

Application of Scaffolding-based Learning Media PhET Simulation in Improving Student Learning Outcomes at SMA Negeri Ambulu

Penerapan Media Pembelajaran Simulasi PhET Berbasis Scaffolding Dalam Meningkatkan Hasil Belajar Siswa Di SMA Negeri Ambulu

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ABSTRAK

Berdasarkan penelitian penerapan model pembelajaran kooperatif tipe jigsaw pada siswa kelas X-6 SMA Negeri Ambulu pada materi pencemaran lingkungan diperoleh hasil yang terdiri dari tiga siklus yaitu siklus I, siklus II, dan siklus III. Penelitian ini merupakan penelitian tindakan kelas yang bertujuan untuk mengetahui peningkatan siswa dalam memecahkan masalah berupa keberhasilan siswa pada nilai aspek kognitif dan nilai aspek afektif. Pada siklus I diperoleh hasil pada aspek kognitif dan afektif masing-masing dengan nilai rata-rata 62,5 dan 67,25. Sedangkan pada siklus II diperoleh hasil pada aspek kognitif dan aspek afektif dengan nilai rata-rata masing-masing 66,67 dan 70,67. Sedangkan pada siklus III diperoleh hasil pada aspek kognitif dan afektif dengan nilai rata-rata masing-masing 75,32 dan 77,32. Sehingga dapat disimpulkan bahwa pada setiap siklus pembelajaran terjadi peningkatan hasil belajar dan penerapan model pembelajaran kooperatif tipe jigsaw dapat berjalan efektif dan optimal.

Kata Kunci: Gain Normalisasi, Pretest, Posttest, Simulasi PhET.

ABSTRACT

Computer simulation is an alternative and effective solution in understanding physics concepts that are difficult to describe through laboratory experiments. One of the platforms that provide experiments in the form of simulations is a virtual laboratory. One of the virtual laboratory applications is PhET Simulation. In this study, based on research on the application of virtual lab-based learning media PhET Simulation for students in class X-6 SMA Negeri Ambulu on the topic of Global Warming. This study uses two parameters, namely the experimental class and the control class. The data of this study were obtained from the results of the pretest and posttest using the Learners' Worksheet which was tested using normalized gain. Based on the research that has been done, the results of the normalized gain value of the experimental class are 0.64. While the control class normalized gain value is 0.14. From this N-gain value it can be concluded that student learning in experimental classes with the help of virtual lab PhET Simulation can increase more significantly than student learning in control classes that do not use virtual lab PhET Simulation.

Keywords: Phet Simulation, Pretest, Posttest, Normalized Gain.

INTRODUCTION

Physics is a branch of science that studies phenomena consisting of processes, results and scientific attitudes that are systematic, interrelated, and show natural symptoms that can be measured through observation and research (Darti et al. 2017). Physical science contributes importantly to human life. Physical science must be

understood and developed, especially for students. Learners must understand physics concepts correctly (Maulidina dan Bhakti 2020).

The limitation of laboratory equipment can affect the activeness of students during the learning process. The unavailability of complete laboratory equipment causes

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learning to be less effective and physics concepts tend not to be maximally understood (Athailah et al., 2017). This can be seen from the physics laboratory room at SMA Negeri Ambulu which is still not optimally used.

According to Laila (2020), laboratories must provide complete equipment to fulfill practicum activities. The laboratory as a place to conduct experiments, research, and scientific research aims to provide a continuous understanding between existing theories and experiments conducted. Learners can improve scientific performance skills, develop a mindset to seek scientific truth from an object. Skills in using laboratory equipment will further increase the curiosity of students which is one of the scientific attitudes.

Laboratory practicum activities can be beneficial for students because they can understand the use of laboratory equipment, conduct experiments, draw conclusions and be able to analyze in conducting experiments. However, there are obstacles that arise, namely expensive laboratory equipment which causes the availability of equipment to be limited and usually has difficulty updating.

