

The Effect of the Guided Inquiry Model Assisted by PhET Media on Students' Critical Thinking Skills

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Abstract: The purpose of this study was to examine the effect of guided inquiry learning in the use of PhET media on students' critical thinking skills. This study used quasi-experimental methods, group design for pretest and posttest. The independent variable in this study is the PhET media-assisted guided inquiry model used in the experimental class, while the control variable is the critical thinking ability of students. The study population consisted of all students who were in science class XI at SMAN 1 Pringgasela. The experimental group was selected from class XI IPA 2, while the control group was selected from class XI IPA 3. The mean value of the experimental group was determined at 37.54, in contrast to the average value of the control group of 39.36. Following the treatment, the average score of the experimental group exhibited a rise from 67.18 to 72.36, in contrast to the control group. The t test in this study showed a total value below the significant value of 0.050, indicating a value of 0.045. The application of the guided inquiry learning approach, in conjunction with the integration of media, has an apparent effect on developing and improving students' critical thinking abilities

Keywords: Critical thinking skills; Guided inquiry model; PhET media

Introduction

Thinking abilities, such as logical, critical, and creative thinking, are needed to build education for the twenty-first century. In addition, learners play an active role in being able to develop their potential. This means that learners can think more quickly and responsively and are trained to develop courage in themselves.

High-level thinking skills, especially critical thinking, are still in the low category, where during the teaching and learning process students memorize more facts, principles, and theories, especially in the field of science. Science learning is not enough with explanations and listening but students must better understand the concepts that have been taught with activities to find the concepts themselves.

The ability to think critically provides a more precise direction for thinking, working, and determining the relationship between something and others (Saputra et al., 2020). According to Munandar et al. (2018), critical

thinking involves asking questions, doing experiments, and having faith in the knowledge that has been discovered via those experiments. According to Nurmayani et al. (2018), critical thinking skills are fundamental in learning because they help students gain a broad understanding of various topics and encourage them to be sensitive to their problems. One of the subjects that promotes critical thinking in students is physics. However, students find physics lectures challenging since there are too many formulae, they are monotonous, and they don't fully understand the lesson (Algiranto, 2022).

The observation showed that the critical thinking skills of students of SMAN 1 Pringgasela still need to be developed. Students who need guidance to understand the given problem, connect the ideas needed to solve the challenge, describe the solution in writing, and draw conclusions from the problem are indicators of this.

The lack of critical thinking skills is also due to teacher-centered learning, so the first step to overcome this problem is learner-centered and innovative

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learning. The necessity of using a learner-centered learning model can aid students in developing their skills and pique their interest (Fajrina et al., 2018). In this instance, PhET media was chosen because students had never used it. Some learner-centered learning methods, such as guided inquiry, contain innovations that can be applied to learning through the use of media.

According to Joenaidy (2018), in inquiry learning, students must search for and research a problem to solve it systematically, logically, and critically. The same thing was stated by Nurmaya et al. (2021), the guided inquiry learning model provides good encouragement in using critical thinking to search and select answers to a problem independently. Through experimentation with the material, it is intended that students will better understand the topics by exploring and discovering their own expertise. This is due to the fact that learning outcomes and students' critical thinking abilities are affected when students actively seek out knowledge through first-hand experience rather than just hearing and receiving it from what the teacher says (Nurmayani et al., 2018). The guided inquiry learning model can engage students in learning through virtual media, especially PhET media.

PhET simulation is a teaching aid that displays various types of real-world experiments virtually, according to Saputra et al. (2020). PhET simulations provide convenience for teachers and students in situations where practical tools and materials are limited (Handayani et al., 2021). PhET simulation is effectively used as a practicum solution medium during out-of-school learning to improve understanding (Inayah et al., 2021). According to Nurrita (2018), some of the benefits of learning media for teachers include providing guidelines for achieving learning objectives so that they can explain learning material in a systematic order. Ardisa et al. (2022) revealed that virtual-based activities with certain methods can help students solve their problems. The following is the initial appearance of the PhET simulation media, as shown in Figure 1.

According to Nuryanti et al. (2018), the PhET media-assisted learning model can contribute to the development of critical thinking abilities among students. Using the PhET media-assisted learning approach can improve students' critical thinking abilities. The guided inquiry model is used to train students independently in addition to using the model with assistance from PhET media, which can provide feedback and students enjoy trying new things. Teachers are able to create a pleasant learning environment for their students, preventing boredom during the learning process. This PhET media can help the learning process, including physics learning. These innovative media-based learning strategies can help students understand the material so they can solve problems and improve their ability to think critically about what they have learned.

Method

SMAN 1 Pringgasela is the school chosen for this research. In this study, 5 questions were used in the experimental group. This research consisted of Class XI IPA II as the experimental group, while Class XI IPA III was the control group. This research used a quasi-experimental research approach, both groups completed pre-tests for the instruments used according to specified criteria.

