DEVELOPING INTERACTIVE MULTIMEDIA FOR PHYSICS LEARNING SIMULATION MODEL OF GAS KINETIC THEORY FOR SENIOR HIGH SCHOOL STUDENTS GRADE XI

Umar Komarudin[1], Sardianto Markos Sihaan[1], Sudirman[1]
Physics education, Universitas Sriwijaya[1],
1)umar.physics09@gmail.com

Abstract

This research is aimed to produce a valid and practical interactive multimedia physics learning simulation model of gas kinetic theory, which could increase student' learning outcomes. This is a development research using Rowntree model. Rowntree model consists of three phases, namely: 1) planning, 2) developing, and 3) evaluating. In evaluating phase, Tessmer formative evaluation was used that consists of self evaluation, expert review, one-to-one, small group test, and field test. In collecting data, validation sheet, questionnaire, and achievement test were used. In expert review phase, prototype of multimedia for interactive physics learning was considered valid with the result of 89,82%. In one-to-one phase, prototype 1 was assessed by the students in their point of view. In small group phase, prototype 2 was considered very practical with the questionnaire results of 86.50%. In field test phase, multimedia for interactive physics learning was considered very practical with the questionnaire result of 79.71%. Field test phase was done to the students in grade XI Science 2 of SMA N 1 Inderalaya Utara, and the students' learning outcomes in this phase was categorized medium with N-gain of 0.5. The results of the research show that the developed interactive multimedia physics learning simulation model of gas kinetic theory for senior high school students grade XI was valid and very practical that could increase the students' learning outcomes.

Keywords : development research, interactive multimedia learning, Simulation model, the gas kinetic theory

INTRODUCTION

Information and communication technology has grown rapidly along with the globalization, so the delivery of information and communication can occur quickly. The development in this era of globalization influence in many aspects of human life, including in the education. Every era of technology has influence andestablish an education era of his day (Sharpless, 2010:1). In the world of education, the influence of the development of information and communication technology can be seen in its use as a means of supporting the learning process.

During the learning process will always be interactions associated with the term communication or relationship that accurs between teachers and students. The process of learning-teaching will always be a process of human interaction between two elements, namely the students as learners and teachers as those who teach, with students as main subjects (Sardiman, 2012:14). Interaction between teachers and students can occur directly or with the help of media.

The media of learning is an important component in the learning process that leads students to understand the science and the achievement of learning objectives by

enhancing the effectiveness of interaction in the learning process. This is in appropriate with the statement by Hamalik in Arsyad (2007:2) that the media as a communication tool in order to further streamline the learning process. Thus, the selection of relevant the media of learning use make the learning process effective and efficient.

Physics as a subject in school is part of the natural sciences are seen as important and helps in solving real life problems of daily life. The importance of teaches physics subjects are seen on special purpose physical learning that provide students the knowledge , understanding and knowledge , and capabilities that required to enter higher education and develop science and technology. Many students think and said, "Physicsis hard" (Ornek, 2008:30). Student perception is very possible happen given physics as lessons derived from the observation that requires understanding and good analytical abilities in order to understand.

In the learning of physics, there are several difficult concepts displayed significantly with the other terms is called abstract concepts, so it is not easy for students to understand. Subject matter that is an abstract make students have misconceptions or even do not understand the concept. “Usually the misconception occurs when students understand the microscopic structure and behavior of matter” (Trindade, 2005:212). For example, an abstract concept in the subject matter of physics, namely: gas, electromagnetic waves, electricity and microscopic materials such as atoms, all the material can not be captured directly by observation of the human senses. The difficulty in directly observing make the students should use of tools such as media of learning.

Microscopic structure of the material is a topic that is quite clear when visualized in his teaching and in computer simulations is an idea that can help to handle it (Trindade, 2005:214). Graphic media can show the shape but still weak to explain the behavior of particles. Thus, it can be concluded that required media can help explain the behavior or properties of the gas in a room, so that the media simulations can be one solution that can provide a clear picture to students. It is appropriate according to Daryanto (2010:52) that “the benefits of multimedia learning is magnify the objects which is very small and invisible eye”. Gas is a form of substance that is very difficult to be seen directly because the gas is composed of tiny particles that movement can not be seen directly by eye. Material kinetic theory of gases into the research material selected for consideration the characteristics of the material.

