



## **The Implementation of STEM-Based Discovery Learning Model in Motion Systems Concept to Improve Learning Outcomes**

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### **ABSTRACT**

The learning outcomes of students in class 11<sup>th</sup> Islamic Senior High School Banda Aceh are still low, the low learning outcomes of students in learning the motion system concept in class 11<sup>th</sup> Islamic Senior High School Banda Aceh are due to the teaching and learning process using practicum equipment on the concept of inadequate motion systems, this is evidenced by the laboratory space untapped and incomplete equipment. So that students are more likely to learn only from handbooks without direct learning experiences in real life. The research approach used is quantitative with the type of pre-experimental research, the research design used is the One-Group Pretest-Posttest Design. The population of the study was all students of class 11<sup>th</sup>, amounting to 292 people. The sampling technique used was total sampling, the sample in this study consisted of 292 students. Pretest and Posttest questions in the form of reasoned choice test questions are used as instruments to measure learning outcomes. Data analysis consisted of normality test, paired sample t-test and N-gain test at a significant level of 0.05. The results of the paired sample t-test obtained  $p < .001$ , so it was concluded that there were differences in student learning outcomes before and after learning with the application of the STEM-based Discovery Learning model on the motion system material in Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City. The results of the N-gain test using the Meltzer formula, the n-gain of learning outcomes obtained is 0.50, so the increase in student learning outcomes is in the moderate category.

**Keywords:** Discovery Learning, STEM, Learning Outcomes

### **INTRODUCTION**

This 21st century information can be accessed by everyone so quickly. Each individual must have qualified soft skills in order to enter the world of work and be ready to compete (Ritonga, et al., 2020). This is a challenge for the world of education to develop the quality of school graduates, not only in their cognitive abilities but also in their psychomotor and affective abilities. In order to improve learning outcomes, it is necessary to make a quality learning process plan so that the results achieved are maximized.

### **Problem of Research**

Findings in Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City are still low, the low learning outcomes of students in learning motion system material in class 11<sup>th</sup> MAN Banda Aceh are due to the teaching and learning process using practicum equipment on the concept of inadequate motion systems, this is evidenced by laboratory space

untapped and incomplete equipment. So that students are more likely to learn only from handbooks without direct learning experiences in real life, so that their critical thinking skills does not develop and their learning outcomes are low.

The solution that will be carried out to improve student learning outcomes is by applying a STEM-based discovery learning. Discovery learning emphasize the discovery of concepts or principles that students do not yet have. The application of the discovery learning model aims to change the passive learning conditions to be active and creative, by changing teacher centered learning to student centered learning (Hotang, 2019).

Learning through inquiry-based STEM can improve critical thinking skills (Onsee and Nuangchalerm, 2019). The implementation of STEM education can be seen from student solutions, some students use the concept of biology or chemistry or physics or a combination and mathematics designing solutions (technology) for wastewater treatment. Thinkers practice is a developmental stage of critical thinking, in which they have sufficient skills in thinking to criticize their own plans for systematic practice, and to construct a realistic critique of the power of their thinking to solve contextual problems (Mutakinati, et al., 2018).

STEM-based discovery learning models are used to improve learning outcomes. The hypothesis in this study, the application of STEM-based discovery learning can improve student learning outcomes on the material of motion systems in Islamic Senior High School 1 and Islamic Senior High School 2 in Banda Aceh City. The benefits expected from the results of this study are as motivation to use a more attractive learning model to increase learning outcomes.

## **Research Focus**

The research objective was to determine the increase in student outcomes through the STEM-based discovery learning model on the motion system material in Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City.

## **METHODOLOGY OF RESEARCH**

### **General Background of Research**

This research was conducted in Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City, Aceh Province. The approach used was quantitative. This type of research is pre-experimental and uses applied methods. This study used a one-group pretest-posttest design.

### **Subject of Research**

The population in this study were all students in class XI Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City, totaling 292 students. Sampling in this study using total sampling. Samples in this study were 292 students.

### Instrument and Procedures

The characteristics of STEM and discovery learning used during the research are implementing discovery learning syntax which consists of 6, namely stimulation, problem statement, data collection, data processing, verification and generalization then combined with science, technology, engineering, mathematics in the process of making the existing human framework. on the worksheet. The instrument used to measure learning outcomes was multiple choice questions. The implementation of this research uses learning tools, including: lesson plans and student worksheets.

### Data Analysis

The stages of data analysis were: 1) normality test, to test the normality of the data the Kolmogorov-Smirnov test was used. To perform this normality test using the SPSS program. The criteria for the normality test if the value ( $p > 0.05$ ) is declared normal, 2) the paired sample t-test, to do this test uses the SPSS program, with the criteria if ( $p < 0.05$ ) then there are differences in student learning outcomes. 3) the n-gain test uses the Meltzer formula (2002).

