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IMPLEMENTASI OF MEDIA PHYSICS EDUCATION TECHNOLOGY (PHET) IN LEARNING SCIENCE WITH SAINTIFIC APPROACH

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Abstract
This research aims to describe the use of PhET media in science learning, specifically on the topic of electricity, with the expectation that students can engage in active, independent learning, think critically, enhance digital literacy, and facilitate understanding of electrical circuit concepts. The research method used is qualitative, focusing on the application of PhET simulation media in science subjects, particularly electricity, for the fifth-grade students at SDN Sukasari. The subjects of this study are 16 fifth-grade students. The data obtained were analyzed using the Miles and Huberman data analysis model, which includes data collection, data reduction, data presentation, and conclusion drawing. The observations revealed that after implementing the PhET simulation media, students were able to engage in learning actively, independently, think critically, enhance digital literacy, and facilitate their understanding of electrical circuit concepts. However, there were challenges encountered, such as the instability of the internet connection at SDN Sukasari during the simulation process using PhET, which hindered the learning process since PhET is a digital media that requires an internet connection.
Keywords: PhET media, Science learning, Digital literacy

INTRODUCTION

The rapid development of technology and information provides educators with various alternative learning media, one of which is Physics Education and Technology (PhET). PhET, in particular, helps students understand abstract concepts in physics (Rizaldi, Jufri, and Jamaluddin, 2020:11). PhET Simulation is a website designed as a virtual laboratory that allows students to explore enjoyable simulations and, through this exploration, discover scientific ideas (Sulistiawati, 2022: 925).

Integrated Science (IPAS) is a subject taught in elementary schools, covering the study of living organisms and events occurring in their environment. The PhET media, as a simulation tool that can replace real laboratories, systematically, orderly, rationally, and objectively explains facts and principles in IPAS learning. According to Lusidawaty et al. (2020), science learning in elementary schools enables students to learn about their natural surroundings and its contents through various activities during the learning process. Susanto

(2017) states that current science learning tends to focus on students viewing science as a product, considering only the drafts, ideas, and principles. One of the topics requiring laboratory facilities is electrical circuits. The use of PhET media has several advantages, such as overcoming time constraints, addressing limited resources, clarifying abstract physics concepts, and demonstrating phenomena that are difficult to observe directly (Fitriani and Cahyaningsih, 2023:31).

The use of PhET simulation media was also implemented at SDN Sukasari during IPAS lessons. Fifth-grade students practiced learning about electrical circuits, including parallel and series circuits. Students were asked to bring equipment and materials such as wires, small light bulbs, batteries, scissors, and tape to practice assembling electrical circuits. However, during the process, students encountered numerous difficulties, such as cutting wires, a lack of materials, and some students not bringing complete equipment. By the end of the lesson, students complained about the difficulties and many did not want to finish their projects. In the next session, the researcher presented the same material but used the PhET simulation media instead. The results were significantly different; students became active, found it easier to understand the concepts of series and parallel circuits, and remained enthusiastic and engaged until the end of the lesson.

This aligns with research conducted by Ariyanto (2022) titled "The Effect of Using PhET Virtual Laboratory on Elementary School Students' Science Learning Outcomes on the Topic of Electrical Circuits." This research indicates that PhET media helps students understand concepts and increases learning activity. Similarly, Narulita et al. (2024) conducted research titled "The Use of PhET Simulation Media on Elementary School Students' Science Learning Outcomes on Electrical Circuit Material," showing that PhET simulation media positively impacts students' learning outcomes and enhances their performance.

Based on the implementation of PhET media at SDN Sukasari in the fifth-grade IPAS lesson on electrical circuits, where problems continuously arose and evolved, the researcher intends to conduct a study titled "Implementation of Physics Education Technology (PhET) Media in Learning IPAS with a Scientific Approach on Electrical Material for Fifth Grade at SDN Sukasari." This study aims to describe the use of PhET media in IPAS learning, particularly on electrical circuits, with the expectation that students can participate actively, independently, think critically, enhance digital literacy, and find it easier to understand the concepts of electrical circuits.

METHOD

The research methodology used is a qualitative method, focusing on the use of PhET simulation media in the IPAS subject, specifically on electrical material for the fifth-grade students at SDN Sukasari. The subjects of this research are 16 fifth-grade students. The study was conducted in November 2023. The data collection technique used in this study is triangulation (combined), which involves gathering data, primarily verbal data, through books, articles, notes, and various other scientific literature. The data collection process is facilitated by research instruments that have been developed, including observation guidelines, questionnaires, and interviews conducted during the IPAS lesson on electrical circuits for fifth-grade students at SDN Sukasari. The data obtained are analyzed using the Miles and Huberman data analysis model, which involves the following stages: data collection, data reduction, data display, and conclusion drawing.