Computer simulation is an alternative and effective solution in understanding physics concepts that are difficult to describe through laboratory experiments (Chen et al. 2016). One of the platforms that provide experiments in the form of simulations is a virtual laboratory. A virtual laboratory is a laboratory that provides experimental tools and materials through a computer program that can be accessed online by students. Virtual laboratories have advantages compared to physical laboratories, namely that they can carry out simulations in various places and time conditions, do not require complex equipment design, and are certainly safer to use (Zacharia & Jong, 2014).

Scaffolding is based on Vygotsky's theory that learning occurs when students learn to face tasks that have not been learned but the task is still within the range of abilities or the task is in the Zone of Proximal Development (ZPD). According to Vygotsky, the level of development of learners abilities is at two levels or levels, namely the level of actual ability (which students have) and the

level of potential ability (which students master).

The zone between the actual and potential levels is called the zone of proximal development (ZPD). The scaffolding learning strategy is an interaction between educators and learners with the aim of helping learners who are experiencing difficulties. The assistance provided is sufficient for learners who are experiencing difficulties (Chamidy et al. 2020). The provision of this assistance aims to reduce the freedom of learners in doing tasks so that they focus more on understanding what is considered difficult. The provision of assistance is given gradually and slowly reduced. Various forms of scaffolding that can be used include conceptual, verbal, visual and decision-making scaffolding. Scaffolding is one of the good strategies to be applied in the classroom (Ashari et al., 2016).

One of the virtual laboratory applications is PhET Simulation. This application was created and developed by the university of colorado, USA. PhET Simulation can be used through computers and cellphones that can be accessed online or offline. Learning by using PhET Simulation makes students more comfortable and fun so that it can improve student learning outcomes (Khasanah et al., 2016).

METHOD

According to Zacharia & Jong (2014), this research study was conducted quantitatively using the Quasi-Experiment method with a Nonequivalent Control Group research design. This research was conducted by providing two parameters, namely the experimental class and the control class. The experimental class was taught using PhET Simulation, while the control class was not taught using PhET Simulation.

The research was conducted in class X-6 and X-7 SMA Negeri Ambulu. Where X-6 as the experimental variable and X-7 as the control variable. The material taught was about global warming. The data of this study were obtained from the results of the pretest and posttest using the student worksheet (LKPD) of students who were tested using normalized gain (N-gain).

RESULT AND DISCUSSION

Based on the research that has been done, the results of the normalized gain (N-gain) table are as follows:

Table 1. normalized gain assessment test

N-gain	Category
$N\text{-gain} \geq 0,7$	High
$0,7 > N\text{-gain} > 0,3$	Medium
$N\text{-gain} \leq 0,3$	Low

This research was conducted in several stages, namely planning, giving pretest questions, learning using PhET Simulation for grade X 6 and learning by not using PhET Simulation, and the posttest stage. The following is a simulation of the topic of global warming taught in grade X 6:

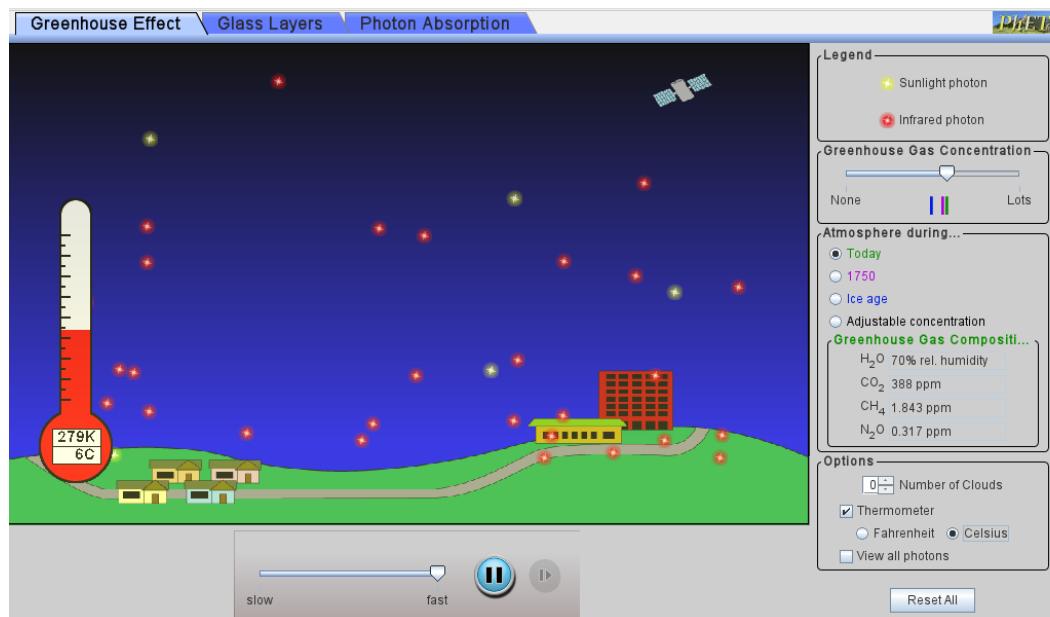


Figure 1. Use of PhET Simulation on global warming

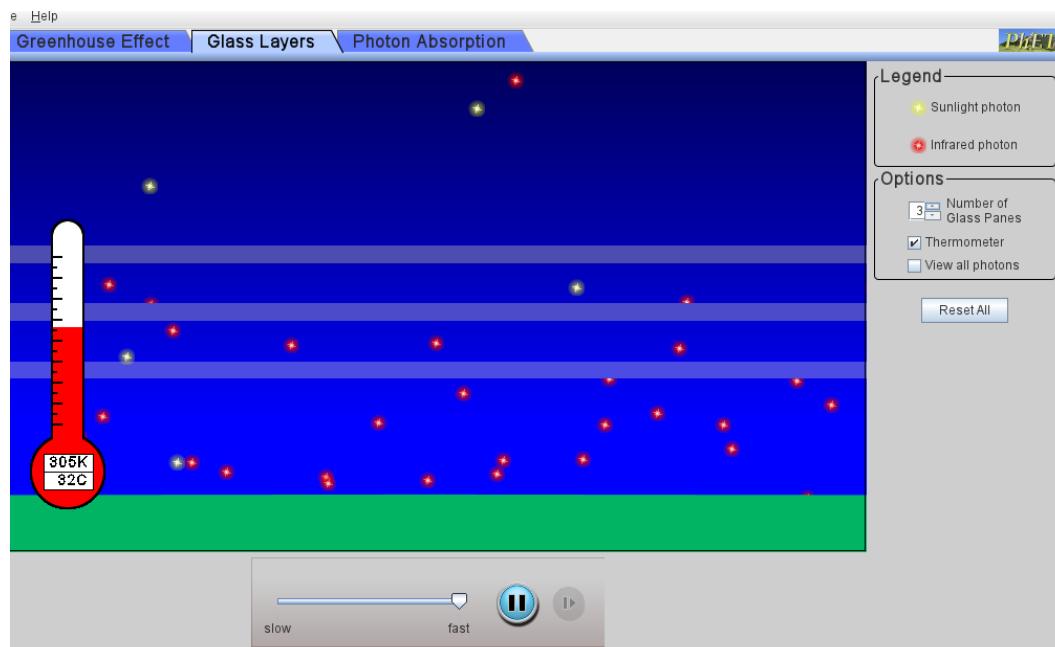


Figure 2. Use of PhET Simulation on Global Warming Topic

Hypotheses are temporary conjectures from the research process and still have to be

proven. The hypothesis formulation in this research is:

H0 : There is no increase in understanding of physics concepts using PhET Simulation scaffolding.

H1 : There is an increase in understanding of physics concepts using PhET Simulation scaffolding.

Table 2. pretest and posttest scores

Class	X-6 Class (Experiment Class)	X-7 Class (Control Class)
Pretest Average	52,57	51,42
Posttest Average	81,30	58,31
Gain	0,64	0,14
Description	Medium	Low

The following is a bar chart of the comparison of scaffolding in grade X-6 and X-7 on physics concepts in students

