Developing Android Assisted Worked Example Application On Kinematics (Weak) To Improve Mathematical Representation Ability In High School Physics Learning

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Abstract: assisted kinematic worked example application to improve mathematical representation ability in physics high school students. It is research and development (R&D) approach with a combination of 4D models (Four-D) and ADDIE. Product validation was conducted by 7 validator and product testing was conducted by 67 high school students. Research result showed that the developed WEAK is rated reliable to be use, could improve the mathematical representation ability and has the biggest effectiveness to improve the mathematical representation ability in physics high school student.

Index Terms: Android, worked example, mathematical representation.

1. INTRODUCTION

Mathematical representation has an important role in physics learning. Physics structure use the mathematics model to explain relationship the variables[1]. [2]define that mathematics in physics have an important role cause the mathematics is basic science that needed for physics learning. Mathematics equation in physics can used as a basic for determining unknown values or variables[3]. In the leaning process a lot off student has difficult to understanding the mathematical representation. There is difficulty in understanding symbols and mathematical equation in physics. The strategy to using mathematical representation are: using the numeric and symbol, combine the symbol dan mathematical structure in physics and using the mathematical equation to explain the physic problem[4]. The are mathematical representation indicators, namely student able to make a mathematical equation or models, making connections from a patern of number and able to solve a problem with mathematical operation. [5]define the mathematical representation indicators are: (1) symbolic form that, how the student able to read and understanding the symbols, related them to concept and able to use then in equation, (2) equation understanding, is how student able to determine the right equation. Focus mathematical representation indicators are show in Table 1.

***Table 1**. Mathematical Representation Indicators*

representation	indicators
Mathematical	Determine the right mathematical symbols
	Understanding the right mathematical symbols
	Determine the right mathematical equation
	Determine to use the numbering and symbols in the right equation

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Difficulties in physics learning can be reduced by using the worked example approach. Worked example is a learning device that able to teach problem solving abilities such as representation mathematics in physics by presenting example of problems and showing the steps of the solution as well as the final answer[6]. Using the worked example requires less time and much better than using conventional methods[7]. The use of worked examples requires appropriate strategies and steps. Working example design is needed to be effective, namely by providing procedures or steps to complete the example problems with given an explanation of each step. The effectiveness worked example by giving a consent to procedure in the form of a step-by-step explanation on worked examples[8]. The procedure can be using is problem solving strategies there are: understanding the problem, provide a qualitative explanation of the problem, plan solution, implementation the plans, verify internal consistency and the relationship of the equation used, and examine and evaluate the solution obtained[9]. Problems solving strategy for the high school students is: principle, justification and the plan step[10]. The problems solving strategy can be use in worked example are: understanding the problem, describe the problem, design and implement strategies, determine the results and conclusions. Effective learning can also be obtained by using learning media. Using of media in learning can facilitate understanding, strengthening memory, can provide a relationship between the content of subject matter with the real world. Technological progress is indeed developing rapidly. one of the learning media that is assisted by technology and informatics that can be used as a learning media is a smartphone device with an android operating system[11]. Use the mobile learning such as android in learning media can provide motivation to student. android assisted kinematic worked example application that contains learning materi and example of problem solution in physics kinematical. This application can help students to understand learning material and assist students in solving problems to improve the ability of mathematical representation

2. METHOD

The method in this research use a combination of research and development (R&D) approach with a combination of 4D models (Four-D) and ADDIE with stage: analyze, Design,

Develop, Implementation, Evaluation and Disseminate. Simply put, the chronological flow diagram of the development phase of WEAK can be seen in Figure 1

