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THE EFFECT TO USING PhET SIMULATION AS A SCIENCE LEARNING MEDIA ON JUNIOR HIGH SCHOOL STUDENTS' CONCEPT MASTERING

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ABSTRACT

Mastery of the concept is needed to measure the success of students' learning process. The objectives of this study were 1) To describe the mastery of the concept of dynamic electricity in class IX students at Junior High School Negeri 26 Banjarmasin who taught using PhET media, and 2) To describe whether or not there was an effect of using PhET as a learning medium in class IX at Junior High School Negeri 26 Banjarmasin. The type of research used is quantitative research with quasi-experimental methods and a nonequivalent control group research design. The data in this study is collected from the test (pre-test and post-test), which contain cognitive domains. The data analysis techniques used to test the hypothesis are the N-gain and simple linear regression tests. The result showed: 1) There were differences in the mastery of concepts in the control class and the experimental class as seen from the post-test average scores, namely 47,94 and 74,76; 2) There is an increase in students' mastery of concepts in the experimental class with an N-gain score in the experimental class of 54,09 in the medium category and the control class 22,76 in the low category; and 3) There is an effect of using PhET media on increasing mastery of students' concepts by 52% based on the results of simple linear regression test. Using PhET media with the guided inquiry method positively influences and increases students' mastery of concepts.

Keywords: PhET; concept mastery; dynamic electricity

INTRODUCTION

When conveying learning in schools, the teacher as an educator has an important role; various ways are carried out so that learning can be appropriately conveyed to students. One of them is learning media. Since the first, teachers have used the media as an intermediary in conveying material so that it can be understood by students properly. Not only that, the media can also arouse the curiosity and desire of students to continue learning. This is as revealed by Wahyuningtyas and Sulasmono (2020), media increases learning motivation, provokes learning stimuli so that students can repeat what they have learned, and activates student responses.

Media comes from the Latin term medical, meaning "middle" or "introduction". If interpreted in Arabic, the media is an intermediary from the sender to the message's recipient. According to the message analogy, the teacher is the message's sender. The message intermediary is the media and students as message recipients. That is, the media as a message delivery channel is tasked with bridging the learning message conveyed by the teacher to students. Having a broad meaning, the Association Of Education Technology (AECT) provides limitations

regarding media; in the world of education, if the media carries a message or information that contains teaching intent, then the media is called learning media (Wahyuningtyas & Sulasmono, 2020).

Learning media should be effective and efficient for educators and students. Not only that, but learning media must also be adapted to the conditions of students in their use and maintenance (Mardhatila, 2021). Each learning medium must have different characteristics, advantages, and disadvantages. Therefore, systematic planning is needed in the use of learning media. Learning media has two elements: the hardware used and the message's contents (Hamid et al., 2020).

A lesson's success can be seen from achieving a learning goal. The core learning objective is that a learner can master the concept; a concept cannot form through the teacher's interpretation with conventional methods only. Good experience in learning gives better results in learning outcomes (Nurhamidah et al., 2022). Therefore, appropriate methods and strategies are needed to achieve learning objectives, one of which is the improvement of learning media. Therefore, as information providers, teachers must have sufficient knowledge and understanding of instructional media (Kustandi & Darmawa, 2020).

Technology in learning media is one of the innovations that can be used in the learning process, as emphasized in 21st-century learning (Nurhamidah et al., 2022). However, several learning practices found that many science teachers still needed to rely on the lecture method rather than experimenting and involving students in learning media. This is in line with what was written by (Wahyudi et al., 2019) in their book Science Learning Media for Middle School Simple Design to ICT-Based; there are still many schools that carry out learning that is managing classically, that is generally communication only occurs in one direction from the teacher to the students.

Some science subject matter is theoretical or cannot be witnessed directly, requiring special media for delivery (Nurhamidah et al., 2022). Science is also a lesson that discusses facts and concepts related to real life based on human observations and experiments. The material for learning electric current in dynamic electricity requires special media because students only know the electric current flowing in an object without being able to see the shape of the electric current directly.

Understanding concepts is very significant for students because, ideally, the science learning process will be successful if students can master the concepts presented. This aligns with what was conveyed by (Anisa & Astriani, 2022). Ideally, the science learning process should improve students' ability to understand and master science concepts.

