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GUIDED – INQUIRY LEARNING MODEL ASSISTED BY PHET MEDIA ON STUDENT'S LEARNING OUTCOMES

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Abstrak

Penelitian ini bertujuan untuk mengetahui hasil belajar siswa yang diberi perlakuan dan pengaruh model pembelajaran inkuiri terbimbing media PhET terhadap hasil belajar siswa sekolah menengah atas. Jenis penelitian ini adalah desain penelitian kuasi eksperimental dengan desain kelompok kontrol *pre-test – post-test*. Populasinya adalah seluruh siswa kelas XI IPA SMAN 2 Medan pada tahun ajaran 2022/2023. Sampel diambil menggunakan teknik sampling khusus dan diperoleh dari kelas XI IPA 3 sebagai kelas eksperimental dan XI IPA 1 sebagai kelas kontrol. Variabel bebas dari model pembelajaran inkuiri terbimbing berbantuan media PhET, dikenakan pada kelas eksperimental, sedangkan hasil belajar siswa adalah variabel terikat. Data diambil menggunakan tes pilihan ganda untuk mengukur hasil belajar siswa. Hipotesis penelitian diuji dengan menggunakan uji Lilliefors dengan tingkat yang signifikan 0,5% berbantuan Excel dan hasil uji hipotesis menunjukkan signifikan sehingga Ha diterima. Berdasarkan hasil ini, dapat disimpulkan bahwa adanya pengaruh dari model pembelajaran inkuiri terbimbing berbantuan media PhET pada hasil belajar siswa di sekolah menengah atas.

Kata Kunci: Inkuiri terbimbing, Pembelajaran Inkuiri, PhET Media, Hasil Belajar

Abstract

This study aimed to determine the learning outcomes of students who are given treatment and determine the effect of PhET media guided inquiry learning model on the student's learning outcomes of high school. This type of research was quasi – experimental research design with pre-test – post-test control group design. The population was all students of class XI IPA of SMAN 2 Medan in the 2022/2023 academic year. The samples were taken using purposive sampling technique and obtained from classes XI IPA 3 as an experimental class and XI IPA 1 as a control class. The independent variable of guided inquiry learning model, assisted by PhET media, was imposed on the experimental class, while the student's learning outcomes were the dependent variable. The data were taken using multiple-choice tests to measure students' learning outcomes. The research hypothesis was tested using the Lilliefors test with a significant level of 0.5% aided by Excel and the results of the hypothesis test showed a significant so Ha was accepted. Based on these results, it can be concluded that there was an effect of of guided inquiry model assisted by PhET media on the students' learning outcomes at senior high school.

Keywords: *Guided inquiry, Inquiry learning, PhET Media, Learning Outcomes*

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1. Introduction

The 21st century is a digital era marked by the rapid development of technology and information. The development of technology and information affects all aspects of life, including education. The world of education requires information or knowledge insight that aims to gain broader knowledge in the fields of science, social, computer, and other fields. It is hoped that the field of education can also keep up with developments in the 21st century. One alternative for the educational process to synergize with technological developments in the 21st century is learning that prioritises scientific analysis skills, followed by the ability to use today's technology.

Learning in the 21st century is different from learning in the past. To adapt to the globalisation era marked by developments in the field of technology, teachers should support technology-based education to expand the power of education and develop the potential of teachers, students, and schools. In realising this, teachers are required to provide a strong response to this technology. Because indirectly, the 21st century teaching profession focuses on a broad field. Where educators focus on the use of technology in the learning process (Agustina et al., 2020).

In this case, the teacher plays an important role in guiding and directing the potential of students so that they become better at channelling their potential. The success of the process of teaching and learning activities in physics can be measured by the success of students who can participate in these learning activities.

There are many factors that influence students' low learning outcomes regarding physics concepts, including the learning methods applied by teachers not scientific inquiry in accordance with Permendiknas Number 22 of 2006 (Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 22 Tahun 2006, 2006). Teachers tend to apply conventional learning methods where learning is teacher-centred. Efforts that can be made to improve the quality of learning is through the selection of innovative learning models, which can help students achieve learning objectives (Rizal & Danial, 2014).