RESULTS AND DISCUSSIONS

Based on the results of research conducted in November 2023 in the learning process in class V of SDN Sukasari in the science and science subject, the topic of discussion was Electricity material with a total of 16 students. In the previous learning process, students have carried out practice by assembling a series of traffic lights, in which case students have been assigned to bring equipment such as batteries, cables, small light bulbs, scissors, cardboard and solutions, which in the end students can produce a product discovery of a series. This is in line with Abdurahman, Sri Afira Ruhyadi, & Binasdevi, 2022, stating that project-based learning is learning that is carried out through the process of discovering a work or project being worked on. However, in the process there were obstacles and difficulties that occurred where in this activity there was one group whose light bulb broke due to falling, and many students complained that they had difficulty pairing 1 cable with another cable, and students experienced difficulty when assembling an electrical circuit because incompleteness in carrying equipment. This was proven during the interview process where most students complained that they experienced difficulties during the practicum process directly involving materials, in which case the researcher asked the question "What do you feel after studying practical practicum directly involving the materials that must be provided?" there were several students who expressed that "*when installing cables it is very difficult, because you have to remove the fibers and cables first, and when cutting cables that cannot be cut at all it is difficult"* then there were students who complained *"it was difficult because they had to buy the materials and then some will be damaged."* This is in line with research conducted by Widiyanto, Khatimah and Atika (2023) that the obstacles encountered in carrying out science learning practicums are that students do not understand the work steps in practicums, there are some students who do not participate enough in carrying out tasks in their groups, students also experience obstacles/difficulty.

Figure 1. interview documentation

Given the obstacles and difficulties faced by students when carrying out practical work on making parallel and series electrical circuits, media is needed to support the achievement of learning objectives for students, especially in the science and science learning process on electricity, which makes it easier for teachers and students to understand the learning concepts involved. is abstract and increases student activity by using PhET simulation media. According to Prihatiningtyas in (Priyanto, 2020) PhET Simulation is research-based interactive simulation software and has a free license. PhET Simulation is fronted by Carl

Wieman as the founder of the higher education institution, namely the University of Colorado. The process of implementing PhET Simulation in electrical materials uses a scientific approach. The scientific approach is a learning model which in the process contains scientific principles, starting from collecting data by observation, asking questions, carrying out experiments, processing information or data, to communicating (Sulistiawati, 2022:953). The scientific learning approach uses five learning steps, namely; observing, questioning, experimenting, associating and communicating (Permendikbud No. 103/2014 concerning Learning in Elementary and Elementary School).
The process of implementing PhET simulation with a scientific approach to Class V Electrical material

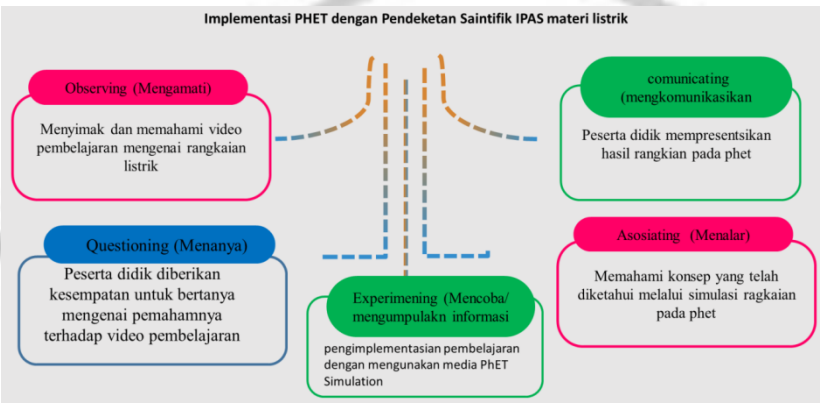

Figure 2. Concept map for PhET implementation

1. **Observing**
   Students are directed to watch videos related to electrical circuits in life. After listening and understanding the video students are asked to understand and analyze the types of electric current in the video. This is in line with Banawi, 2019, stating that through the medium PhET Simulation can provide stimulus; reading, or observing pictures, or situations, according to the learning material/topic/theme. At this stage, motivation and reinforcement are also provided regarding the material presented. Students were grouped into 4 groups where after the groups were formed the teacher distributed LKPD and each group also received 1 chromebook to support learning practices through PhET media.