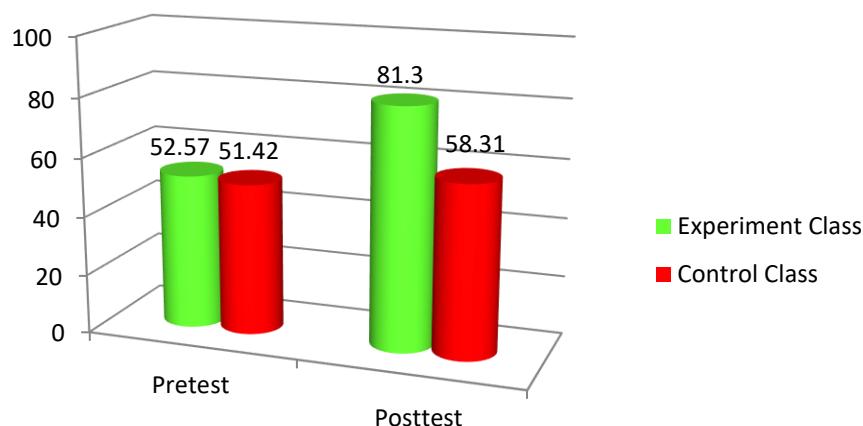


Figure 3. Bar chart of pretest and posttest scores of PhET Simulation scaffolding

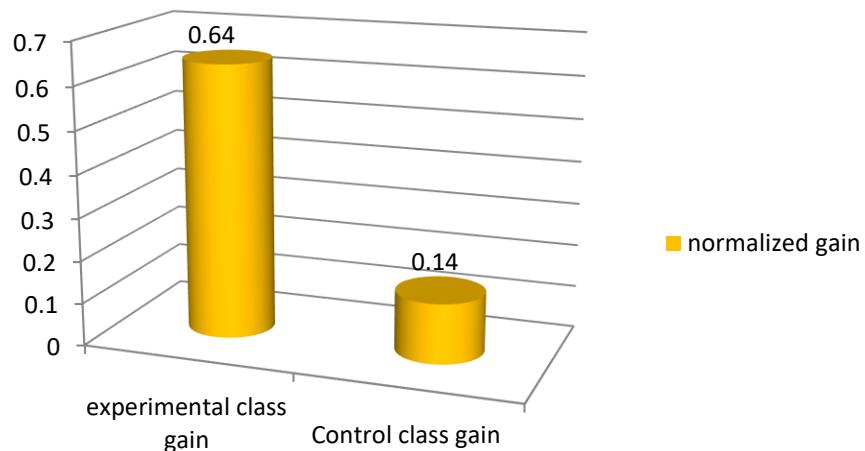


Figure 4. normalized gain diagram between experimental and control classes

Based on the calculation data above, the average value of the experimental class pretest (X-6) was 52.57 and the average value of the

posttest was 82.30. Thus the experimental class experienced an understanding of physics concepts with a moderate category using

PhET Simulation scaffolding. While in the control class (X-7) the pretest average value was 51.42 and the posttest average value was 58.31. The control class experienced an understanding of physics in the low category. The gain value obtained from the experimental class and control class was 0.64 and 0.14, respectively. Based on the above results, the increase in understanding and learning outcomes using PhET Simulation scaffolding is higher than those not taught using PhET Simulation scaffolding.

Learning media using PhET Simulation can improve understanding of the concept of global warming (Heryaningsih and Khusna 2018). Learning using a virtual platform can also improve students' thinking skills because it can illustrate and explain abstract concepts and present complete physical concepts. However, the simulation accessed via mobile phone is constrained because the display on the mobile phone screen is too small so that it still has difficulty in simulating PhET simulation.

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CONCLUSION

Scaffolding based on PhET Simulation is an alternative to improve understanding of physics concepts with global warming material. Understanding of physics concepts in grade X-6 has increased with PhET Simulation-based scaffolding and the gain has a medium value. While grade X-7 although experiencing an increase but still in the low category. The obstacle that arises is the use of PhET Simulation on the mobile phone display is too small so it is still difficult to run the simulation.

Therefore, the suggestion that can be conveyed by the author is that the school is expected to provide a more complete laboratory. So that in running a simulation program using PhET Simulation can run smoothly and can help understanding and physics concepts related to global warming.

Author declaration

Author Contributions and Responsibilities

The authors made major contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Availability of data and materials

All data is available from the author.

Competing interests

The authors declare no competing interests.

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