In achieving the objectives of learning physics, the existence of a laboratory is very influential in the learning process. Practicum activities can be done not only in real laboratories but also in virtual laboratories, which will make it easier for students to improve their critical thinking

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skills. One of the virtual laboratory media that can be utilised in practical learning is PhET media. According to Ekawati et al. (2015), the application of PhET simulation media in learning can improve student physics learning outcomes, while according to Jauhari et al. (2016), PhET can be used as an alternative to activate students so that student learning results increase. Besides that, there is a massive influence of PhET-based remote practicum learning and interactive simulation on science progress skills (Efendi & Sartika, 2021).

Facts in the field were found based on the results observations at SMAN 2 Medan are the student achievement score when carrying out daily tests is still quite low. Besides that, the physics learning process was still teacher-centred with conventional methods.

One learning model that can be applied to improve students' learning outcomes for the better is the guided inquiry learning model. This is because guided inquiry learning is in accordance with the characteristics of science learning, which emphasises the process of discovery (inquiry) of a concept so that a scientific attitude emerges and students can solve the problems they face well. Students generally have curiosity when discovering new things. This curiosity can be used for knowledge in students. Inquiry-based learning is more effective in increasing understanding of physics content. Guided inquiry learning is also considered to be able to attract students' interest to be active during the learning process. The inquiry learning model is expected to help students more easily understand physics concepts and can improve students' learning outcomes (Pahriah & Hendrawani, 2020).

2. Methods

This research method was a quasi-experiment. The research sample was selected using a random class sampling technique, where each population class has the right to have the same opportunity to become a research sample. The research design used was the pre-test – post-test control group design. The research definition is shown in **Table 1.**

Table 1. Control Group Pre-test – Post-test Design

Class	Pre –Test	Treatment	Post – Test
Experiment	T	X1	T
Control	T	X2	T

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The population in this study were all students of class XI in the even semester of SMA Negeri 2 Medan T.P 2022 – 2023 consisting of classes XI IPA 1 to XI IPA 9. The research sample was selected using a random class sampling technique (cluster random sampling), so it got XI MIPA 1 as the control class and XI IPA 3 as the experimental class.

There are three types of variables in this study: independent variables, dependent variables, and moderate variables. The independent variables in this study are guided inquiry learning models and conventional learning, the moderate variable in this study was PhET-assisted, and the dependent variable in this study is student learning outcomes.

The instrument used in this study was a test of students' conceptual knowledge of mechanical wave material, which totaled 20 questions in the form of multiple choice with five options, namely a, b, c, d, and e. This instrument measures cognitive aspects such as remembering (C1), understanding (C2), applying (C3), analysing (C4), evaluating (C5), and creating (C6) carried out by students on learning material. Before conducting the research, the tests that had been prepared were first tested for validity.

Learning outcome test instruments before used in research must meet the requirements, namely the validity test. The data analysis tests used are the normality test, homogeneity test, two-sided and one-sided hypothesis testing, and the n – gain test using the Lilliefors test with a significance level of 0.05%.

3. Result and Discussion

This study aims to determine the effect of the guided inquiry learning model assisted by PhET media on the physics learning outcomes of high school students. The results of the research that has been done based on the initial test of student learning outcomes in the experimental and control classes are still low. The low average value of the initial test is because students have not yet obtained material about mechanical waves, besides that the knowledge that students have is only limited to the basic knowledge they get from junior high school, other references, or experiences they experience in the surrounding environment.

The post-test (final test) given the same number and weight of questions as the initial test. Based on the results of the final test, the experimental class obtained a higher average score of 87.22 compared to the control class which was 80.97. Data on learning outcomes for experimental and control classes can be seen in Table 2 below.

