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Investigating the Use of Phet Simulation as a Substitute for Practical Tools in Understanding the Concept of Static Electricity

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Abstract: The purpose of this research is to see and find out how the understanding of the concept of Static Electricity towards students of SMAN 9 Muaro Jambi Class X MIPA using web-based learning media, namely PhET (Physics Education Technology) simulation. This type of research is quasi-experimental research, where this research involves variables, namely, the independent variable is Phet Simulation, and the dependent variable is class X Sma N 9 Muaro Jambi students. The data collection technique in this study consisted of 20 students taking both tests, learning using Phet Simulation and not using Phet simulation learning (Conventional). In collecting data, the test method was carried out twice, namely the initial test (pre-test) and the final test (post-test). The test instrument used was five questions in the form of an essay. After the test instruments are distributed, the results are obtained where in the pre-test, the average score obtained by students is 40.02, and in the post-test with an average of 85.21, it can be concluded that the practicum media with Phet simulation has an influence on student learning outcomes.

INTRODUCTION

The educational process is expected to change a person's attitude and behavior with the learning process. Education also has an essential role in the progress of a country because the progress can be seen from the quality of education in that country. The development of science and technology (Science and Technology) and the community's increasing needs need to be balanced with improving the quality of education. One of the efforts made by the government is the improvement of the 2006 curriculum into the K'13 curriculum, in which the K13 curriculum is a science-based learning program, and students are required to be more active, creative, innovative, and productive (Trianto, 2012 & Zb, A., dkk. 2020).

Physics is a branch of natural science (science) that contains abstract principles, and these principles can be understood by conducting research, experiments, and presentations based on general rules and theories (Depdiknas, 2003). But in essence, physics does not only discuss theories or memorizing formulas but the many concepts that must be understood and understood properly and correctly so that there are no misconceptions between understanding and concepts (Masril, 2008).

Studying physics also requires the right way to develop students' thinking skills (Agustina, 2021: mahdalena & Daulay, 2020; Saraswati et al., 2018). Physics learning materials cannot be explained verbally but need to be supported by practical activities (Putra, M. I. J., Junaid, M., & Sulman, F. (2021). to support the physics learning process. (Yanti et al., 2020). Practical activities in physics learning are carried out online during the Covid-19 pandemic (Rozal, E., dkk. 2021). In practicum activities, the learning media found at this time are still minimal (Sulman, F. 2012 & 2012) and limited to the use of practicum tools (Sulman, F., Tanti, T., Habibi, M., & Zb, A. 2021). in laboratories at school (Sulman, F., Sutopo, S., & Kusairi, S. (2021).. Where this practicum activity requires learning media that can support the student's learning process remotely; therefore, it is essential to have virtual practicum activities to fulfill the process of practicum activities during the current pandemic.

Based on the results of several observations of physics learning conducted on students (Sulman, F., dkk 2020)., it was found that there were several obstacles and problems they complained about, including learning methods that were too monotonous, the teacher's lack of creativity in delivering learning materials (Zb, A., dkk. 2021)., and inadequate practicum tools, causing students to be less motivated to understand more profound physics concepts (Bandem, 2014). Because for students who are still in the process of self-development (Zb, A., dkk. 2021). understanding physics concepts will not be engaging if they only focus on listening and taking notes on the teacher's delivery. Therefore, to help foster student interest and get around the lack of practical tools, more creative learning resources and media are needed and can fulfill the concepts of physics material (Cecep, 2011; Mustaji, 2013).

Learning resources currently play an important role in solving problems in the learning process, so it is very necessary to use technology and innovation in the physics learning process (Azhar et al., 2021). One of the learning media that can be used in this virtual practicum process is a virtual laboratory using Phet (Physics Education Technology) Simulation. Phet Simulation is a site developed by the University of Colorado that can provide various simulations for virtual learning processes. Using this Phet Simulation can make the learning process more interesting, fun, and challenging (Fauzia et al., 2021). After that, the learning process is no longer only limited to hearing material from the teacher, but students can carry out activities such as demonstrating and observing practice as in the actual laboratory.

But what happened, at this time, there were still some schools that did not know about the simulation media. One of them is SMA 9 Muaro Jambi, so they do not realize the advantages of this learning media. Therefore, we observed the use of this PheT simulation media at SMA 9 Muaro Jambi school to introduce the benefits of this learning media so that it can help and make it easier for students to understand physics concepts and be able to do practicals without fear of being constrained by the tools. Because one of the objectives of learning physics is to build an understanding of students' knowledge about student concepts which will later be useful for them to be able to explain various kinds of phenomena in physics learning and be able to solve related problems (Docktor & Mestre, 2014; Hegde & Meera, 2012). ; Ryan, Frodermann, Heller, Hsu, & Mason,

2016; Sutopo, Jayanti, & Wartono, 2016). One of the concepts that are currently very useful and often encountered in everyday life, but students often have difficulty in building a complete understanding, namely static electricity. This study aims to test whether the learning process using this PhET simulation can help students understand the concept of static electricity correctly.

