



Guided Inquiry Model Assisted with TPACK Strategy Influence Students Learning Outcomes

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Abstract

This study aims to improve physics learning outcomes of SMA Negeri 11 Banda Aceh students through the implementation of guided inquiry TPACK strategy. The background of this research is students' underutilization of computer laboratory and science laboratory equipment. The research approach used was a pre-experimental design with one pre-test and one post-test group. This research sample included 31 students from class XI MIPA 3. The results revealed a considerable improvement in problem-solving ability in Physics after using the guided inquiry TPACK method. The average score of the students' pretest was 33.55, but it increased to 88.06 in the posttest. The test data analysis indicated an average N-Gain score of 81.88%, this shows the positive influence of the implementation of TPACK learning method on student learning outcomes. By applying the guided inquiry TPACK method, this study contributes to overcome the issue of low physics learning outcomes at SMA Negeri 11 Banda Aceh. It is intended that this research would encourage Physics teachers to apply the TPACK technique in their classrooms in order to improve student learning outcomes and employ laboratory equipment to its fullest potential.

Article Info:

Received:
14/06/2023

Revised:
31/08/2023

Accepted:
30/09/2023

Keywords: TPACK, Guided inquiry, Learning outcomes

1. Introduction

Professional teachers are those who are capable of carrying out their roles, duties, and responsibilities in terms of planning, implementing, and evaluating existing learning. The teaching quality of a teacher has a significant impact on students' ability in understanding lessons at school [1]. Therefore, as a facilitator in learning activities, a teacher must be competent enough to attain learning objectives [2].

According to the results of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) survey in the 2020 Global Education Monitoring (GEM), the quality of human resources for the education sector (teachers) in Indonesia is still far behind other ASEAN countries, particularly Singapore [3]. The use of technology in the learning process is one of the reasons Singapore's education is considerably superior compared to Indonesia. The technology in question includes creating educational activities that are integrated with applications, utilizing direct experience-based virtual labs, and utilizing the web in the learning process [4], [5]. However, in Indonesia, using technology in the learning process is still quite limited, owing to limited facilities in some schools and teachers' lack of understanding of how to use various technologies in the learning process.

This is an obstacle as well as a challenge for Indonesian teachers to develop their skills and abilities. As a result of the teacher's lack of understanding in utilizing technology in the learning process, namely decreased student interest in participating in learning and has an impact on low student learning outcomes. The selection of learning models that place technology in the learning process for the millennial generation can affect student learning outcomes [6], [7].

In general, technology-based learning can boost student learning activities and outcomes [8]. The application of learning with technology contains three fundamental components: technology, pedagogy, and learning material, as well as the link between these three components [9]. The application of these components in learning is known as Technological Pedagogical Content Knowledge (TPACK) [10]. According to [5], [11], [12] Technological Pedagogical Content Knowledge (TPACK) helps students improve their concepts and learning outcomes related to the content being taught. The integration of technological, conceptual, and pedagogical mastery is the core of TPACK framework [11]. Technological knowledge is important for both student and teacher to attain effective and efficient learning [13].

TPACK learning strategies cannot be mixed or combined with other learning models, so the guided inquiry learning model is used to support the TPACK method [14]–[16]. The guided inquiry learning model is considered appropriate because the role of the teacher guides students to carry out activities by starting with questions that lead to learning topic [17]. Guided inquiry is a learning model that prioritizes the process of discovering concepts in teacher-guided learning [18]. The guided inquiry learning process includes an investigation that is integrated, planned, and guided by the teacher to obtain information [19].

This research is an implementation research of TPACK combined with guided inquiry learning model. The novelty of the research conducted is in the implementation or implementation of learning activities and the results obtained, namely to improve student learning outcomes. This research is actually in line with the study by [17] who applied technology and information in biology learning to improve TPACK in students. The difference from this study is in the research subjects and research focus.

In practice, guided inquiry learning cannot be separated from LKPD, which is expressly designed to make it easier for students to make observations, collect data, and draw conclusions. In implementing this, the TPACK strategy is needed to carry out investigations and collect data more efficiently. Besides that, the pedagogic abilities that must be mastered by the teacher in order to find the right way for student learning, and the selection of appropriate and interesting content to increase student interest in learning. The combination of guided inquiry models with the use of this technology is expected to improve student learning outcomes.

