

Developing Android Assisted Worked Example (WE) Application on Electrodynamics as Physics Learning Solution

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Abstract. This research aims to determine the feasibility of android assisted Worked Example (WE) application on the electrodynamics materials. The research method employed was a 4-D model (Four-D Models) consisting of define phase, design phase, develop phase, and disseminate phase. Data collection instruments in this research were the media feasibility instrument, material feasibility instrument, WE feasibility instrument and preliminary field testing instrument. Data analysis technique used was Aiken's V for assessing the quality of the WE application product. Research subjects involved 7 experts, 23 high school students of class XII for preliminary field testing. Research results show that the developed WE application is eligible for use based on the material aspects assessment with Aiken's V value of 0.81, media aspects with Aiken's V value of 0.79, WE aspect with Aiken's V value of 0.89 and preliminary field test results on the students with Aiken's V value of 0.82.

INTRODUCTION

Physics is one of the subjects considered important and must exist in the school curriculum due to the contribution of physics to the development of technology and science [1]. It is also one of the school subjects that are considered difficult by most students. That is proven by the research [2] which explains that students regard physics as a school subject with material which is densely packed, full of equations to memorize, mathematical in nature, and not contextual. One of the solutions to overcome students' physics learning problems uses what is called WE.

WE is a learning tool which provides students with a solution in learning [3] and a learning means which could teach the competence of solving problems like those in physics and mathematics by presenting examples of such problems and showing the steps of solving each problem, which includes showing the final answer [4].

WE in the research concerned here was constructed in the form of an application loaded in a mobile learning device which is an operating system for touchscreen mobile devices given the trade name of Android. Data from eMarketer [5], a market research company located in New York, indicate that the number of smartphone users in Indonesia reached 55.4 million in 2015, occupying the third rank in Asia and the Pacific and assumed to rise to 65.2 million in 2016 and 74.9 million in 2017.

Android in Indonesia could be made use of as an aid to the learning media used by the teacher and the students in the teaching and learning process. Android as mobile learning device is a learning media which takes account of technological mobility, learner mobility, and teaching and learning mobility with the purpose of making learning become pleasant and creative [6]. Android has advantages related to the interactive ability, the access, and the pleasure offered [7] and to articulating reviews of thinking processes and participating in collaborative cognitive processes [8]. Another advantage that android has is in line with the opinion of [9] and [10] in stating that, as mobile learning device, it is beneficial by being easy to use, by making it easier for students to learn, and by already becoming part of the educative process. Lynette [9] also states that mobile learning is a type of e-learning with educational content and learning support materials by means of a wireless communication device.

The availability of Android as mobile learning device in the educational world makes mobile technology become an educational resource. The improved educational resource because of mobile technology makes access to learning become more reachable, personal, interactive, and effective for anyone wanting to learn [11]. Based on those experts' statements, it is considered necessary to make learning applications that could draw students' interest in learning with the purpose of overcoming learning problems and especially those involving physics. One of the applications that have been made is the Android-assisted WE application.

The main reason for the WE application to have been the application made is that there had not yet been any application of the same type developed prior to it in, particularly, Indonesia. The WE application is an application that could be installed on Android. The said application contains items which are examples of problems in physics together with their solutions in which there are important concepts of physics presented according to predetermined problem levels in order to aid students in learning physics. The WE application which contains examples of problems and their solutions could assist students in learning so that it could hopefully improve students' competence in dealing with particularly physics material concerning electrodynamics.

Developing android assisted WE application would itself draw the teacher's and the students' interest in physics learning media because WE is a collection of problem examples together with their answers in the form of concepts explained in a detailed way so that students could learn on their own or in class. There is not yet any general WE application making in Indonesia so that a WE application made would be an attraction that could be used to improve students' competence in the matter of comprehending concepts in physics.

With the above discussion as basis, the research meant here focused on the making of a media in the form of an Android-assisted WE application as an aid to students in comprehending concepts of physics in particularly materials concerning electrodynamics.

The research problem could be expressed as follows: what is the feasibility (or appropriateness) of the android-assisted WE application on electrodynamics according to evaluation by experts and students? The research objective was, therefore, to know the feasibility of the Android-assisted WE application on electrodynamics that was made.

METHOD

Research Method

The research method used is a Research and Development (R & D) with 4-D model (Four-D Models) [12]. The 4-D model consists of define, design, develop, disseminate. Simply put, the flow diagram of the 4-D model development procedure can be seen in Figure 1.