Research on media of learning physics have also been carried out by several researchers. Rahman et al (2010) conduct research on the design media of learning to produce the media of Newton's laws. The resulting media has a main menu screen with submenu. The program of learning media is proved have input, process and output according to the results to be achieved. From the results of the test media, all of the indicators contained in the media of learning that designed Rahman et al (2010) classified in good category. Media of learning developed in materials terms of engaging and motivating students to learnso it isfeasibleto use in learning physics subject of Newton's laws of motion.
Research conducted Setiabudi (2005) with the development of learning media based multimedia with a straightmotion materials. Results of research conducted is the packets of multimedia teaching materials that can be used in physics learning of straight

motion. Researchers also suggest a further development of the research tools produced, among others add narration and exercises.

Research on other media of learning conducted by Muller (2008) with the title Designing Effective Multimedia for Physics Education. The results of the research is a good innovation in the form of multimedia. The material chosen is quantum mechanics in physics Australian schools. In this research a solution was obtained essential that researchers and students interpret the difficulties challenges in teaching and learning physics. From the results of the data analysis, by comparing the results of pre-test ($t(71) = -.21$, $p > .05$) and post-test ($t(71) = 3.01$, $p < .01$) showed that by watching the video can increasing mastery's student of learning of concepts. These results indicate some kind of learning can be a method of affecting change in concept and increase their mastery of physics concepts.

Previous research on the use of interactive multimedia learning of the kinetic theory of gases done by Khisnarini (2010) in class XI SMA Negeri 2 Palembang. The results of research in the use of interactive multimedia seen from the students' outcomes. Based on the analysis of data obtained from the pre-test and post-test researchers concluded that the use of interactive multimedia on learning the kinetic theory of gases effect on student learning outcomes. Results from student responses as much as 67% gave positive responses and 57% of students have agreed that interactive multimedia response that is used interesting.

Media of learning can be a positive influence in the learning process and help achieve the goals of learning. The importance of learning media in physics learning to make the researcher intends to do research media of learning that need to be developed and can be used in the physics learning. Therefore, researchers intend to conduct research with the title "Developing Interactive Multimedia Physics Learning Simulation of Gas Kinetic Theory for Senior High School Students Grade XI"

THEORETICAL FRAMEWORK

Multimedia is media that involves multiple types of media and equipment were integrated in a process or learning activities. Multimedia learning involves the senses of sight and hearing through the medium of text, visual silent, visual motion and audio, and interactive media and computer -based communications and information technology (Asyhar, 2011:44). Similar statements expressed Daryanti (2010:51) that interactive multimedia is a multimedia tool that comes with a controller that can be operated by the user so that they can choose what is desired for the next process.

Based on the opinion of several experts in the above, it can be concluded that interactive multimedia is a combination, synergy and integration of various types of media such as text, graphics, and audio are packaged in an integrated and interactive and equipped with a control device which can be operated by the user and aims to presents a message or specific learning information. Multimedia same role as media that carry messages or convey a message which contains information about the course of learning in this regard.

Multimedia learning presentationformatscan be categorizedintofivegroups(Daryanti, 2010:54) namelytutorial, drillandpractice, simulation, experimentorexperiments, andgames. Instructional mediadevelopedin this study isan interactive

multimedialearningsimulation model.The simulation model is one lesson which aims to provide a more concrete learning experience through the creation of imitations experience gained form approaching the real atmosphere and without any risk. In accordance with that proposed by Arsyad (2002:161) that "with the help of computer simulations program try to match the dynamic processes that occur in the real world ".

The purpose of the simulation according to Rusman (2012:231) is for training (training), studies the behavior of the system (behavior) and entertainment/games (games). Simulations shown in the gas kinetic theory is adapted to the simulation of artificial molecular properties, simulating the motion of particles, and the impersonation form. Engineering behavior of these particles is expected to provide concrete learning experience considering the gas is abstract and difficult to perform real experiments.

