

The Development of Student's Worksheet of Physics Based on Virtual Simulation and Its Influence on Physics Learning Outcomes of Students

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Abstract. Have been conducted the development research of student's worksheet based on virtual simulation. The aims of this research were (1) to produce a physics students worksheet that was valid; (2) to improve physics learning outcomes of students by applying students worksheet that have been developed. This study was development using 4-D model which is covering define phase, design, develop, and disseminate to produce the student's worksheet and the method was pre-experimental with One Group Pretest-Posttest Design by involving students of XII IPA 1 of SMAN 11 Unggulan Pinrang at 30 people. Physics learning outcomes collected by using choices test form instrument that was taken after students complete the assignments in student's worksheet. The improvement of learning outcomes of physics evaluated according to the comparison of normalization gain value average, N-gain. The result of this research shows (1) student's worksheet based on virtual simulation was valid. (2) the result of N-gain percentage to evaluate students shows that the implementation of student's worksheet of physics based on e-learning can improve student's learning outcomes in high level.

Keywords: *Physics Learning Outcome, Student's Worksheet, Virtual Simulation,*

INTRODUCTION

Nowadays, the development of education world change significantly. To study something, people are not only depend on books obtained in school environment, local library or book shops but also with the advancement of information and communication technology based on online, everybody can access website to find information and knowledge. By using HP based non android, laptop or iPad that can be connected with the internet, user can download their various needs such us videos, audios, pictures, documents and books. Internet is collection of computer using communication network in the world and connected each other. Utilization of information technology is purposed to improve learning quality so it can rise education quality (Wisnu, 2012).

Physics as one of the part of science in senior high school is expected can be understood by students so the purpose of learning can be reached. However according to the researcher observation result when teach physics in classroom, there are several problems founded. The first, many students assume that physics is much difficult to be comprehended, less interesting, monotonous and meaningless. Second, in the past and now, teachers seldom conduct laboratory activity, in the other word learning is only theoretical form in the classroom. In addition, the laboratory equipment which is quite less making students never do the experiment process in 3 years.

Whereas there are some advantages had by schools and students that can became solutions to face these problems in physics learning. Those benefits are (1) internet network is quite enough that can support learning based online. (2) All of students have knowledge and ability about utilization of communication advices such us Handphone, laptop and iPad.

Abstract material in physics and difficult to be conducted in real experiment, so we can be designed a simulation or virtual laboratory. Interactive simulation uses computer to simulate complicated thing, expensive experiment

learning and changing experiment in dangerous environment (Yusuf, 2012). Interactive classification in learning media is not located on hardware, but it is more refer on characteristic of student's learning to respond the stimulant shown on computer monitor screen. Interactive means effect each other, so the advantage is can show audio and visual that makes learning process is more easy (Ali, 2009)

The idea of physics concept comprehension development for students is based by some theories: (1) physics conception is a subject that is constantly changing. (Wenning, 2006), (2) learning physics is not about memorizing facts, it is about comprehension and mathematics (Zhaoyao, 2002). According to those explanations, comprehension is a key word in learning process. Some theories conception base the conclusion are (1) if the purpose of learning is to foster the transfer capability in five cognitive domains (understanding, applying, analyzing, evaluating and creating), then the cognitive process resting at transfer capability and emphasized in schools and universities (Anderson, et al, 2006). (2) One of the purposes of education is to facilitate students to reach comprehension that can be revealed verbally, numerically, positivistic framework and life in groups' framework (Gardner, 1999). (3) The comprehension is mental process of the adaptation and transformation of science (Gardner,1999). (4) The comprehension is a new device of educational program that reflect competence. (5) The comprehension is a base for students to build insight.

From explanation above, researcher conducted a study release with development of student's worksheet based on experiment. Students executed laboratory process through virtual simulation.

CONTENT AND METHOD

Type of research

This research used 4D model which include definition phase, design phase, development phase and dissemination phase. But in this case, researcher only conducted until development phase. And to collect physics learning outcomes of students was used pre-experimental with One Group Pretest-Posttest Design.

Definition phase

The aims of this phase are to decide and define the requisites of learning which include initial analysis, students, tasks, concepts, and learning purpose specification.

Design phase

The aim of this phase is to prepare the prototype of student's worksheet and interactive virtual simulation which include media selection steps, format and initial design.

Development phase

The aim of this phase is to produce student's worksheet and interactive virtual simulation that have been revised according to the suggestions from experts than conducted trial limited in class of XII IPA 2.

Research subjects

The subjects of this research are students in class of XII IPA 1 SMA 11 Unggulan Pinrang at 30 people in study year 2016/2017.