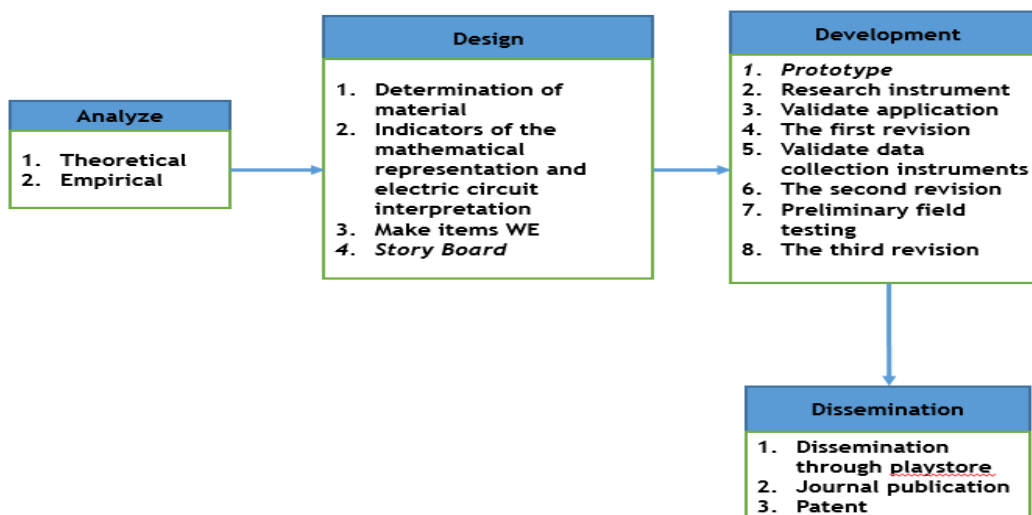


FIGURE 1. Diagram of Procedure Development Model

Participants

The research was conducted in Samarinda, Kalimantan Timur, Indonesia. Involved as research subjects were seven experts and twenty-three students of Grade XII at SMA N 5 Samarinda for the restricted testing of the research product. The research objects were the quality and feasibility of the WE application according to material validation, media validation, WE validation, and empirical validation.

Data Collection Instruments

The research used data collection instruments in the form of respective instruments for media, material, and WE feasibility evaluation and the restricted testing instrument. The data used to evaluate the quality of the WE application product were analyzed by using Aiken's V ranging in acceptable value from 0 to 1 [13].

$$V = \sum s / [n(c - 1)] \quad (1)$$

Data Analysis

The product quality measuring instrument was constructed with each item having a likert scale ranging from 1 to 5 in value in the validation by the aforesaid seven experts. The results of the validation were then analyzed by using Aiken's V ranging in value, as previously mentioned, from 0 to 1. The analysis resulted in information of the product quality and improvement done on the WE product based on the experts' evaluation. What resulted from the revision of the WE application evaluated by the experts was then tried out on twenty-three students of Grade XII in the IPA (*Ilmu Pengetahuan Alam* 'the physical sciences') field of study at SMA N 5 Samarinda.

RESULT AND DISCUSSION

One way to improve learning motivation and learning outcomes of students are using technology-based instructional media [14]. Use of technology-based instructional media can also make learning more effective [15]. Technology that is growing rapidly in Indonesia are android, which reached 55.4 million in 2015, occupying the third rank in Asia and the Pacific and assumed to rise to 65.2 million in 2016 and 74.9 million in 2017 [5]. Therefore, the development of android-based learning media especially android assisted WE application is very promising.



FIGURE 2. (a) Initial display of WE Application, (b) main menu display of WE Application

The development of android assisted WE application was adopted to high school physics curriculum (K-13). Developing android assisted WE application was done by making a flowchart and storyboard first. The aim of making flowchart was in order to result of media has an easy to use navigation groove in operation, while the making of storyboard aims to make some of the right frame and attractive. Producing media using construct 2. Broadly speaking, the menu listed at the android assisted WE application on electrostatics are (1) material

menu, (2) worked example menu, (3) exam menu, (4) evaluation menu, (5) instruction menu, and (6) profile menu. The display of WE Application can be seen in Figure 2.

The initial product that has been developed further evaluated. Product evaluation is intended to assess or validate the initial product developed media. Validation and assessment carried out by expert judgement. Then proceed assessment by peer reviewer and physics teacher. Media product that have been validated, then tested the students at SMA N 5 Samarinda.

The research results are grouped into five matters: (1) results about the material and media feasibility of the WE application, (2) results about the WE feasibility of the WE application, (3) results about the WE application feasibility based on students' evaluation, (4) the resulting WE application final product, and (5) Characteristic of final product.

