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21th century physics learning in senior high school through interactive computer simulation to enhance students achievement A Swandi1*, B D Amin2 and F Muin3 1 Prodi Magister Pengajaran Fisika, Institut Teknologi Bandung, Jl. Ganesa No. 10, Bandung 40312, Indonesia 2 Departemen Fisika, Universitas Negeri Makassar, Jl. Deng Tata Raya, Makassar 90224, Indonesia 3 Departemen Pendidikan Fisika, Universitas Muhammadiah Makassar No. 259, Makassar 90221, Indonesia *ahmad.swandi@students.itb.ac.id Abstract.

This study aims to harness interactive computer simulation on physics concept that have been developed to improve students achievement by determining the differences in physics learning outcomes of students who were taught using computer simulations with students who were taught using conventional media and also evaluating students activity and their perception. The research type is true experiment with Posttest-Only Control Design.

The research instrument used is the test of physics learning result of 20 questions in the form of multiple choice test which has valid on "Fluid" subject. Data analysis techniques used in this study is descriptive statistics and hypothesis testing. The results of descriptive analysis showed that the average score of physics learning outcomes of learners who were taught using a computer simulation is 13.5

and the average score of physics learning outcomes of learners who were taught using conventional media is 10. The results of hypothesis testing showed that there are significant difference in physics learning outcomes between learners who were taught using computer simulations with learners who were taught using conventional media.

The percentage of students activity and their perception are above 85% that indicate students were active and agree on physics learning through interactive computer simulation 1. Introduction Physics is one of the subjects that can develop the ability to think inductive and deductive analysis of learners in solving problems related to natural phenomenon around. Physics is a science that is understood through the steps of research, observation or experimentation using scientific methods.

Physical learning will be more interesting when taught not only in the classroom but also in the laboratory or in the nature laboratory. However, many faculty members in teaching positions have little to no formal training in pedagogical approaches to teaching and limited time to devote to improving or changing their approach; relying instead on familiar practices despite having a desire to change their mode of teaching [1].

In-class learning with conventional and one- way teaching is not able to improve students' understanding of physical matter optimally. As a result, based on the results of TIMSS [2] states that (1) the average student physics learning outcomes in Indonesia for cognitive aspects is still very low; (2) the tendency of physics learning result always decrease in cognitive aspect.

The results of the observation show that learners have not fully understood to the physics concept provided by teacher. Most of them can not related they comprehension with the nature phenomenom around. They can not solve the problem after studying physics in the classroom. They think that physics is really difficult to be understood and not interesting. In fact, physics concept that always happen in their daily life can not be explained.

The evidence of this incomprehension is seen in which some learners are unable to relate what they have learned from textbooks to solve the physics problem To mitigate those cases, teachers can facilitate learners to discover scientific truth by means other than experiments in laboratories. One way is to demonstrate the phenomenon in front of the class.

The way this demonstration can be done using the equipment used in the experiment, can also use a substitute object that has the same function and physical symptoms as the experimental apparatus. Learners are expected to discover the scientific truth of the demonstration activity because they see the phenomenon and analyze the relation with the existing concept.

Better yet if the learners themselves are involved in the demonstration activities

Partnership for 21st Century Skills identified six key 21st century elements in encouraging learning, four of the six key elements were (1) using 21st century tools to develop learning skills; students need to learn how to use tools that are essential for everyday life and to be productive in the workplace. The ability to utilize ICT is indispensable in the 21st century.

(3) Teaching and learning in a 21st century context; students learn the material through examples, applications, and real-world experiences both inside and outside school. (3) Teaching and studying the contents of 21st century; educators need to integrate knowledge and skills in the 21st century. (4) Use 21st century assessments that measure 21st century skills; to measure skills in the 21st century needs high-quality assessment so as to measure student achievement in the 21st century elements.

In order for the instrument to be used effectively must be made precisely, sustainably and affordably for all levels of education using information technology to improve efficiency and clear the timing [3]. Currently many lessons are using technology as a learning medium, especially the harnessing of computers. Not only in the city alone, even in some villages already have computers in the school. There are several purposes of computer use in learning.

Nowadays, utilization of technologies in science are rapidly evolving and, for many, the scientific practices, tools, and thinking around which they were trained bears little resemblance to the interactive and dynamically enhanced practices of modern science. Along that same line, it is not uncommon for science faculties to have little or no training in teaching methods and practices, relying on traditional approaches with which they are familiar, such as direct instruction by lecture, rather than the diverse non-traditional approaches to teaching that are advocated by current research [4].

One of the alternatives to improve the process of physics learning is to involve abstract physics concepts by utilizing relevant information technology such as the use of interactive multimedia consisting of text, hypertext, sound, animation, video and graphics [5]. By using computer animation, physics concept is easily described in front of class.