Research Instrument

Instruments used in this research are media experts evaluation questionnaire, material expert evaluation for material on simulation media, evaluation experts for material on student's worksheet and Physics learning outcomes collected by using choices test form instrument

Data analysis technique

Data which was obtained from expert evaluation analyzed by coding, then described qualitatively and continuum describing data to know evaluation category (Lawshe,1975). Then calculating content validity *CVR* (*Content Validity Ratio*) and *CVI* (*Content Validity Index*). Evaluation is valid if *CVR* or *CVI* is in range between 0 until 1, as follows:

$$CVR = \frac{n_e - (\frac{N}{2})}{(\frac{N}{2})} \quad (1)$$

Information:

n_e : how many judges giving essential value (good and very good)

N : the amount of judges

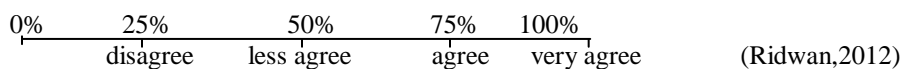
Validity every aspect using formula as follows:

$$CVI = \frac{CVR}{\Sigma n} \quad (2)$$

Information:

n : the amount of item in every aspect.

Data obtained by coding of student, then analyzed descriptively and quantitatively by same formula with determining of PK, then averaged so that gained data in form of interval as follows:



Physics concept comprehension increase is clarified in average percentage of normalization gain score (N-Gain). N-gain calculated by formula which have been developed by Hake and Richard (Mariatin,2012), where:

$$\%g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \times 100\% \quad (3)$$

RESULT AND CONCLUSION

Student's worksheet of physics

Assessment on student's worksheet is conducted by experts. Analysis result indicated that student's worksheet is valid for all aspect as follows:

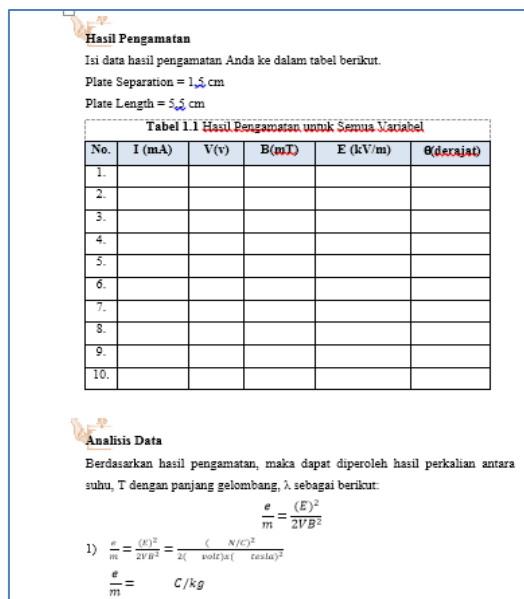
Table 1. Validation analysis result on students worksheet

No.	Aspect	Percentage (%)
1	Quality of appearance	95,8
2	Attractiveness	91,7
3	Technical	94,5
	Average	94

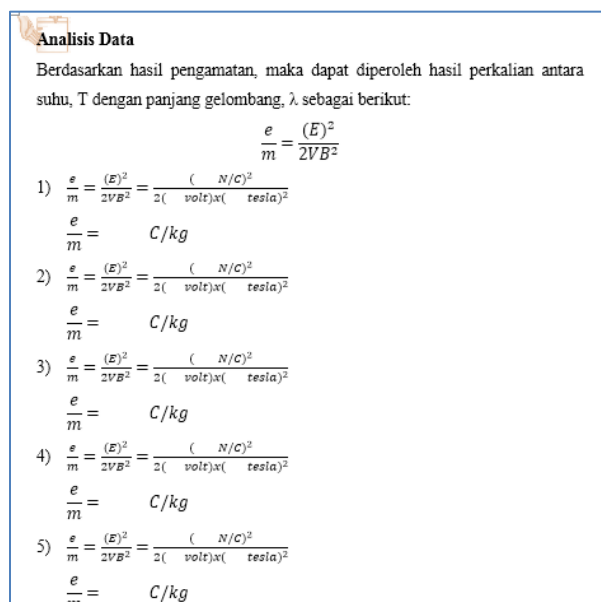
The figures bellow are appearance of cover and some content pages of student's worksheet based on virtual simulation.