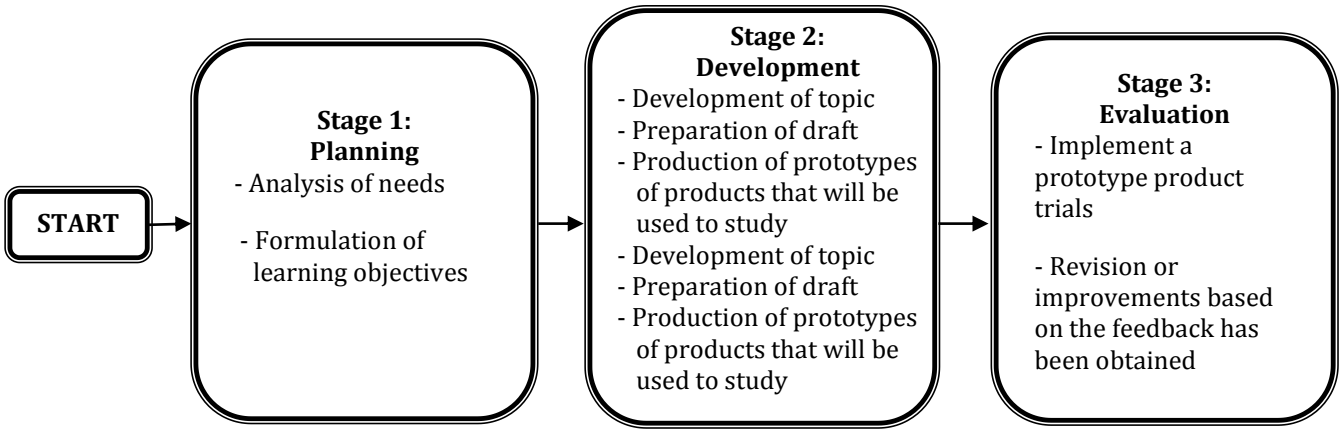

Figure 1. The development product rowntree's model (Prawiradilaga, 2008:46)

The simulation modelis dividedinto 4categories:physical, situations, proceduresandprocesses. Generallyphasesof matteraccordingto Rusmansimulation model(2012:232) are asfollows: (1) Introduction, (2) Presentation ofinformation(simulated 1,2,3, andso on), (3) Questionandanswerresponses, (4) Responseassessment, (5) Giving feed back tothe response, (6) Correction, (7) Segmentteachingsettings, and(8) Closing.

METHOD

The method used development research. The model research is rowntree's model.According Prawiradilaga (2008:46) Rowntree product development model consistsof three stages, namely planning, development, and evaluation.Phase the Rowntree's model show in figure 1.

Evaluation phase aims to determine whether the interactive multimedia physics learning is being developed feasible for use.In this research, to evaluate interactive multimedia the evaluation use formative evalution. According Sadiman, et al(2011:182), formative evaluation is a process that intended to gather data about the effectiveness and efficiency learning materials(including the media).

The descriptive of data obtained through suggestions and criticisms of expert and than it is used as a reference to make revisions at each manufacturing prototype. Suggestion and critisms write on peices of validation expert. Expert answer in the form likert scale

which range from four categories that is very good, good, bad, and very bad. The category is shown in the table 1.This topic, computational estimation, is apparently integrated in whole number topics, specially the thousand.

Table 1. Category value validation (Sugiyono: 2012)

Answer category	Very good	Good	Bad	Very Bad
Statement	4	3	2	1

Furthermore, the assesment of experts obtain an average of the score using the formula(Fikriyaturrohmah and Rini Nurhakiki:3) :

1. Determine total score of each criteria
   $Rk_i = \frac{\sum_{i=1}^{v} S_{x_i}}{SMK_i} \times 100\%$
   and$SMK_i = v \times 4$

2. Determine final score
$$NA = \frac{\sum_{i=1}^{v} Rk_i}{n}$$

knowing :
Rk_i = average every criteria to-i
S_{x_i} = score from expert to-x against criteria to-i
SMK_i = maksimum score criteria to-i
x_i = expert
v = number of expert
n = number of criteria assessed
NA = Average total score validity from all criteria