After the instrument test is carried out, the next stage is to use questions that meet the criteria to be used as pre-test and post-test to measure students' critical thinking skills. Before the experimental class and the control class are given treatment, the two classes are first given a pre-test to measure the initial abilities possessed by both classes, after that, only the two classes were given treatment where the experimental class was given treatment in the form of a guided inquiry model assisted by PhET media while the control class applied a conventional learning model, giving this treatment for three meetings in the experimental class and the control class. After the treatment is given, the last step taken is the provision of a post-test to measure the improvement of students' critical thinking skills.

Result and Discussion

The results of the instrument trial used in this study include 5 items that assess both pre-test and post-test critical thinking skills. Table 1 below displays the outcomes of the instrument trial.

Table 1 shows that all questions are categorized as valid and reliable in the qualifications carried out by Purnasari et al. (2021), all questions are in the sufficient category in the difference test (DB), while the level of

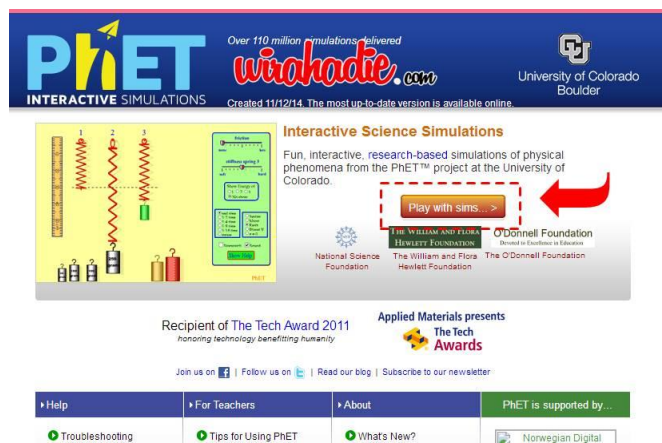


Figure 1. Initial display of PhET media

difficulty (TK) uses criteria from Hadi et al. (2023), and the results obtained are all in the difficult category.

Table 1. Instrument Test Result

Question	r_{table}	r_{xy}	r_{11}	df	dl	Information
X ₁	0.36	0.38	0.46	0.20	0.83	Accepted
X ₂	0.36	0.42	0.46	0.26	0.67	Accepted
X ₃	0.36	0.65	0.46	0.36	0.83	Accepted
X ₄	0.36	0.72	0.46	0.23	0.55	Accepted
X ₅	0.36	0.62	0.46	0.32	0.41	Accepted

The original abilities of the two classes were tested prior to the two classes receiving treatment. 22 pupils were enrolled in each class (Prihandoko et al., 2021). Table 2 below shows the results of the pre-test.

Table 2. Critical Thinking Skills Pre-Test Results

Description	Pre-test	
	Experiment	Control
Highest Score	53.00	54.00
Lowest Score	17.00	28.00
Average	37.54	39.36
Normality Test	Normal	Normal
Homogeneity Test	Homogeneous	

A pre-test was given to both classes before the implementation of any treatment. The pre-test findings are displayed in Table 2, as described above. The experimental class had a minimum score of 17.00, whereas the control class indicated a minimum score of 28.00. The experimental class achieved a maximum score of 53.00, which was only one point lower than the control class's score of 54.00. The mean for both classes shows a minimal difference, with a value of 37.54 for the experimental group and 39.36 for the control group.

Figure 2 below shows the following graphic representations of the initial test results.

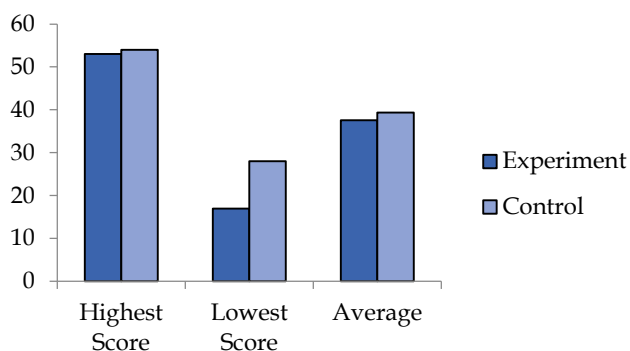


Figure 2. Initial test results for the experimental class and control class

The graph above illustrates the minimal difference in the initial scores between the experimental and control classes. The control class showed a higher mean

score than the experimental class. After that, tests for normality and homogeneity were performed. The Shapiro-Wilk test was employed in SPSS 21 software to assess the normality of the data (Fahrudin et al., 2022). The homogeneity test, which assesses the level of homogeneity between two groups, utilizes the F test in conjunction with SPSS 21 (Lestari et al., 2020).

In data table 2 above, the data is declared customarily distributed because the value obtained is more than the significance number, namely 0.050, and the data comes from a homogeneous sample because it is greater than the significance number. Following the pre-test performance, both groups of participants were subjected to treatment. The experimental group received instruction using the guided inquiry learning model enhanced with PhET media, whereas the control group received instruction using standard learning approaches. Following the treatment, a post-assessment was carried out to evaluate the level to which the student's critical thinking abilities had advanced. Table 3 below shows the post-test results.