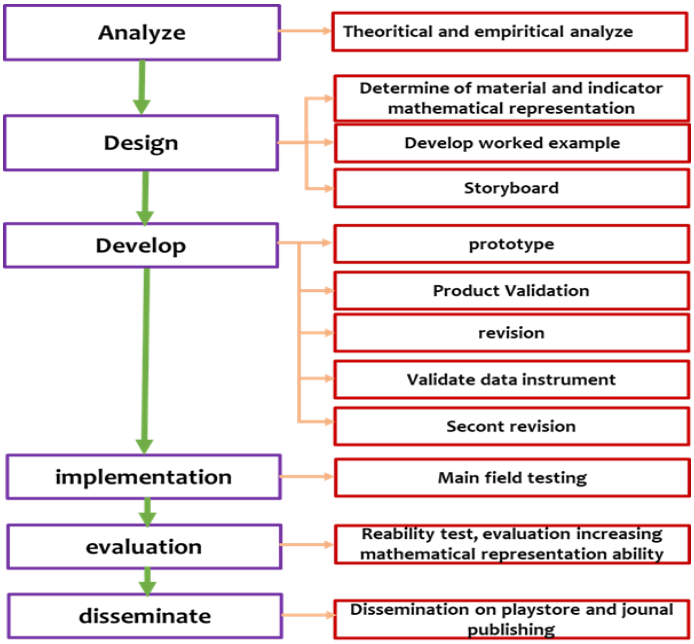

***Figure 1**. Diagram of Procedure Develop Model*

The research design employed was pretest and posttest control group design show in Table 2.

***Table 2**. Research Design*

Group	*Pretest*	treatment	*Postest*
Experiment	T_{11}	X_1	T_{12}
Control	T_{21}	X_2	T_{22}

This research was conducted in SMAN 9 Yogyakarta Indonesia. The subject involved are 7 expert judgment and 67 students of class XI SMAN 9 Yogyakarta. The experiment class was conducted in 33 student of class XI IPA4, are using the WEAK in learning process. The control class was conducted in 34 student of class XI IPA3, are use the print kinematic theory media in learning process. The object of the study which is a feasibility of WEAK which consists of material validation, media validation, worked example validation, improvement the mathematical representation ability and effectiveness of WEAK. Data collection instrument in this research were non-test instruments and test instruments aim to feasibility and effectiveness of WEAK product. The test instrument consists of pretest and posttest data to to measure the mathematical representation in physics students. data analysis technique use to assess the quality of the WEAK product is using Aiken's V with the equation[12]:

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

Data obtained compare with Aiken's V table value. Rater in this research were 7 validators with number or rating scales is 3 categories. Compare the Aiken's V value with quality category[13] show in the Table 3.

***Table 3.** Product Criteria*

No	Range of score	quality category
1	$0,8 < V \leq 1$	Excellent
2	$0,6 < V \leq 0,8$	Good
3	$0,4 < V \leq 0,6$	Fair
4	$0,2 < V \leq 0,4$	Poor

Statistical test using General Linear Model (GLM) analyze to aim the improve representation mathematic ability physics student and effective use of WEAK.

3. RESULT

a. Result of material feasibility obtained from Aiken's V show on Table 4.

***Table 4.** Result of Material Feasibility*

No	Validity Aspect	Aiken's V	Category
1	material	0,92	Excellent
2	Worked example	0,92	Excellent
3	language	0,97	Excellent

Table 4 show that Aiken's V score of the material on WEAK is excellent categories, this shows that the material on WEAK is feasible to be use in a learning physics.

b. Result of media feasibility obtained from Aiken's V show on Table 5.

***Table 5**. Result of Media Feasibility*

No	Validity Aspect	Aiken's V	category
1	Design	0,90	excellent
2	software engineering	0,94	excellent

Table 5 show that Aiken's V score of the WEAK media is excellent categories, this shows that the WEAK media is feasible to be use in a physics learning.

c. Result of worked example validation obtained from Aiken's V show on Table 6.

***Table 6.** Result of Worked Example Validation*

No	Validity Aspect	Aiken's V	Category
1	problem solving procedure	0,95	excellent
2	Mathematical representation	0,91	excellent

Table 6 show that Aiken's V score of the worked example on WEAK is excellent categories, this shows that the worked example on WEAK is feasible to be use in a learning physics statistic general linear model (GLM) Test the GLM test conducted by using the SPSS program by analysing the pretest and posttest value of student to find out (1) improvement the mathematical representation ability in experiment and control group class, and (2) know the effective contribution of WEAK to improve the mathematical

representation physics student. Before conducting the GLM test, Assumption tests have been conducted to see the normality and homogeneity of the sample. The results show that the sample is normally distributed and comes from a homogeneous postulation. Analysis of Improvement mathematical representation ability used by post hoc test on SPSS program, the result show in Table 7.

***Table 7**. Multiple Comparison Bonferroni Type of Mathematical Representation*

(I)group	(J)group	Mean Difference (I-J)	Std. Error	Sig
Experiment	Control	3.083	0.608	0.00
Control	Experiment	-3.083	0.508	0.00

Table 7 show that sig value is < 0,05. Experiment group had a mead Difference value greater 3,08 than control group. Based on this information the use of WEAK media has the highest influence compared to print media. Improved students' mathematical representation ability can also be seen through Plot Estimated Marginal Means show in Figure 2.