Results about the Material and Media Feasibility of the WE Application

The data resulting from the material validation were in the form of evaluation and input concerning the material, WE, language, and material presentation as the aspects validated by the seven experts. From the material validation data, it was found that the material concerning electrostatics was ready to be used in the research with attention paid to suggestions given. The experts involved in the research suggested that the researcher adjust the learning material to the evaluation instrument, give additional material concerning resistance chain, namely, material concerning star-to-delta transformation, and give the title page the developer information in the form of the developer's name. The evaluation data could be seen in Table 1.

TABLE 1. Aiken's V Scores for the WE Application Quality Evaluation by Experts

Validity	Aspect	Aiken's V
Material	Material	0.79
	WE	0.83
	Language	0.82
	Presentation Material	0.82
	Mean Score	0.81
Media	Display	0.83
	Software Engineering	0.76
	Mean Score	0.79

From Table 1, it was seen that Aiken's V scores obtained for the respective validities of material and media as aspects of the WE application quality were 0.81 and 0.79 while, according to Aiken [13], the values of Aiken's V considered acceptable are those ranging from 0 to 1.00. In other words, it could be said that 0.81 and 0.79 could be interpreted as very good coefficients for the items concerned so that it could be concluded that the WE application had very good quality and it was feasible to be used in physics learning according to the evaluation by the experts

Results about the WE Feasibility of the WE Application

The data resulting from the WE validation were of the feasibility (or appropriateness) of thirty-four items which were examples of problems concerning dynamic electricity in the WE application. The WE validation was done by means of the seven experts' evaluation of the problem solving procedure, mathematical representation, and electrical circuit interpretation as the aspects evaluated. In brief, the data resulting from the feasibility mean scores of the WE items could be seen in Table 2.

TABLE 2. Data Resulting from the WE Validation

No	Aspect	V Aiken's Mean Score	Category
1	Procedure of Problem Solving		
2	Electric Circuits Interpretation	0.89	Very Good
3	Mathematical Representation		

From Table 2, it could be seen that WE was already feasible to be used in learning from the point of the problem-solving procedure, mathematical representation, and electrical circuit interpretation as the aspects concerned. It is in line with the statement by Aiken [13] that the range of the values of Aiken's V considered

acceptable is between 0 and 1.00. In other words, it could be said that 0.89 could be interpreted as a very good coefficient for the items concerned.

Results about the Feasibility of the WE Application Based on Students' Evaluation

The evaluation of the WE application product by students was done by responding to a questionnaire concerning the WE application used with appearance and software technology, language, learning, content of material, and comprehension as the aspects concerned. In brief, the data resulting from the evaluation of the WE application product quality could be seen in Table 3.

TABLE 3. Data Resulting from the WE Application Quality Evaluation by Students

No	Aspect	V Aiken's Mean Score	Category
1	Display and Software Engineering		
2	Language	0.82	Very Good
3	Learning		
4	Contents of Material		
5	Comprehension		

The data resulting from the WE application product evaluation were analyzed and became the references for revisions of the product that had been made. With the evaluation from the twenty-three students in the restricted testing of the product as basis, it was found that the Android-assisted WE application was very good in quality and feasible to be used in learning. It was in line with the statement made by Aiken [13] that the range for Aiken's V values considered acceptable is between 0 and 1.00. In other words, it could be said that 0.82 could be interpreted as very good coefficient for the item concerned.

Resulting WE Application Final Product

The visual appearance of components contained in the Android assisted WE application on electrodynamics materials among others are: (1) The initial view on the WE opening menu, containing Yogyakarta State University logo, the name of the application, the developer name, and a button menu to the next layer, the exit button to exit the application, followed by the main menu, and contains several menus and buttons. The hint button contains instructions in using the WE application, profile button contains the developer profile. The initial display of WE application can be seen in Figure 3.



FIGURE 3. Initial Display of Android assisted WE Application

2) Main menu display, containing the materials menu, the worked example menu, the evaluation menu, the hint menu, the exam menu, and the profile menu as shown in Figure 4.



FIGURE 4. Main Menu Display of android assisted WE Application

3) Materials menu, containing description of the materials that will be learned. Display of the materials menu is divided into sub material parts. To view each of the desired materials, simply click on the materials. The home button functions to return to the main menu as shown in Figure 5.



Figure 5. Materials Menu Display of android assisted WE Application

4) Worked example menu, containing 34 examples of problems, which are arranged based on the level of question and the solution. Display of the worked example menu is divided in sub material parts as shown in Figure 6.