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Table 2. Pre – Test and Post – Test Result

Class	Pre – Test	Post – Test	Students
Experiment	57.85	87.22	36
Control	59.72	80.97	36

Table 2 shows that the experimental and control classes have the same ability before being given treatment. After being given treatment shows that there is an increase in the experimental class to the control class.

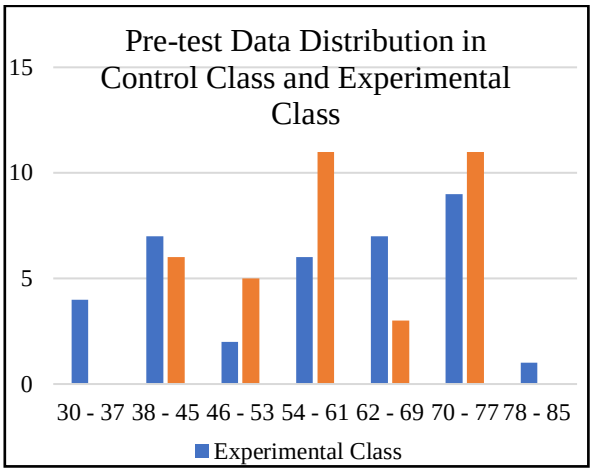

Figure 1. Pre – test data result on experiment and control class

Figure 1 shows that the average of pre-test in experiment and control classes is still very less category. And, after we gave a treatment using guided inquiry learning model assisted by PhET, the results of tests increased in control and experiment classes. The result will be presented in the Figure 2.

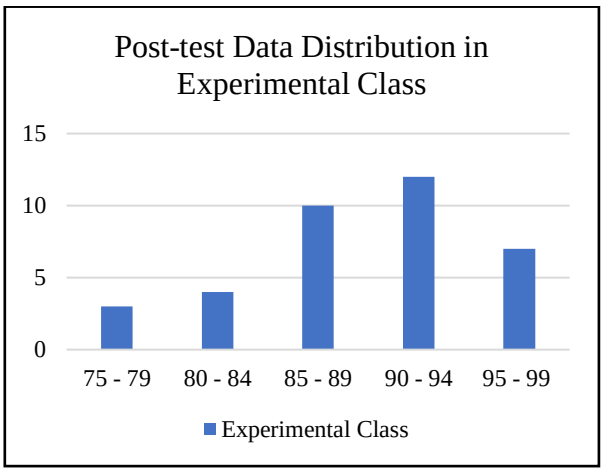

Figure 2. Post – test data distribution in experimental class

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Based on the figure above, we can see that the diagram of post–test in experiment class showed in a good result. Even though the control class has increased too, the significant result we can look at in the experiment class. Which the pre–test result is from 57.85, it can up to 87.22. Whether in the control class, the pre–test result is 59.72 that higher than control class, and the post–test result increased too but not significantly as the experiment class, the result is 80.97.

The hypothesis test in this study was performed using the Lilliefors test with Excel. Before we do the hypothesis test, we must do some of the tests. The first is normality test. Based on the result of normality test by using Lilliefors, the value of the count in the experiment class is 0.12475556 and the control class is 0.123644444. Then the value of table is 0.1476, so count less than table. So, the H0 is accepted. So, the data distribution is normal. Then, for the homogeneity test of post-test result, a homogeneity test is performed to determine whether the sample variance is homogeneous or not. Post-test homogeneity test experimental class and control class using Lilliefors test. The homogeneity test of the data done by F – Test. From the result, the value of count is 1,7454959017. It means the count less than table (1,5880 < 1.7571), so H0 is accepted. It shows that there is no variance difference between pre-test data in both of classes, or distribution level of student's learning outcomes of both of classes is equal.

To see the pre-test to post – test increase in students' learning outcomes obtained with the guided inquiry learning model assisted by PhET simulation media and conventional learning on mechanical wave material, the normalised gain average score is shown in Table 3 below:

Table 3. N – Gain Score of Experimental and Control Class

Class	**Pre – Test**	**Post – Test**	**N – Gain**	**Category**
Experiment	57.85	87.22	0.6987	High
Control	59.72	80.97	0.527586	Middle

Based on the data below, it means that student's learning outcomes on experiment class is increasing, which means the score is 0.6987. So, the category is high according to the applicable provision. And then, the student's learning outcomes in control class including in middle categories, according to the applicable provision, had a score of 0.527586.