This is in accordance with the opinion of Swandi and Bunga Dara which states that the concept of abstract physics is very difficult to explain by using a real laboratory so that we can design an interactive simulation [6]. Interactive simulations use computers to describe particular concept. Interactive classification in this case allows users to set the simulation in accordance with the wishes or concepts that want to be observed, especially relating to the relationship of some scales Learning by using computer

simulations is a small part of the utilization of information technology (IT) in the learning process.

In general, computer-based learning is called Computer Based Instruction (CBI). In this study CBI form used is a form of simulation, which is a program that provides a picture or simulation of a state or phenomenon that resembles the actual state or phenomenon. Learning outcomes are the abilities that a student gets through learning activities.

The learning objectives in programmed and controlled learning activities were pre-determined by the teacher. Student who succeed in learning are students who are able to achieve the learning objectives that have been set. Students rng comesarfmuled al nstriobji IU)whi are expressed in more specific forms and are a component of the general purpose of the course or subject area.

This learning outcomes state what the student will be able to do or master as a result of the lesson, but does not cover all the components of ICT. Evaluation of learning outcomes is the overall measurement activity (data collection and information), processing, interpretation and consideration to make decisions about the level of learning outcomes achieved by students after learning activities in an effort to achieve the objectives of learning that have been determined.

Learning outcomes point to learning achievements, while learning achievement changes in the behavior of learners. Based on the description above, the researchers are encouraged to conduct research on "The Effect of Using Computer Simulation on Physics Learning Results of Students Class XI of Senior High School 14 Makassar" Based on the above description, one of the utilization of computer in learning can be packed in the form of simulation.

The physics simulation used meets the requirements as hypermedia. According to Fabos, the current media is hypermedia as a revolution inlearning because hypermedia not only consist of text, graphics, video and audio, but also provide network to be access by students [7].

Beside of the use of hypermedia in learning magnetic induction improved the mastering of concept and generic skill student [8]. 2. Research Method The type of this study is true-experimental with Posttest- Only Control Design. which is expressed in the following pattern [2]: Figure 1. Figure Posttest - Only Control Design .

E xplanation : R = sample randomization X = Treatment using computer simulation - = Treatment using conventional media O 1 = Observation after treatment for the

experimental class O 2 = Observation after treatment for the control class This research took place at Senior High School 14 Makassar academic year 2017/2018 in odd semester. The population in this study is all students of class XI IPA Senior High School 14 Makassar consisting of four classes.

Based on simple random sampling method chosen class XI.MIA.2 and XI.MIA.3 Senior High School 14 Makassar as many as 66 people with the assumption that the whole class is homogeneous. To measure learners' learning outcomes, an instrument developed based on indicators of learning outcomes of learners in the form of evaluation questions.

This problem is supplemented by scoring guidelines for learning outcomes. Analysis of learning result test data is done based on the truth of completion done by learners with guided completion instruction and scoring rubric. Scores given to each student's answers are determined b ased on the scoring guidelines.

Descriptive analysis technique used is the presentation of data in the form of score, average, and deviation [9]. a. The average score of students ???? = S ?? ?? b. Deviation Standard S = v ? (?? ?? - ?? ¯) 2 ?? ?? = 1 ?? - 1 Further testing is conducted Hypothesis research, to test whether the hypothesis that has been submitted can be accepted or not.

To test the hypothesis used t-test with the formula: (1) (2) R X O1 R - O2 International Conference on Mathematics and Science Education of Universitas Pendidikan Indonesia Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252 133 http://science.conference.upi.edu/proceeding/index.php/ICMScE/issue/view/3 | ICMScE 2018 [Date] ?? ???????? = ?? ¯ 1 - ?? ¯ 2 v (?? 1 - 1) ?? 1 + (?? 2 - 1) ?? 2 (1 ?? 1 + 1 ?? 2) ?? 1 + ?? 2 - 2 3. Result And Discussion 3.1

Result of Research The results of this descriptive statistical analysis will be discussed the results of research obtained through post test. Post test is conducted by using the same test device in the form of written test in the form of multiple choise as much as 20 question . Here is presented description of physics achievement students class XI IPA 4 Senior High School 14 Makassar academic year 2017/2018 as follows. Table 1.