2. Methods

This study uses a quantitative approach and includes Pre-Experimental Design research because the variables in this study still have other variables that influence the formation of the dependent variable. This quantitative technique is being used to determine the application of the guided inquiry-based TPACK strategy in order to improve student learning outcomes. This study used a one-group pretest and posttest design research pattern. This research was implemented in gassal semester 2021/2022 academic year. The population of this research is class students XI SMAN 11 Banda Aceh, while the sample is XI MIPA 3 taken using purposive sampling technique.

The data collection technique uses student learning outcomes based on pretest and posttest using a multiple choice test instrument of 25 questions given during the implementation on this research and student response questionnaire that contains specific scores for each categories. Data analysis techniques using Hypothesis-test, N-Gain Test, and student questionnaire analysis. The table below shows scores category for student response questionnaire.

3. Results and Discussion

Guided inquiry learning by applying the TPACK strategy in it is one of the efforts to improve student learning outcomes. Applying the five steps of guided inquiry, namely asking questions, formulating hypotheses, collecting data, analyzing data and making conclusions [18]. In detail, the stages of guided inquiry learning adapted from [17] include four steps and learning activities that can be displayed in Table 1.

Table 1. The Stage of Guide Inquiry Learning

Steps	Teacher and students activities
Explains the learning procedure	<ul style="list-style-type: none"> • The teacher explains to students about the objectives and learning steps using presentation media and learning videos. • Students paid attention when the teacher explains well
Presenting the problems	<ul style="list-style-type: none"> • The teacher presents learning problems supported by learning media in the form of questions • Students pay attention to the question and find solutions through group discussion activities to the problem based on daily experience and the surrounding community.
Data collection and hypothesis testing	<ul style="list-style-type: none"> • The teacher gives instructions to students on how to collect data and how to prove the hypothesis. • Students explore information and try to find solutions to questions and problems using a variety of learning resources.
Summarize and draw conclusions	<ul style="list-style-type: none"> • The teacher gives feedback on the answers from the students and the learning activities that have been carried out. • Students make conclusions and test hypotheses. • Students draw conclusions based on the discussion results and feedback from the teacher.

Through the use of technology and content that interests students, namely .peth and .ppt in the process of formulating hypotheses and collecting data on guided inquiry. Learning activities were carried out over two meetings with static fluid material, before learning begins, the researcher gives a pre-test to see the students' initial abilities and after learning is complete a post-test is given to see the students' abilities after implementing the guided inquiry-based TPACK strategy. The average pre-test and post-test scores can be seen in Figure 1.

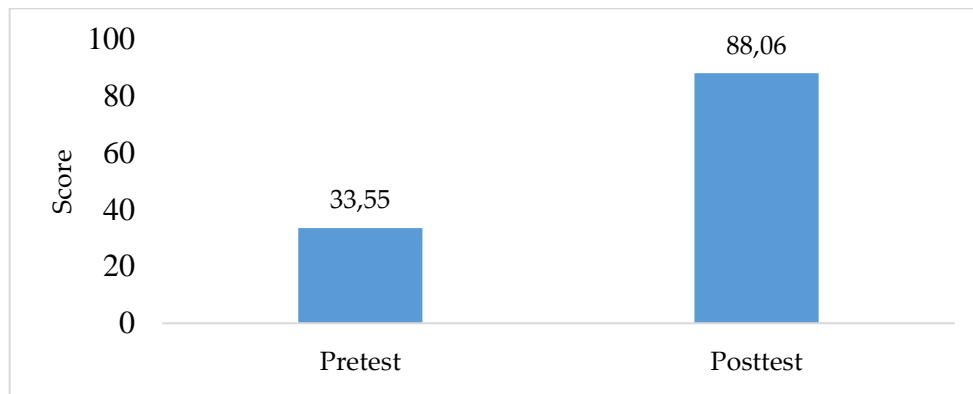


Figure 1. Student Learning Outcomes Based on Pre-test and Post-test Scores

Based on the [Figure 1](#), it can be seen the comparison of the average pretest and posttest values. The research data shows that there is an increase in learning outcomes, which is the average value pretest of 33.55 and on value post-test to be 88.06. [Table 2](#) shows an increase in student learning outcomes of 54.51 from the pre-test after implementing the physics learning method with TPACK guided inquiry.