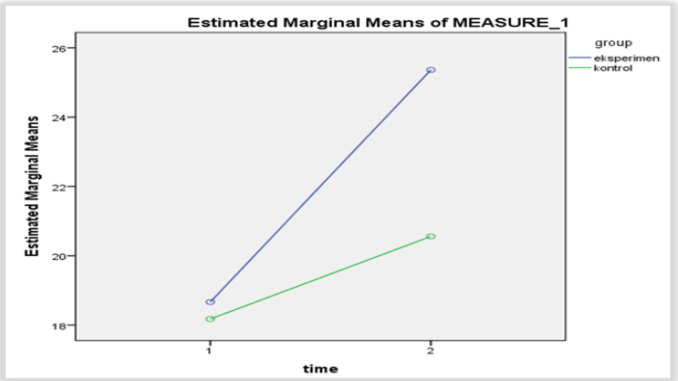

***Figure 2**. Output Graph of Estimated Marginal Means on the GLM Mixed Design*

Figure 2 show the student's improvement their ability of mathematical representation in the experiment and control group. The experiment group was greater that control group. The graph also show there is no interaction between the experiment and control group. No interaction showed not influence cause both of class. Effectiveness WEAK to improve mathematical representation can be known with multivariate test can show in Table 8.

***Table 8**. Multivariate Test Hotelling Trace Type*

Representation	Group	F	Sig	Partial Eta Squared
Mathematical	Experiment	228,735	.000	.77
	Control	33,226	.000	.33

Table 8 show that effective contribution by WEAK to the experimental class was 77%. Overall it can be concluded that WEAK provides the highest effective contribution in improving the mathematical representation ability of students.

4. DEVELOP RESULT

The visual appearance of components contained in the WEAK among others are: (1) WEAK logo (2) opening page, display the name of application, learning material, Yogyakarta state university logo, and the button to start the application, (3) home page, display the menu in WEAK, (4) instructions page, display the instruction how to use the application. (5) introduction page, display the information of WEAK and purpose the learning progress, (6) theory page, display the summary of kinematics physics theory, (7) WE page, display the worked example in kinematical theory, (8) exam page, display the kinematic physics exam, (9) profile page, display the developer application. The display WEAK partially show in Figure 3

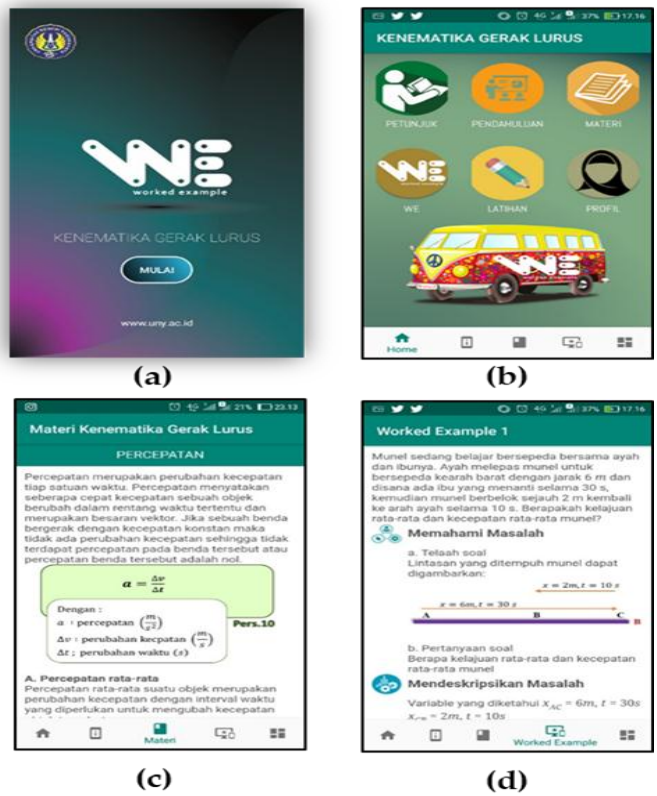

***Figure 3**. Example of Display WEAK*

5. CONCLUSION

Based on result of research and development, it can be concluded that the developed WEAK has god and feasible to be use with excellent category, based on feasibility material, media and WE assessment. WEAK can improve the mathematical representation ability physics learning student and had the greater effectiveness.

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