Then the final value primarily used to determine the validity of using the following intervals :

Table2. Criteria validity MPI (Fikriyaturrohmah and Rini Nurhakiki:3)

Percentage(%)	Criteria Validity
$76 \leq NA \leq 100$	valid
$56 \leq NA < 76$	quite valid
$40 \leq NA < 56$	less valid
$0 \leq NA < 40$	invalid (revisi)

The data obtained through the questionnaire was analyzed with a Likert Scale to get the opinion of students on interactive learning multimedia.

Table3.Category student opinion (Sugiyono : 2012)

Category	Very Good	Good	Bad	Very Bad
Statement	4	3	2	1

The result from student responses will be presented in table and then find the mean scores using formula :

$$P = \frac{\sum X}{\sum X_i} \times 100\%$$

knowing:
P = percentage
X_i = number the answer
X_{mak} = higest number answer

Table4.Practically Criteria (Yamasari, 2010:2).

Questionaire (%)	Category
$75 \leq P \leq 100$	Very Practical
$50 \leq P < 75$	Practical
$25 \leq P < 50$	Less practical
$1 \leq P < 25$	Not practical

The Data from test used to determie the gain score.To know the score use the formula :

$$< g > = \frac{(skor\ post\_test) - (skor\ pretest)}{(skor\ maksimum) - (skor\ pretest)}$$

(Meltzer, (2002))

Then Gain score will be categorized according to table 5:

Table5.Gain Score (Hake, 1998)

Category	Gain Score
High	$(< g >) \geq 0{,}7$
Moderate	$0{,}7 > (< g >) \geq 0{,}3$
Low	$(< g >) < 0{,}3$

RESULT AND DISCUSSION

The results of developmentis interactive multimedia development program. Display interactive multimedia pages are developed as follows.

Figure2. Display Interactive Multimedia Learning

After making a prototype of an interactive multimedia researchers evaluate the interactive multimedia learning has been developed. Researchers conducted a validation of multimedia interactive learning using sheet of validation and the practicalities of media developed by the student questionnaire, then the result show in table.

Table 6. The Result from Expert Jugment

No.	Indicator/ Aspects are Assesed	Average score
1.	Content	
	Truth and compliance with curriculum materials	4,0
	Coverage of material	4,0
	Systematics presentation of the material	3,5
	Linguistic content authoring	3,3
	Conformity audio and visual	3,0
Average aspects Content *(Rk_i)*		89,15 %
2.	Learning Design (*Construct)*	
	Suitability approach (granting competency goals, apperception, and giving a conclusion)	3.5
	The effectiveness and efficiency of achievement of competencies	3,0
	Organizing the presentation of the material	3,5
	Compliance with the characteristics of the target (audience)	4,0
	Conformity evaluation with indicators of competence	4,0
Average aspects*Construct (Rk_i)*		89,15 %
3.	Aspects of Media (Lay-Out)	
	Attractive visual appearance, innovative and interactive	3.5
	Link menus and navigation links	4,0
	The clarity of the text displayed	3,0
	Convenience for users	4,0
Average aspects Lay-Out *(Rk_i)*		91,17%
Average total multimedia (*NA*)		89,82%

Table 7. The Result of Student Responses in Small Group Phase

No.	Indicator/Aspectsare Assessed	Questionnaire score (%)	Category
1.	attractiveness	87,50	very practical
2.	clarity	90,74	very practical
3.	ease of navigation	84,44	very practical
4.	linguistic	83,33	very practical
Average		86,50	very practical

Validation of data analysis and questionnaires, interactive learning multimedia are valid and very practical. Based on the comments and suggestions of experts, the lay out necessary repairs and figures about writing important things.