Table 3. Critical Thinking Skills Post-Test Results

Description	Post-test	
	Experiment	Control
Highest Score	88.00	85.00
Lowest Score	50.00	55.00
Average	72.36	67.18
Normality Test	Normal	Normal
Homogeneity Test	Homogeneous	

Based on Table 3 above, the average difference of the experimental class after treatment was 34.82, while the difference of the control class was 27.82. The highest score significantly differs between the two classes, 35.00 in the experimental and 21.00 in the control classes.

Figure 3 below displays the final test findings in the following graphical format.

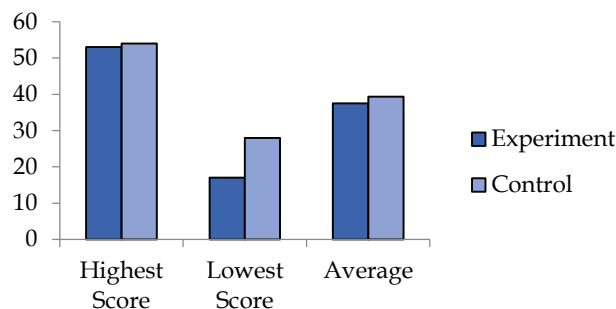


Figure 3. Diagram of experimental and control class final results

According to the graph above, the experimental class's final critical thinking ability score has improved in comparison to the control class.

The post-test data is then processed to test the hypothesis, which aims to determine which hypothesis is in this study (Parnabhakti et al., 2020), where the initial hypothesis is that the guided inquiry learning model assisted by PhET media does not affect students' critical thinking skills and the alternative hypothesis is that this model does have an effect.

The alternative hypothesis is accepted because the value, 0.045, is smaller than the significance number, which is 0.050, after being examined using the independent sample t test.

Research conducted by Anniswati et al. (2015) showed that the implementation of inquiry-based learning has the potential to enhance students' comprehension and proficiency in scientific subjects. In the study conducted by Fauzia et al. (2019), it was found that using inquiry-based teaching methodologies can facilitate the development of critical thinking abilities among students. Parwati et al. (2020) conducted a study which showed that students enrolled in schools employing conventional instructional approaches showed significantly lower levels of critical thinking abilities compared to their equivalents exposed to guided inquiry learning models.

Students play a more active role in learning activities than teachers when using the guided inquiry learning style. Students' problem-solving ability is limited, and learning is still conventional (Siagian, 2015). The learning model that the teacher will use can impact students' critical thinking skills (Agustin et al., 2020). Teachers must develop instructional approaches that develop students' interest towards knowledge, provide positive improvements in problem-solving proficiency, and enhance comprehension of complicated problems. and improve students' critical thinking skills so that learning is centred on students and the teacher as a facilitator who directs students to conduct experiments on PhET media whose processing steps are explained in the LKPD that has been provided (Anggraeni et al., 2019).

The use of PhET media during learning has a tremendous influence on teaching and learning activities. Students are very enthusiastic and excited to start learning because of the PhET media that they first feel or know, so students become more interested in learning and trying physics practicum, thus losing boredom in learning physics and creating physics learning that is cool and fun because students are more interested in learning that involves technology in learning (K. Hadi et al., 2019). According to Khaerunnisak (2018), PhET media facilitates students in the learning process, students can also do practicum independently or in groups, solve problems in the laboratory. The application of PhET in learning can also provide students to conduct experiments anywhere and

anytime, because PhET can be accessed from a smartphone or PC (Susilawati et al., 2022). Doyan et al. (2023) revealed that learning using PhET media is very attractive to students because it is in accordance with the times, so students are very interested in learning physics.

The guided inquiry learning model supported by PhET media has a considerable impact on students' critical thinking skills, according to Agustina et al. (2020). The syntax in this model directs students to understand better and draw conclusions from the learning carried out through activities to present problems, make hypotheses, design and conduct experiments, collect data, and draw conclusions.

One of the main objectives of the learning process using an inquiry method and PhET media is to improve critical thinking abilities. This is corroborated by research from Mardiyanti et al. (2022), demonstrating how teachers can employ the guided inquiry model with PhET to help students develop their critical thinking abilities. The results research of Agustina et al. (2020) revealed that students in the experimental class experienced increased critical thinking and problem-solving skills, which is the expected result. Teachers can apply the guided inquiry learning model as an alternative to physics learning. If PhET media implements this learning model, the results will be maximized. Based on the results of Ashabul (2022), it can be concluded that learning uses PhET simulation-assisted guided inquiry model and the conventional model both have effectiveness and improving skills students' critical thinking.

Conclusion

Based on research findings and discussions, the guided inquiry model supported by PhET media affects students' critical thinking skills. This is shown by students combining concepts related to the material they are learning.

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Conflicts of Interest

No conflict interest.

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