One of the media that can be used to help convey material concepts and mastery of abstraction in dynamic electricity concepts and replace practicum activities in the laboratory by supporting the development of new technologies is PhET (Physics Education Technology) simulation. At PhET, some simulations are theoretical and experimental, which involve users actively using animated images (Alridha et al., 2021).

METHOD

The quasi-experimental research method finds a causal relationship between factors the author intentionally causes. To determine whether there is a causal relationship between groups, compare the experimental group given sensitivity training with the control group not. The research method used in this research is the quasi-experimental method (Quasi-Experimental) with the Nonequivalent control group research design (Abraham & Supriyati, 2022).

In this study, researchers used the PhET learning media to find the effect on students' mastery of concepts in class IX junior high school on the subject matter of dynamic electricity. The design was divided into two groups, namely the control and experimental groups, which were not randomly selected. These two groups will take the pre-test and be given treatment, then take the post-test. The following is a Quasi-Experimental research design with a Nonequivalent control group design.

Table 1. Nonequivalent control group design

Class	Pre-test	Treatment	Post-test
Control	O_1	C	O_2
Experiment	O_3	X	O_4

Dantes (2012)

Information:
X = Provision of sensitivity training
C = Not given sensitivity training
O1 and O3 = Giving pretest
O2 and O4 = Giving posttest

Two variables are used in this study: the independent variable and the dependent variable. The PhET (Physics Education Technology) learning media acts as the indents variable, while mastery of the science concept acts as the dependent variable. The research was conducted in the second and third weeks of May 11-May 19, 2023, at Junior High School Negeri 26 Banjarmasin. The population was all class IX students at Junior High School Negeri 26 Banjarmasin, totalling 192 students. The samples used came from two classes, namely class IX-C as the control class with a total of 31 students and class IX-D as an experimental class with 29 students.

Research data will be collected using the test method; a multiple choice test of 10 questions and five short answer questions are tested for validity and reliability. The test was given twice: the initial test (pre-test) and the final test (post-test). The pre-test result will then go through normality and homogeneity tests (F-test). Analysis of the result of the data used includes the N-gain test and simple linear regression test.

RESULT AND DISCUSSION

Result

The result of the research are descriptions of pre-test and post-test data, N-gain test, and simple linear regression test. The result of the normality and homogeneity test in the control and experimental classes during the pre-test and post-test can be seen in the following table. Both classes are typically distributed and homogeneous.

Table 2. Pre-test results in data

Components	Control class	Experimental class
Maximum score	60	70
Minimum score	14	24
Average	32,7	46,2
Normality test	0,98 (normal)	0,948 (normal)
Homogeneity test	0,362 (homogeneous)	

Based on the pre-test carried out in both classes, namely the control class and the experimental class, the average value of the control class is lower when compared to the experimental class. In the homogeneity test, two classes are homogeneous, meaning that both come from the same sample and have the initial abilities.

Table 3. Post-test results in data

Components	Control class	Experimental class
Maximum score	100	92
Minimum score	12	52
Average	43,4	74,7
Normality test	0,200 (normal)	0,200 (normal)
Homogeneity test	0,345 (homogeneous)	

The post-test result showed an increase in the mean scores in the control and experimental classes, with the average experimental class being much higher than the control class. However, both classes are typically distributed and homogeneous. This can be due to the conceptual knowledge obtained after participating in learning. Even so, both classes continued to experience improvement. Next, an N-gain test will be carried out to see how much the interpretation of conventional and PhET media use affects students' mastery of concepts.

Table 4. N-gain test result

Components	Control class	Experimental class
Minimum score	-32,26	13,64
Maxsimum score	100	87,1
Average	23	54

Based on the result of the N-gain test, the control class has an average of 30, so the N-gain score is in the interval $0.00 < g \leq 0.30 = 0.00 < 0.23 \leq 0.30$ and is included in the low category. It can be concluded that the use of conventional media has a low interpretation to improve the mastery of the scientific concept of dynamic electricity. In the experimental class, the average was 54, and the N-gain score was at intervals of $0.30 < g \leq 0.70 = 0.30 < 0.54 \leq 0.7$ and was in the medium category. It can be concluded that the PhET learning media has a moderate interpretation to improve the mastery of the science concept of dynamic electricity.

After that, to find out how much the relationship between the use of PhET media and students' mastery of concepts

can be done with a simple linear regression test.