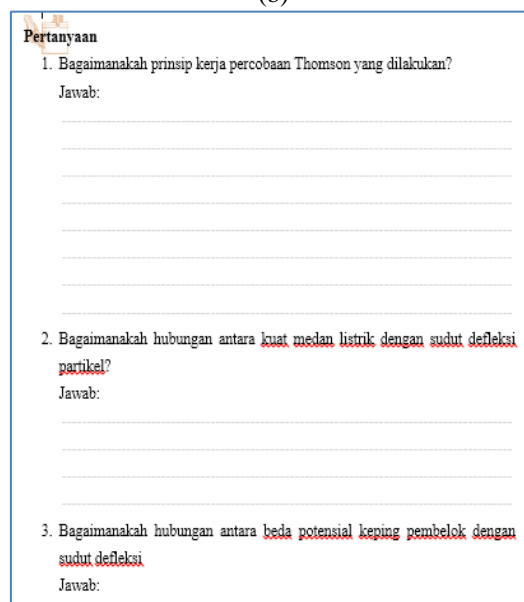
(a)



(b)



(c)



(d)

Figure 1. Student's worksheet. (a) the cover of student's worksheet. (b) Table of observation result on student's worksheet. (c) Example of data analysis page of student's worksheet. (d) Some questions on student's worksheet.

Based on data analysis result of student's worksheet that have been developed according to the virtual experiment on CD *autorun*. Each experiment completed with *screenshot* program that can be easy students in following every steps that was given. Student's worksheet also supported purpose of experiment and introduction material that can be learnt by students before conduct experiment virtually, so they have initial knowledge about virtual experiment that will be conducted. In addition, student's worksheet also completed with questions based on experiment purpose that will be achieved. In conclusion part, some student's got matters caused unsuitable with experiment aim or limiting time problem to reach conclusion. However, in general, students gained good result. The achievement of students was as the consequences of completeness of student's worksheet facilities. On data analysis of observation prepared analysis technic and writing space on students' worksheet so that students can analysis easily the data of observation result gained virtually. Study like this, indirectly sharpen students thinking ways. To

finish each tasks directly and lavishly, have been provided space work on student's worksheet. This is crucial because to make students work independently and also can interact with their friends.

Virtual simulation media

There are several softwares used in development of virtual simulation such us *Flash Decompiler* to adapt and develop physics simulation downloaded from *The King's Center For Visualization in Science (KVCS)* <http://www.kvcs.ca>. the dominant *Software* used is Lectora to appearance arrangement of media program.



Figure 2. Initial Appearance of Virtual Simulation

Media program built contained of material which was completed with images, animations and interactive virtual simulation. The appearance of virtual simulation as follows:

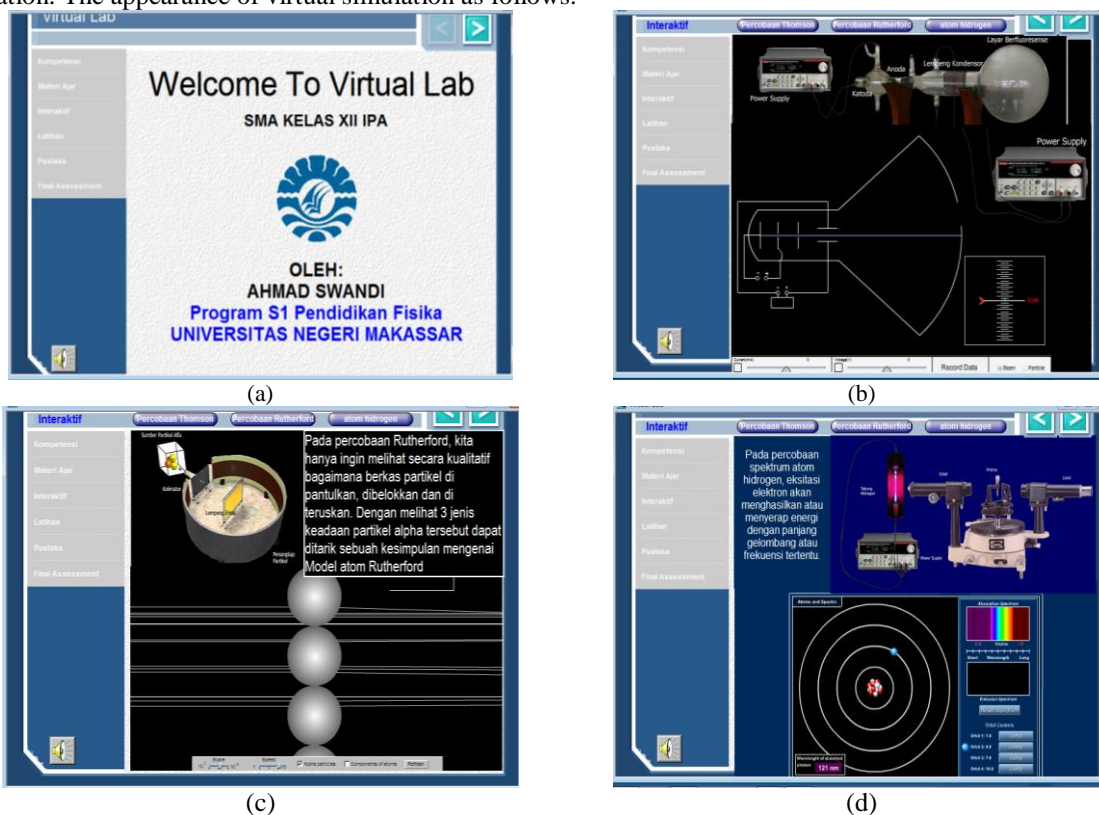


Figure 3. Virtual simulation that have been developed. (a) Initial appearance of virtual simulation. (b) Thomson experiment virtual simulation. (c) Rutherford experiment virtual simulation. (d) Bohr experiment virtual simulation

Assessment to the media conducted by material and media experts. Validation analysis result shows that virtual simulation is valid for all aspects as follows:

Table 3. Validation analysis result of virtual simulation

No.	Aspect	Percentage (%)
1	Quality of appearance	95,8
2	Attraction	91,7
3	Technical	94,5
Average		94

Whereas validation analysis result shows that material on virtual simulation is valid.

Table 4. Validation analysis result of material on virtual simulation

No.	Aspect	Percentage (%)
1	Concept	97,0
2	Language	93,8
3	Delivery	91,7

Student's learning outcomes

Score average of pre-test, post-test and %N-gain of concept comprehension shown on table 5. Based on table, appear that N-gain of comprehension concept on topic Thomson experiment, Rutherford experiment and Bohr experiment are 79,7%, 81,2%, 79,9% respectively. These indicated that all of are in good category. By looking the table, it indicate that concept comprehension increase for all topics. According to %N-Gain achieved. Evident that thorough implementation of student's worksheet based on virtual simulation can increase student's concept comprehension.

Table 4. Average comparison of pre-test and post-test score and %N-gain of concept comprehension

Topic	Average score of pre-test	Average score of pot-test	N-gain (%)	Category
Thomson experiment	58,17	91,50	79,7	Good
Rutherford experiment	59,17	92,30	81,2	Good
Bohr experiment	63,50	92,67	79,9	Good

Maximum score is 100

Figure 4. Shows the comparison of %N-gain of concept comprehension verified detailed based on each aspect which include interpretation, imitation, comparison, classification, explanation and conclusion. According to the figure.. %N-gain of concept comprehension for all topics in each indicator is variation. The highest of %N-gain of concept comprehension is on explanation aspect (MJ) at approximately 95%. It means that after studying use student's worksheet based on virtual simulation, students can explain concept of topic in particular Thomson experiment. However the lowest %N-gain is interpretation aspect at above 60% which indicate that the improvement of students' comprehension in this category is not significant.

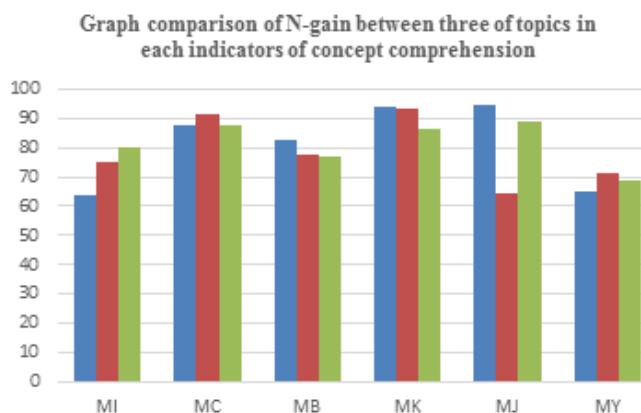


Figure 4. Graph comparison of N-gain between three of topics in each indicators of concept comprehension

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CONCLUSION

Characteristic of student's worksheet follows experimental report form which concludes Introduction, The Purpose of Experiment, Steps of Work, Questions, Opinion and Conclusion. While characteristic of virtual simulation produces 3 concepts which include Thomson Experiment, Rutherford Experiment and Bohr Experiment. In addition, virtual simulation developed in learning program form having 3 main menus in each explanation which conclude Competence, Introduction and Virtual Experiment.

Student's worksheet, virtual simulation and media on virtual simulation are valid for each aspect, it indicates that this student's worksheet and virtual simulation can be used in learning. According to the data analysis result of pre-test, post-test and %n-gain shows that implementation student's worksheet and virtual simulation can improve student's learning outcomes in good category.

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