Figure 6. Worked Example Menu Display of android assisted WE Application

5) Evaluation menu, containing exercises. Evaluation menu contains 10 short answer questions which are set not to proceed to the next step if the students answer incorrectly. It is shown in Figure 7.

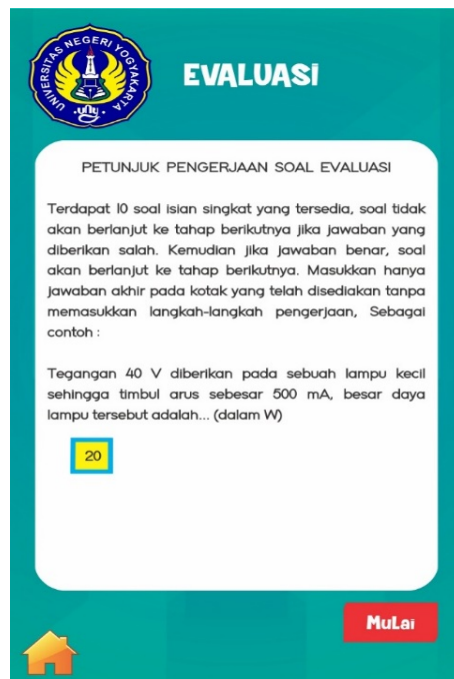


Figure 7. Evaluation Menu Display of android assisted WE Application

6) Exam menu, containing additional independent test questions for students which contain 12 essay questions consisting of mathematical representation and electric circuits interpretation as shown in Figure 8.

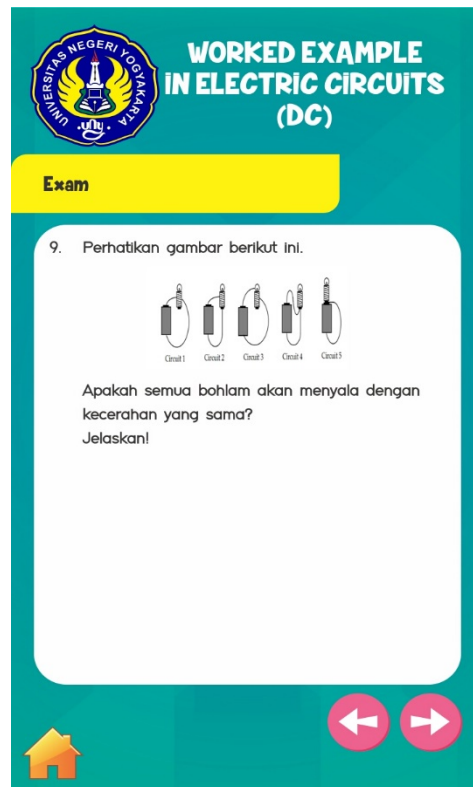


Figure 8. Exam Menu Display of android assisted WE Application

Characteristic of Final Product

Android assisted WE application on electrodynamics that has been developed has characteristics, namely (1) the relevant learning material, meaning that the material presented in the instructional media in accordance with high school physics curriculum and according to the characteristics and needs of the students in high school. The relevance of these media is essential in making instructional media [16], (2) clear and interesting visualization, meaning images, and layout was made clear in the media and makes appeal students in use. This is in accordance with the submitted [17] that the mobile media learning should have a clear picture and good to facilitate students in understanding the material and makes the appeal in the use of media, (3) flexible, meaning that media can be used anywhere and anytime. This is consistent with the result of research [18] that the digital learning media can facilitate students in learning anytime and anywhere and can increase motivation and memory students because it can be used repeatedly, and (4) vary of evaluation, means android assisted WE Application developed has many types of evaluation that can be used students to hone their ability in absorbing material. Android assisted WE application can support students in improving learning outcomes and motivation to learn. it was delivered by [14] and [19] that uses the technology-based media can enhance learning motivation and make learning more attractive, interesting, and fun. Jabbour [20] in the results of the research also revealed that the use of mobile learning can impact on improving learning outcomes.

CONCLUSION

Based on research and development results as basis, it could be concluded : (1) android-assisted WE Application on electrodynamics was successfully developed using construct 2 and can be run on android device (2) android-assisted WE application that has been made is good in quality and feasible to be used with the Aiken's V average score by expert judgement of 0.79 on the media feasibility, 0.81 on the material feasibility, and 0.89 on the WE feasibility and obtain Aiken's V score of 0.82 assessed by the students, so it feasible to use in learning.

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