Figure 3. Video observati

2. **Questioning**
   After forming and distributing the student worksheet, students are given the opportunity to ask questions regarding the results of their understanding of electrical circuits. In this

activity, the teacher also monitors and directs the discussion activities, as well as providing opportunities for other groups to help answer questions given by students. The purpose of this questioning stage is for students to be able to extract information from learning, develop curiosity and increase students' self-confidence. This is in line with Banawi, 2019, which states that the competencies being developed are developing creativity, curiosity, the ability to formulate questions to train critical thinking which is necessary for living intelligently and learning throughout life.

Figure 4. Group distribution

3. Experimenting

At this stage, learning is implemented using PhET Simulation media, where in the process, students in each group are given a chromebook and a LKPD, which contains the steps that students must take in making an electrical circuit. In this process, students are also directed and controlled on the use of PhET, where in the first step, each group accesses the website https://phet.colorado.edu/. Each group is given 10 minutes to be able to put together a series, in this case students are given the freedom to be able to access and operate the page with the understanding they have, which means they can put together this series through a virtual laboratory which provides components such as batteries, bulbs, cables, switches and others.

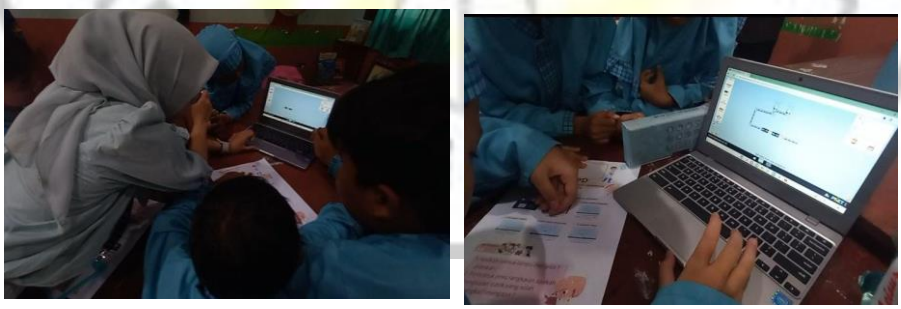

Figure 4. Implementation of the use of PhET Simulation media

Students can understand and be enthusiastic when the circuit they carry out is successful, where the circuit can be said to be successful if the lights can be lit brightly, but if the lights cannot be lit then there are components that are installed incorrectly, the group whose lights cannot be lit is given direction and guidance.

4. Asosiating

Students can understand concepts that are already known through series circuit simulations through PhET where students record all the information known from the simulation activity of arranging electric currents so that students in this case can answer the questions contained in the LKPD.

Figure 5. Electrical Material LKPD

5. Comunicating

Students can present the results of the series that have been assembled together with their group members, in which case students can draw conclusions and report the results of their series to other groups.

Figure 6. Results presentation

CONCLUSION

Based on the results of the Electrical Circuit practicum, in this case the students directly tried the PhET simulation media by creating series and parallel electrical circuits. From the results of direct observations and simulations by students using PhET media, in the process students become active in the classroom and are more enthusiastic in participating in learning, this is because PhET media is a newly discovered media and is applied directly by students, with With the use of PhET media, students experience learning while playing games that attract students' attention and interest in learning, This is in line with Muzana, Lubis, and Wirda, (2021:228) by using PhET simulations you can also prove things that are difficult to see from practical work carried out in real laboratories, this PhET simulation can be used online or offline, shape design The images and colors in the PhET simulation are very interesting because they are directly adjusted to the basic color of the material and correspond to the original shape or tool during practicum in the real laboratory. In line with this, Aizaturredha Fatmawati & Yuliani (2019) also argue that learning outcomes, science process skills and students' interest in learning will increase when using PhET, besides that, PhET simulation media has interesting and fun illustrations and is able to foster higher interest in learning.

This is in line with Hanik (2020) stating that web-based learning education can train self-directed learning and increase digital literacy. Where with self-directed development students can foster learning independence and responsibility in learning, apart from that, digital literacy can increase knowledge and skills in applying technology in everyday life. However, there are obstacles experienced when implementing electrical circuits using This PhET simulation media, in this case the lack of stable connection/network at SDN Sukasari during the simulation process using PhET, so in this case it becomes an obstacle to the learning process because in this case PhET is included in digital media which requires an internet connection. For this reason, it is important to use a stable internet connection during the learning process using PhET simulation media.

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