Table 5. Simple regression test result

Model	R	R Square	Adjusted R Square	Std. The error in the Estimate
1	,520[a]	,270	,243	13,50479

The calculations using the IBM SPSS Statistics 23 application show that the value of the relationship (R) between PhET media and concept mastery is 0.520. This means that the use of PhET media on students' mastery of concepts is 52%.

Discussion

The study was conducted to compare the level of mastery of the science concept of electricity between the control class, which was taught using the guided inquiry method and electrical physics KIT as the medium, and the experimental class, which was taught using the same method, namely guided inquiry and PhET simulation as the medium.

Based on the research data in Table 4.1, the results show that the use of PhET media accompanied by the guided inquiry method has a higher difference in the mastery of concepts compared to the control class, which is taught using the physics KIT media. Differences in the mastery of the concepts between the two classes occur because the media used in learning differs. Classes taught using PhET media tend to be more relaxed, enthusiastic, and able to independently apply the media provided. This is what Azizaturredha (2019) has done in his research. Namely, relaxed and fun learning with a virtual laboratory will increase students' interest in learning.

Differences in students' mastery of concepts abilities are also caused by the activeness of students in the experimental class who can complete experiments smoothly with their groups. In addition, students in this class can also draw conclusions based on the learning that has been undertaken; this makes students remember the material provided by the teacher. This is in line with the opinion that students who are taught using PhET media can draw their conclusions or abstracts so that the understanding of the concepts provided will be embedded longer in students (Alam et al., 2021) when compared to the control class which listened to some help and input provided by the teacher regarding the learning that had taken place.

In the experimental class, students can independently manipulate the experimental variables given in the student worksheets without feeling doubtful and insecure. This is due to the ease of using PhET media, so students can operate it independently without having to be supervised by the teacher (Maulida et al., 2022). Another difference between the control and experimental classes can also be seen in the average post-test scores. The control class has an average value of 47.94, while the experimental class has an average of 74.76. These results are by the learning that has taken place, and the final result of students' mastery of concepts with PhET media is higher than a class with electrical physics KIT media.

The learning in question is learning that makes students able to master concepts, know facts and explain them with words that are arranged independently but do not change the meaning—especially students who can

find examples of what has been learned (Wijaya et al., 2020). Wijaya (2020) also wrote an explanation of the series of learning that the students had to do, referring to Anderson's and Kratwhol's revised Bloom's Taxonomy. The research will measure students' mastery of concepts through factual, conceptual, and procedural knowledge dimensions.

The categories of Operational Verbs (KKO) used in these three dimensions are remembering (C1), understanding (C2), and applying (C3), which the researcher outlined in the pre-test and post-test questions. The following is the result of mastery of the science concept in the control and experimental classes, as seen from the post-test result.

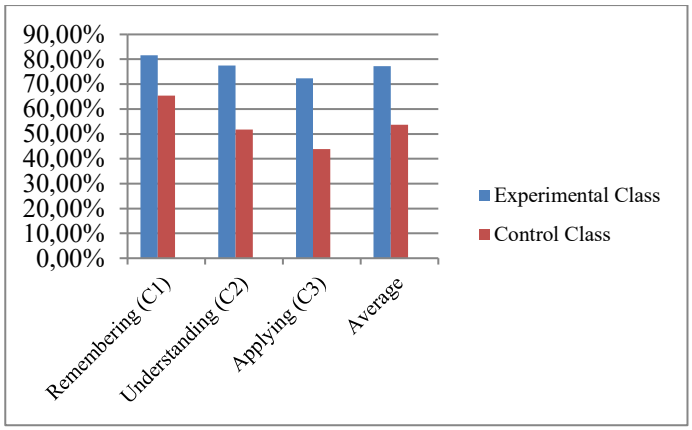

Diagram 1. Results of concept mastery

In addition, to increase the ability to master science concepts in the control class and the experimental class is the N-gain score test. The calculation results show 0.23 in the control class, which is in the low category, and 0.54 in the experimental class has a higher score because students can independently explain a phenomenon related to the problems given and interpret the experimental results. In the control class, students can only remember facts but not relate them to existing phenomena.