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The two-sided t-test was used to determine the similarity of students' initial abilities in the experimental class to those in the control class. Based on the result, we get that the count is -0.664 and then the table of data is 1.996. The test criteria for the pre-test average similarity test are: Ho accepted if $-t1 - \frac{1}{2}\alpha < t < t1 - \frac{1}{2}\alpha$ where $t1 - \frac{1}{2}\alpha$ in get from distribution list t with $dk=n_1+n_2-2$ and $\alpha=0,05$. For other t prices, Ho rejected. So, the data analysis shows that $-1.996 < -0.664 < 1.996$, so the hypothesis Ho is accepted, which means we can conclude that the initial abilities of students in the experimental class are the same as the initial abilities of students in the control class.

The hypothesis testing using a t-test that is distinguish the average of post – test result of students in experiment and control class to know whether or not significant difference of student's learning outcomes using guided inquiry learning model assisted by PhET and conventional learning on Mechanical Wave topic class XI SMA Negeri 2 Medan in academic year 2022/2023. Based on the table of one tail t-test above is obtained count = 4.166 whereas table= 1.6683. The value of count is greater than table (4.166 > 1.6683) the Ha is accepted and H0 is rejected. So, we can conclude that guided inquiry learning model assisted by PhET has significant effect in learning process toward student's learning outcomes. According to Febniani et al. (2022), there is an influence of guided inquiry learning model assisted by PhET on student physics learning outcomes. In addition to improving student learning outcomes, guided inquiry learning assisted by PhET simulation also affects the improvement of student's science process skills (Aulia et al., 2019) and improves student understanding of concepts (Ardiannisa et al., 2020).

The guided inquiry learning assisted by PhET process puts emphasis on meaningful learning, in which students participate actively in the learning outcomes. Inquiry models can also train students to fully develop the skill to present the result. When students present the result of experiments that have been conducted of students, students looked at the difficulties from students in communicating to propose experiment results. Students are not familiar and not been able to decipher the information obtained systematically.

The success in this study can be said to have not been maximized due to several factors. The first factor is that the guided inquiry learning model assisted by PhET media on physics learning outcomes of SMA Negeri 2 Medan students is a new model applied at school, so students are not yet accustomed to learning independently and being more active in learning.

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Lack of experience of students in using PhET media so that time is wasted to explain how to use. The effectiveness of group work is still low, there are still students who do not work optimally in conducting virtual labs. The efforts that researchers make to overcome these obstacles are to slightly repeat the material and carry out each phase of guided inquiry with a shorter time shortened.

There are several benefits that can be obtained when applying this guided inquiry learning model. Application of guided inquiry learning, students who are active and directly involved in experiments will learners who are active and directly involved in experiments will deepen the concept by making the relationship between separate parts of information that are separate from each other to become a detailed picture. Inquiry-based learning is well applied where students feel that learning gives new nuances and improves the generic skills of science (Junaidi et al., 2016). Moreover, inquiry-oriented learning models provide significantly larger learning outcomes compared to conventional models (Handriani et al., 2015).

4. Conclusion

Based on the research results and discussion, it can be concluded that there is an effect of the guided inquiry learning model assisted by PhET media on students's learning outcomes in SMA Negeri 2 Medan. The intended effect in question is that there is an increase in the experimental class. A guided inquiry learning model can be used as an alternative to physics learning by the teacher. This learning model will be even better if applied with the help of PhET media. However, its application requires careful planning and preparation so that learning can run according to the objectives to be achieved, namely the characteristics of the material that will be taught. The time used during the implementation of learning must be used efficiently. For further research, the guided inquiry model can be reapplied when researchers teach physics at school with the aim of helping students understand physics lessons and improve students' learning outcomes.

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