## RESULTS AND DISCUSSION

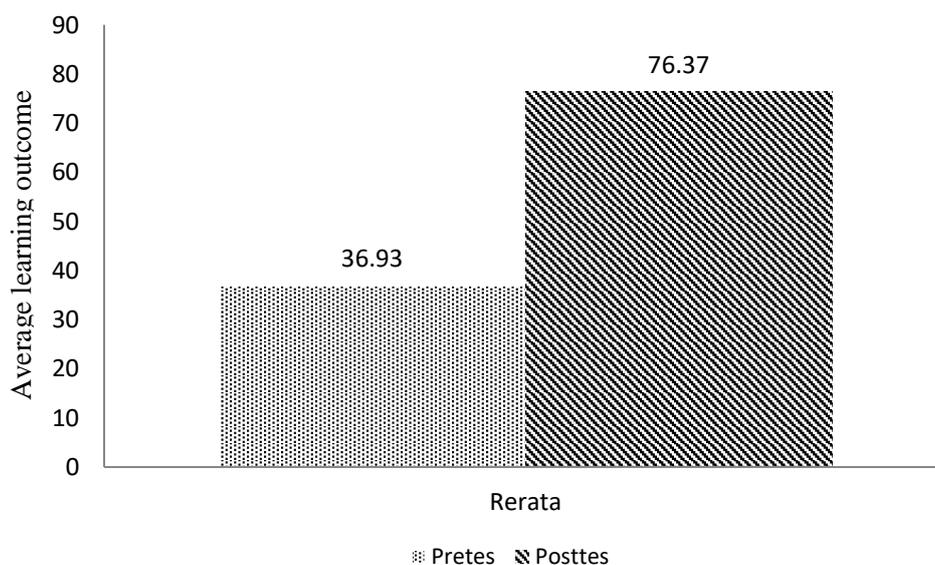
Assessment of learning outcomes using the application of discovery learning model based on STEM is seen from the pretest, posttest, and N-gain values. The results of the paired sample t-test are presented in Table 1.

**Table 1.** Paired Sample T-test for Student Learning Outcomes

Score	Sample	Average	Normality test	Paired Sample t-test
Pretest	292	36,93	0.066	$p \text{ value} < 0,05$
Posttest	292	76,37	0.082	

Table 1. Shows the pretest normality test of student learning outcomes obtained  $p (0.068) \geq \alpha (0.05)$  (normal). The posttest normality test for students' critical thinking was obtained in the experimental class  $p (0.082) \geq \alpha (0.05)$  (normal).

The results of the paired sample t-test obtained  $p < .001$  then hypothesis was accepted, so it was concluded that there were differences in student learning outcomes before and after learning with the application of the STEM-based Discovery Learning model on the motion system concept in Islamic Senior High School 1 and Islamic Senior High School 2 Banda Aceh City . In line with the opinion of Muyassarrah et al., (2019) there is a significant average difference between the motor skills of students before (pretest) and after (posttest) STEM learning is carried out. Analysis of the difference in the mean score of the pretest and posttest learning outcomes can be seen in Figure 1.



**Figure 1.** The Average Score of Student Learning Outcomes

Figure 1 shows that the mean difference in the learning outcomes of students in the pretest and posttest participants. The mean pretest of student learning outcomes was 36.93 and the mean posttest of student learning outcomes was 76.37.

The improvement of student learning outcomes was analyzed through the N-gain formula by Meltzer. The results of the test for increasing student learning outcomes are presented in Table 2.

**Table 2.** Improving Student Learning Outcomes

Score	Sample	Average	Std. Deviation
Pretest	292	36,93	12,25
Posttest	292	76,37	12,20
N-gain	292	49,58	21,65

Table 2 shows the average N-gain of student learning outcomes of 49.58. The results of the gain in student learning outcomes were 0.50. So the increase in student learning outcomes is in the moderate category.

The emergence of an increase in student learning outcomes is caused by the use of STEM, with the use of STEM students become more active in solving problems and students are more enthusiastic in doing practicum because in the STEM there is already a guide for assembling the tools provided by the teacher, the steps which must be followed by students when practicum is more interesting because there are pictures of the steps that must be done by students so that the practicum can be done successfully. In addition, learning with STEM integration makes students discuss with each other expressing their ideas and thoughts to answer the questions on the worksheet according to the steps in learning.

The use of an integrated STEM approach is able to help students gain knowledge by finding and conducting experiments to prove the hypotheses made. Integrated STEM education seems to improve academic achievement more in line with a constructivist approach but has a limited effect on academic achievement (Sarican et al., 2018). The application of STEM can improve students' critical thinking skills (Ritonga & Zulkarnaini, 2021). Application of the STEM-based discovery learning model in concept learning motion systems can improve critical thinking skills of students in Islamic Senior High School Kota Banda Aceh (Fadlina et al., 2021).

In line with Sarac (2018) explaining that using STEM learning can improve student academic achievement, this can be seen from the intermediate level of achievement with a positive score of 0.442, with an intermediate level of 0.620 in the positive direction of students' attitudes towards courses. A large degree effect size of 0.820 on positive process skills in the scientific process of learners.

The use of discovery learning models encourages students to experiment and investigate, so that students learn through their own active involvement. The increase in student learning outcomes is in line with research conducted by Melani (2012) which states that the discovery learning model has an effect on improving students' biology learning outcomes. This happens because the discovery learning model develops an active learning method in which students find out for themselves, investigate for themselves, the results will be loyal and long lasting in memory, and not easily forgotten by students. This is in accordance with the statement of Hosnan (2014) that the discovery learning model is a model for developing learning methods for active learners by finding themselves and investigating themselves.

## **Conclusion**

The application of STEM-based discovery learning can improve student learning outcomes on the concept of motion systems in the Banda Aceh City Islamic Senior High School. The benefit of research is that it can improve student learning outcomes optimally, so biology teachers can use the STEM-based Discovery Learning model which involves students actively in the learning process so that it can improve student learning outcomes as researchers have done. To facilitate learning, students should be better prepared to receive lessons at school and already know the information related to the material to be taught by reading, seeing and looking a lot, so it is very important.

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