The guided inquiry learning model was chosen because it is per the learning characteristics to be carried out. Students will be asked to solve problems and central concepts in the material provided. The steps of the guided inquiry learning model consist of (1) Asking questions, (2) Formulating hypotheses, (3) Collecting data, (4) Analyzing data, and (5) Making conclusions (Puspitasari et al., 2019).

After following all stages of learning, in the final stage, students are asked to make conclusions and make presentations. This activity is carried out so students practice expressing their opinions in groups. After being given learning using the same model and different media, students in both classes were given another question. The post-test to see an increase in students' mastery of science concepts in both classes. It turned out that the effect of using PhET media on students' mastery of concepts in the experimental class was 52%.

CONCLUSION

Based on the research result, it can be concluded from the data analysis and discussion that:

1. There is an increase in the mastery of the science concept of dynamic electricity in the experimental class, with the medium category. This is

evident in the result of the N-gain test in the experimental class, which is in the medium category in increasing students' mastery of concepts, namely at intervals ($0.30 < g \leq 0.70 = 0.30 < 0.54 \leq 0.70$). Whereas in the control class, only at intervals ($0.00 < g \leq 0.30 = 0.00 < 0.23 \leq 0.30$) has a low category in mastering the concept.

2. The simple linear regression test is the final test used to calculate the effect of using PhET media on students' mastery of concepts. The calculation result shows the relationship between PhET media and students' mastery of concepts with an influence value of 0.520 (52%).

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REFERENCE

Abraham, I., & Supriyati, Y. (2022). Desain kuasi eksperimen dalam pendidikan: literatur review. Jurnal Ilmiah Mandala Education (JIME), 8(3), 2476-2482. https://doi.org/10.36312/jime.v8i3.3800.

Alam, Y., Putra, F., & Sholichin, R. (2021). Pengaruh Simulasi PhET (Physics Education and Technology) terhadap kualitas dan hasil belajar. BRILIANT: Jurnal Riset dan Konseptual, 6(1), 225-231. https://doi.org/10.28926/briliant.v3i4.559.

Alridha, A., Alvina, S., & Fatmi, N. (2021). Pengaruh metode praktikum berbantuan simulasi PhET terhadap hasil belajar kognitif pada materi tumbukan. Jurnal Riset Inovasi Pembelajaran Fisika, 4(2), 90-100.

Anisa., & Astriani. (2022). Implementation of PhET simulation with discovery learning model to improve understanding of dynamic electricity concepts. Journal Pijar MIPA, 17(3), 292-301. https://doi.org/10.29303/jpm.vl7i3.3438.

Azizaturredha, M., Fatmawati, S., & Yuliani, H. (2019). Penerapan model pembelajaran inkuiri terbimbing dengan media laboratorium virtual (PhET) untuk meningkatkan hasil belajar, keterampilan proses sains dan minat belajar siswa pada pokok bahasan elastisitas. Edufisika: Jurnal Pendidikan Fisika, 4(1), 1-5.

Banjarani, T., Putri, A., & Hindrasti, N. (2020). Validitas Lembar Kerja Peserta Didik (LKPD) berbasis problem based larning pada materi sistem ekskresi untuk siswa kelas VIII SMP. Jurnal Pendidikan dan Pembelajaran Sains Indonesia (JPPSI),3(2), 130-139.

Haerana, A., Ramlawati., & Yunus, S. (2021). Pengaruh media simulasi PhET terhadap hasil belajar IPA peserta didik kelas IX SMPN 13 Makassar (studi pada materi pokok listrik dinamis). Jurnal IPA Terpadu, 4(2), 12-19.

Hamid, M., et al. (2020). Media Pembelajaran. Medan: Yayasan Kita Menulis.

Hastuti, W. (2021). Meretas motivasi belajar peserta didik di era pandemi melalui video virtual laboratory. Jurnal Kediklatan Balai Diklat Keagamaan Jakarta, 2(1), 32-39.

Inayah, N., & Masruroh. (2021). PhET simulation effectiveness as laboratory practices learning media to improve students' concept understanding. Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 9(2), 152-162. https://doi.org/10.33394/j-ps.v9i2.2923.

Ismalia., Kusumawati, M., & Wahyuni, P. (2022). Investigating the use of PhET simulation as a substitute for practical tools in understanding the concept of statistical electricity. International Journal of Education and Teaching Zone, 1(1), 20-25. https://doi.org/10.57092/ijetz.vli1.7.

