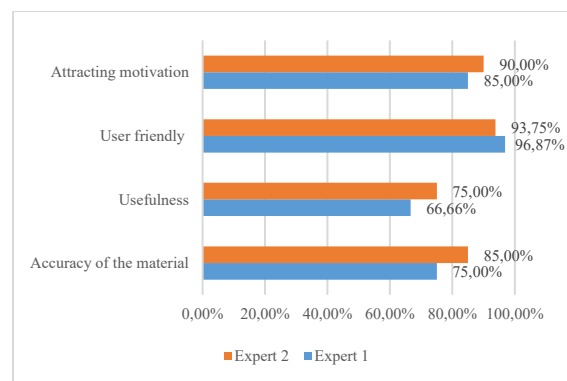


Figure 11. Assessment of Material Feasibility Results Graph

D. Implementation Stage

The implementation was carried out in one meeting with the research subject of class X TITL students at SMK Negeri 2 Yogyakarta. Class X TITL 4 is the experimental class, and class X TITL 3 is the control class. The hazard and risk simulation application was applied to the experimental class, while the control class did not use hazard and risk simulation application media. This development product is implemented in the learning process of the Basic Electromechanical Work subject. In addition, students also filled out user response questionnaires to find out students' responses to

the products being developed.

The user response test was carried out with a questionnaire of respondents filled out by students. The user response test consists of 3 aspects, namely: appearance, presentation of material, and benefits. The user response questionnaire instrument contains 27 statement items, which consist of 13 appearance aspects, 9 material presentation aspects, and 5 benefit aspects. Results assessment by users on the display aspect obtained an average score of 45.69 and a percentage of 87.86% with the "Very Good" feasibility category. The presentation aspect of the material obtained an average score of 32.17 and a percentage of 89.37% in the "Very Good" feasibility category. The benefits aspect obtained an average score of 17.54 and a percentage of 87.71% in the "Very Good" feasibility category. The results of the assessment by users of the hazard and risk simulation applications by media experts are shown in Figure 12.

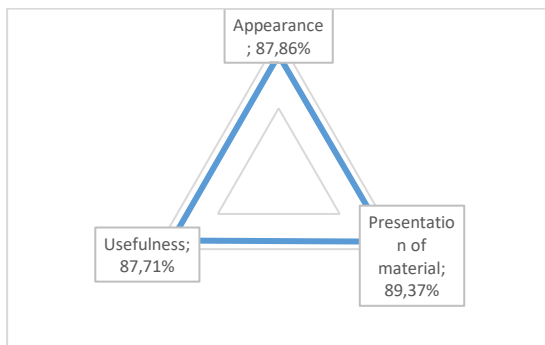


Figure 12. User Response Results Assessment Graph

E. Evaluation Stage

At the evaluation stage, an analysis of the learning outcomes of students who use the product as a learning medium must be carried out. The hazard and risk simulation application was applied to the experimental class, while the control class did not use hazard and risk simulation application media. The learning outcomes of the two classes were then analyzed to determine the effectiveness of the application of simulation and hazard learning media. Learning outcomes are in the form of pretest and posttest scores to determine students' initial

abilities and final abilities.

Table 5. Mann Whitney Test Results Pretest Results for the Experiment Class and Control Class

Test Statistics ^a	
	Pretest
Mann-Whitney U	584.500
Wilcoxon W	1214.500
Z	-.338
Asymp. Sig. (2-tailed)	.735

a. Grouping Variable: Kelas

Based on the results of the Mann-Withney test in Table 5, it is known that the Asymp. Sig. (2-tailed) of 0.735. Asymp value. Sig. (2-tailed) is greater than the significant rate of 0.05, so there is no significant difference in knowledge between the experimental class and the control class.

Table 6. Mann Whitney Test Results Posttest Results for Experiment Class and Control Class

Test Statistics ^a	
	Posttest
Mann-Whitney U	288.000
Wilcoxon W	918.000
Z	-3.858
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Kelas

Based on the results of the Mann-Withney test in Table 6, it is known that the Asymp. Sig. (2-tailed) of 0.00. Asymp value. Sig. (2-tailed) is smaller than the significant rate of 0.05, so there is a significant difference in knowledge between the experimental class and the control class.

Table 7. Experimental Class Wilcoxon Test

Test Statistics ^a	
	Posttest-Pretest
Z	-4.903 ^b
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Rank Test
b. Based on negative ranks.

Based on the results of the Wilcoxon test in Table 7. It is known that the Asymp. Sig. (2-tailed) of 0.00. Asymp value. Sig. (2-tailed) is smaller than the significant rate of 0.05, indicating that there is a difference in knowledge of initial and final conditions in the experimental class after being given hazard and risk simulation learning media.

The gain test is used to state the effectiveness of using learning media. The total gain value for each category of 35 samples includes 7 low categories, 26 medium categories, and 2 high categories. The average obtained in calculating the gain value is 0.43, which is included in the "medium" category. The graph of the distribution of gain values in each category can be seen in Figure 13.

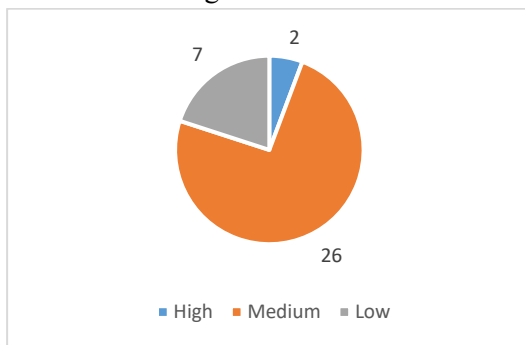


Figure 13. Assessment of Media Effectiveness Results Graph

CONCLUSION

Based on the results of research on the development of simulation and hazard applications, it can be concluded that the results of the media developed are in the form of hazard and risk simulation applications in Android-based Electric Power Installation Workshops. Learning media can be used to support learning in the Electromechanical Basic Work subject for Class X students of the Electrical Installation Engineering Expertise Package.

The function test results of the hazard and risk simulation applications are included in the "Very Good" category, with an average value of 40.00. The results of the feasibility test of media experts get a total average score of 105.50, included in the "Very Eligible" category. The

results of the material expert feasibility test obtained an average score of 97.00, included in the "Very Eligible" category. User response test results get a total average score of 95.40, included in the "Very Good" category.

The effectiveness of using an Android-based hazard and risk simulation application in terms of the learning outcomes of the experimental class shows that there are significant differences in learning outcomes. Wilcoxon test known Asymp value. Sig. (2-tailed) of 0.00. The significant value is less than the significant rate of 0.05, indicating that there is a difference in knowledge of the initial and final conditions in the experimental class after being given hazard and risk simulation learning media. The result of calculating the average gain value is 0.43, included in the "Medium" category. This shows that this hazard and risk simulation application media is effectively used as a learning medium to improve student learning outcomes. This research needs to be followed up with product dissemination activities. Product dissemination can be done by implementing the product for full-scale and regular use in schools.

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