Statistic Scores of Students Learning Outcomes after Post-test Statistic XI.MIA.2 XI.MIA.3 Number of sample 33 33 The highest score 19 15 The lowest score 8 7 Average score 13,5 10 Variance 9,5 5,3 Deviation standard 4,15 2,54 Maximum score 100 100 Minimum score 0 0 The number of post- test samples is 33 students of class XI.MIA.2 and XI.MIA.3. The highest score that can be achieved by students of class XI.MIA.2

is 19 and XI.MIA.3 is 15 of total score 20 that may be achieved (ideal score), while the lowest score in XI. MIA.2 is 8 and XI .MIA.3 is 7 of the lowest 0 score. The results of physics study XI.MIA.2 that were taught using computer simulations had an average score of 13.5 out of a possible total score of 20. While the score of Physics learning outcomes XI.MIA.3

t aught by using conventional learning model has an average score of 10 of a total score of 20 that may be achieved. The results of the analysis also show that the variance value of XI.MIA.2 is greater than XI.MIA 3. This indicates that the scores of learners' learning outcomes in the experimental class are more diverse than the learning outcomes in the control class.

Thus the standard deviation which is the square root of the variance in XI.MIA.2 ie 4.15 will also be greater than XI.MIA.3 which is only 2.54 To clarify the comparison of scores XI.MIA.2 and XI.MIA.3, then presented in the following diagram: Figure 2. Frequency Distribution Chart Score of Physics Students Learning Results .

0 5 10 15 20 Very Low Low Moderate High Very High Number of Student Category The comparison of student's achievement of both classes XI MIA 2 XI MIA 3 (3) Figure 2 shows the basic differences between XI.MIA.2 and XI.MIA.3 Based on the physics learning outcomes scores of learners presented in tabular form and diagrams show that the learner scores XI.MIA.3 and XI.MIA.3

there is a significant difference. From the analysis results obtained tcount = 35 and ttabel = 1.68. So it can be seen that tcount > ttabel, then H1 accepted and H0 rejected. So it can be concluded that there are significant differences in learning outcomes between the experimental class (XI.MIA.2) and the control class (XI.MIA.3) 3.2

Discussion This research is a pre experimental research where the researchers compare the learning result score between the experimental class and the control class after applying the learning by using computer simulation in one class sample. The main purpose of this research is to know the difference or the increase of physics learning outcome between experiment class and control class after applied learning model by using computer simulation in class learning process of experiment class.

To know that, learners are given the form of test or instrument questions after applying the learning model using computer simulation. Before used as a matter of test, instrument questions have been provided in trials on non-sample classes to determine the validity and reliability of the question. The non-sample class that is used as the test

class of question instrument is class XII.MIA 2 Senior High School 9 Makassar.

From 50 questions tested, there are 20 valid and realiable questions to use as a test of learning outcome (post-test). In the implementation of learning model using computer simulation applied in class XI.MIA.2 Senior High School 14 Makassar learners are required to find their own or find concept based on experience and demonstration given in the learning process.

Based on the results of descriptive statistical analysis show that the results of physics learning of students class XI.MIA.2 higher than the results of physics learning students class XI.MIA.3 which in this case the score of students class XI.MIA.2 entry in high category while scores of class XI.MIA.3 students fall into the low category.

Based on the results of inferential analysis, in this case there is a normality and hypothesis testing. From the analysis results on the normality test class XI.MIA.2 and XI.MIA.3 fall into the normal category because ? 2 count smaller than ? 2 tabel . In the hypothesis test obtained ? 2 c > ? 2 tabel so that the hypothesis can be accepted.

The Effort to improve students' physics learning outcomes are not easy, moreover the ability of students are difference. In addition, the use of learning models tends to have an effect. The learning model applied in this research is one of the factors that determine the success of physics learning.

Based on the data that exist in descriptive analysis, obtained information that shows that learning by using computer simulation has a significant impact on the learners' physics learning outcomes. This happens because in the learning process students are more active so that it can help students to understand the material being studied.

This is also supported by the results of research conducted by Swandi, et al [10] shows the results of research that the activity of students of class XI IPA 2 above 80% at each meeting, indicating that learning is able to activate learners. Percentage of learners perception was 89,80% showed strongly agree to Physics learning by using hypermedia based on virtual lab.

In addition, based on the results of research by Swandi and Bunga Dara [6] the use of interactive simulation can increase the activity of learners on abstract concept learning such us atomic physics. Amanda states that technology provides a means by which students at the undergraduate level can become more engaged in the learning process.

There are available many existing resources, from interactive websites to faculty blogs

that can help instructors begin the process of shifting the burden of learning from passive to active. Additional opportunities for training in active learning and engagement would further benefit members of faculty who are interested in shifting their approach in their classrooms [11]. 4.

Conclusion Based on the data of the research results obtained in this study, it can be concluded that There is a significant difference between the results of physics learning learners who were taught using computer simulations with learners who were taught using conventional media. This suggests that the use of computer simulation can affect the students' physics learning outcomes 5.

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