Juniantoro, S., et al. (2021). Literasi digital dalam tantangan pendidikan abad 21. Jawa Tengah: Penerbit NEM.

Kustandi, C., & Darmawan, D. (2020). Pengembangan media pembelajaran: konsep & aplikasi pengembangan media pembelajaran bagi pendidik di sekolah dan masyarakat. Jakarta: Prenada Media.

Magdalena, R., & Krisanti, M. (2019). Analisis penyebab dan solusi rekonsilasi finished goods menggunakan hipotesis statistik dengan metode pengujian independet sample T-test di PT. Merck, Tbk. Jurnal TEKNO, 16(1), 35-48.

Mardhatilla, Z. (2021). PhET simulation sebagai penunjang pembelajaran IPA secara online selama pandemi covid-19. PISCES, 1(-), 441-448.

Masfaratna. (2023). Model pembelajaran inkuiri berbantuan simulasi media PhET meningkatkan hasil belajar. Lombok Tengah: Penerbit P4I.

Masita, S., Donuata, P., Ete, A., & Rusdin, M. (2020). Penggunaan PhET simulation dalam meningkatkan pemahaman konsep fisika peserta didik. Jurnal Penelitian Pendidikan Fisika, 5(2), 136-141.

Maulida, I., Taufik, M., & Kosim. (2022). Pengaruh media PhET dalam model discovery learning terhadap pemahaman konsep fisika peserta didik. Jurnal Ilmiah Profesi Pendidikan¸ 7(3), 1150-1156.

Muzana, S., Lubis, S., & Wirda. (2021). Penggunaan simulasi PhET terhadap efektivitas belajar IPA. Jurnal Dedikasi Pendidikan, 5(1), 227-236.

Nurhamidah, S, D., Sujana, A., & Karlina, D. (2022). Pengembangan media berbasis android pada materi sistem tata surya untuk meningkatkan penguasaan konsep siswa. Jurnal Cakrawala Pendas, 8(4), 1318-1329.

Nurulhidayah, M., Lubis, P., & Ali, M. (2020). Pengaruh model pembelajaran discovery learning menggunakan media simulasi PhET terhadap pemahaman konsep fisika siswa. Jurnal Pendidikan Fisika, 8(1), 95-103.

Rizaldi, D., Jufri A., & Jamal. (2020). PhET: simulasi interaktif dalam proses pembelajaran fisika. Jurnal Ilmiah Profesi Pendidikan, 5(1), 10-14. https://doi.org/10.29303/jipp.v5il.103.

Sartika, S., & Setiyoningrum, E. (Ed). (2020). Buku panduan penggunaan aplikasi PhET untuk SMP. Sidoarjo: Umsida Press.

Ulum., Soetjipto., & Yuanita, L. (2019). Development of physics learning

instruments with guided inquiry learning model by PhET simulation to train student's science process skills on dynamic electricity in high school, 9(12), 425-431. https://doi.org/10.29322/IJSRP.9.12.2019.P9647.

Vasiliadou, R. (2020). Virtual laboratories during coronavirus (COVID-19) pandemic,-(48), 482-483. https://doi.org/10.1002/bmb.21407.

Wahyudi., Saputri, D., & Koriaty, S. (2019). Media pembelajaran IPA SMP desain sederhana hingga berbasis ICT. Pontianak: Program Studi Pendidikan Fisika IKIP PGRI Pontianak.

Wahyuningtyas, R., & Sulasmono, B. (2020). Pentingnya media dalam pembelajaran guna meningkatkan hasil belajar di sekolah dasar. Jurnal Basicedu, 2(1), 23-27.

Wicaksono, I., Indrawati., & Supeno. (2020). PhET (Physics Education Technology) sebagai media pembelajaran untuk meningkatkan kemampuan berpikir kritis siswa. Webinar Pendidikan Fisika 2020, 5(1), 1-5.

Wijaya, L., Jamaluddin., & Hadiprayitno, G. (2020). Penguasaan konsep sains peserta didik berdasarkan dimensi proses kognitif dan dimensi pengetahuan. Jurnal Pijar MIPA, 15(4), 357-361.

Wisma. (2022). Aplikasi PhET, pilihan simulasi pembelajaran IPA. Lombok Tengah: Penerbit P4I.