Table 2. Hypothesis Testing

Data	Varians	t_c	t_{table}
Pre-test	33.55	25.599	2.04
Post-test	88.06		

Based on [Table 2](#), it is obtained that $t_{count} \geq t_{table}$ ($25.599 \geq 2.04$) means that H_0 is rejected and it is stated that there is an increase in learning outcomes by using the physics learning method with TPACK guided inquiry.

Table 3. Test Data Analysis Results

	Score		N-Gain	Category
	Pre-test	Post-test		
Score	1040	2730		
Average	33,55	88,06	0,82	High

Based the data analysis result ([Table 3](#)), student learning outcomes obtained an average N-Gain Score of 0.82 or 82% included in the high category in improving student learning outcomes. It can be stated that the implementation of the guided inquiry-based TPACK strategy can improve student learning outcomes.

Technological Pedagogical Content Knowledge (TPACK) learning model or knowledge about pedagogical technology and content is knowledge about the appropriate use of pedagogical technology to teach content correctly [20]. TPACK is a framework for understanding and describing the type of knowledge educators need to make effective pedagogical practices and understand concepts by integrating technology in the learning environment. Incorporating TPACK into the guided inquiry learning model can increase students' interest in learning, thereby improving student learning outcomes. The development of TPACK is used to provide learning experiences that are tailored to specific pedagogies and materials [20]. This is supported by [16], who states that developing TPACK is critical for novice teachers in order to create an effective learning process.

Teachers must select teaching approaches and learning models that are appropriate for the learning content and any technology that may be used. Because technology-based teaching stimulates a shift in the pedagogical domain and the existing content, proper teaching with technology cannot be achieved simply by adding new parts of technology to the existing structures. For the successful integration of technology and science learning, educational technology must be used to support inquiry learning, learning content, pedagogy, technology awareness, and interactive interactions [21].

Students are expected to improve their TPACK ability through the ICT-assisted Inquiry model, which allows them to create their own learning media using technology. Furthermore, as teachers, they must understand not only the teaching material but also how to help their students understand and apply these concepts through the use of technology. The application of technology, pedagogy and content that can increase student interest in guided inquiry through animation or video, peth and ppt on static fluid material can improve student learning outcomes. This is supported by the results of test data analysis which obtained an average N-Gain value of 81.88%. So it can be concluded that the physics learning method using TPACK based on guided inquiry has the effect of increasing grades on student learning outcomes.

Based on the results and findings of the study, the application of the inquiry model combined with TPACK can improve student learning outcomes. This can be seen from the data on the difference between pre-test and post-test (N-gain) of 0.82 in the high category. This indicates that TPACK contributes significantly to the learning process and improves students' understanding of the material taught. These results are in line with research [14], [22] which shows that simulation-assisted TPACK combined with guided inquiry models can improve student understanding of vibration and wave materials. Similar research was conducted by [23] that through TPACK students can learn better, motivation and science learning outcomes have increased. Improving student learning outcomes also needs to be supported by TPACK-based teaching materials, this is in line with research [24] which examines the development of teaching materials in the form of LKPD based on local wisdom and TPACK, with quite effective results.

Based data analysis which stated that increasing student learning outcomes through the TPACK strategy had a positive effect, namely to improve student learning outcomes as indicated by an increase in the completeness of learning outcomes from initially only 37.5% becomes 100% or all students have completed their studies.

4. Conclusion

Based on the results of the study, it can be concluded that the application of guided inquiry learning strategies combined with TPACK is effective in improving student learning outcomes. This can be seen from the results of the N-Gain test on the pre-test and post-test results in the high category. This shows that the results achieved are effective and significant in improving student learning outcomes. TPACK used in learning can be applied in an effort to improve students' learning experience related to the subject matter presented so that it is easier to understand. Therefore, this study suggests to teachers to integrate technology in the learning process and the implications of guided inquiry learning with TPACK can be rearranged according to school and student circumstances both in the material and the application of technology.

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