METHOD

This type of research is quasi-experimental research, involving variables, namely, the independent variable is Phet Simulation, and the dependent variable is class X Sma N 9 Muaro Jambi students. The data collection technique in this study consisted of 20 students taking both tests, learning using Phet Simulation and not using Phet simulation learning (Conventional). In collecting data, the test method was carried out twice, namely the initial test (pre-test) and the final test (post-test). Moreover, the post-test is carried out after the learning is complete to determine students' understanding of the learning material that has been given. The test instrument used was a multiple-choice test with 20 questions.

RESULT AND DISCUSSION

The purpose of this research is to see and find out how the understanding of the concept of Static Electricity towards students of SMAN 9 Muaro Jambi Class X MIPA using web-based learning media, namely PhET (Physics Education Technology) simulation. This study uses 1 sample, namely students of class X MIPA, totaling 20 people by doing two tests. The first test (Pre-Test) is carried out when students learn conventionally or before students learn to use PhET simulations, and the second test (Post-Test) is carried out after students learn to use PhET simulations.

The learning process was carried out in 2 meetings with an allocation of 45 minutes. At the first meeting, students did conventional learning with Static Electricity material. Meanwhile, students did a PhET simulation lesson at the second meeting with the same material as the first meeting, namely Static Electricity.

Learning at the first meeting, students were given independent worksheets to analyze the nature of the electric charge by observing the paper lifted by the tip of the pen being rubbed. From these events, students can find out how the nature of the electric charge. Furthermore, to see the initial understanding of students with conventional learning, students are given an initial test (Pre-Test) with as many as 20 questions. From the pre-test results, the students' average value was 44.02.

At the second meeting, students studied Static Electricity using PhET simulation. Students observe the PhET simulation media about electric charge, a balloon attached to the wall after being rubbed on a wool jacket. From these events, students can understand how the nature of the electric charge. To determine the students' understanding ability after doing PhET simulation learning, students are given a final test (Post-Test) with as many as 20 questions. From the post-test results, the average score of the students was 85.21.

Table 1. Results of Pre-Test and Post-Test

Components	Pre-Test	Post-Tes
Number of Students	20	20
Highest Score	52	94
Lowest Value	24	70
Averege	40.02	85,21

Based on the table above, it can be seen from the results of the research that has been done that the values obtained in the pre-test and post-test have a significant comparison, namely, the post-test results are higher than the pre-test. This was influenced by the use of PhET simulation media at the second meeting. Because the PhET simulation media can attract the attention of students, it causes students to be more enthusiastic about participating in the learning process. In addition, the PhET simulation media also describes in detail how the process of transferring electric charges causes two objects to stick together or lift. Making it easier for students to understand the concept of Static Electricity.

The results of this study were also corroborated by several previous studies, including research conducted by Rozi Saputra et al., who said that PhET simulation media could affect students' learning outcomes in Physics. In addition, the PhET simulation media can also replace the practical for topics with limited tools, dangerous, and difficult to understand. In addition, PhET is also interactive, shaped like a game and connects simulations with real events, and provides feedback and a creative workplace (Finkelestein et al., 2006). Siti Ita Masita, et al stated that the use of PhET simulation was proven to improve students' understanding of physics concepts.

Student learning outcomes in the classroom experienced a more significant improvement after learning activities using Phet simulation. There are several previous research results that are similar to the results of this study, (Abdisa & Getinet, 2012; Atmojo, 2015; Balim, 2009), it was found that student learning outcomes in the post-study class with PHET simulations experienced a greater increase than in the previous class. The increase in learning outcomes is because students are required to be more actively involved during the learning process (Balim, 2009). This will certainly help students gain knowledge well (Mudlofir & Rusydiyah, 2016), and produce a better knowledge base compared to conventional learning (van 3Joolingen, 1999). Thus, students remember learning activities using Phet Simulation more than conventional learning activities (Castronova, 2001).

By using Phet simulation-based learning media on static electricity material, most students are more interested during physics learning because it is not boring, this is similar to research conducted by (Saregar, 2016) that the use of Phet simulation-based learning media in static electricity material can improve students' thinking skills, and often refers to statements that train students' higher-order thinking skills. In addition, the Phet simulation is also used as a direct substitute for the practical laboratory where the virtual lab is very easy to use and very efficient in its use both in terms of time and place because it can be used anytime and anywhere, even though when using the Phet

simulation learning media it must be connected. with internet network. This statement is in accordance with research conducted by Wieman & Perkins (2006).

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Furthermore, the use of Phet simulation learning media is not only used in static electricity learning materials. However, it can also be applied to other science learning, such as chemistry at the junior and senior high school or university levels. Phet simulation learning media in dynamic electricity material is exciting to use, which can increase the maximum from the use of Phet-based learning media; in this case a teacher can provide a module related to Phet usage guidelines, or the teacher can also provide a simulation in advance by making video tutorials the use or explanation of the Phet simulation, then the teacher can upload the video to youtube or another, then explain to students about how to use the Phet simulation learning media to students so that the learning process can run optimally and be carried out in accordance with the desired learning objectives.

CONCLUSION

Phet simulation can be used as a substitute for practice which has an important role in supporting physics learning, especially on static electricity material. Phet simulation learning media can also encourage participants' interest in improving one's thinking skills, and can make students not feel bored during the learning process. In this case, it can be shown by the research process on learning outcomes data after using PhET simulations where the average results have increased.

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