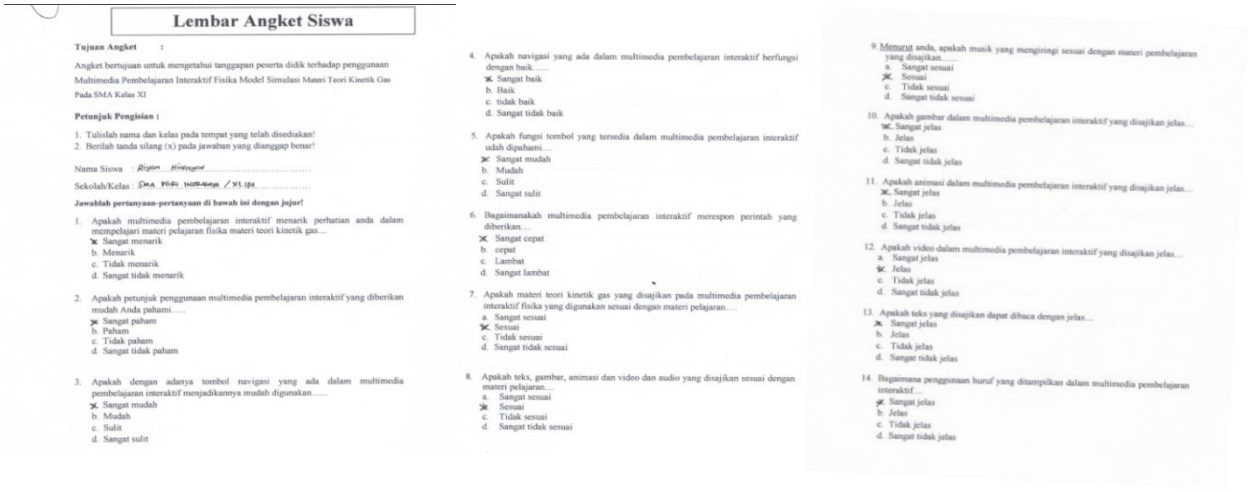

Figure3. Example the result of questionnaire

In the field test stage researchers provide initial tests before learning using interactive multimedia and final test after learning using interactive multimedia. Based on the results of the initial test and final test the average values obtained in the initial test was 25.15 and the average value at the end of the test was 65.68. Based on the average value seen an increase of the value from initial test to the final test scores, to see the improvement category researchers get gain score 0.5.

Then the revised figures writing before continuing on field test stage. Practicality of interactive multimedia learning in a very practical category, the lowest percentage of the data analysis contained in the language, while the highest is clarity. Based on the result of gain score which find out, improvement occurred in the medium category. Improved learning outcomes indicate a positive effect of the use of multimedia interactive learning on student learning outcomes. An increase in student learning outcomes in the medium category with gain score 0.5 analogous with the results of previous studies conducted by Krisnarini (2010) that "the use of interactive multimedia learning materials physics kinetic theory of gases impact on learning outcomes".

Based on the results of student questionnaire data, questionnaire contained statements related to students' responses on the use of interactive multimedia learning in the learning process is about the attractiveness of multimedia interactive learning, clarity, ease of navigation, and linguistics. The cumulative percentage of positive responses to the attractiveness of interactive multimedia at 80.09%. Previous research on student interest in the use of interactive multimedia Krisnarini performed at 52.2%. The big difference student responses to the interactive multimedia can be influenced by several factors, including the attractiveness of interactive multimedia learning. So, interactive multimedia learning has been developed more appealing than previous interactive multimedia.

Through a questionnaire administered, the percentage obtained by the student in response to the overall average is at 79.71%. The results of student responses indicate that interactive multimedia physiscs learning the kinetic theory of gases included in practical category.

CONCLUSION

Based on the research results, it can be concluded that the interactive multimedia physics learning simulation model of the kinetic theory of gases in the high school class XI generated as follows:

1. Based on the results of the validation from expert jugment, interactive multimedia physics learning simulation model of the kinetic theory of gases in the high school class XI is valid, it can be seen from the results of the average ratings of 89.82% validators.
2. Interactive multimedia physics learning simulation model of the kinetic theory of gases in the high school class XI is very practical. Because the results of student responses obtained at the stage of small group at 87.19%.

Based on the analysis of learning outcomes, interactive multimedia learning was developed have gain score 0.5 with the medium category.

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