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Remediation of misconception on straight line motion concept using guided inquiry model assisted by student worksheet based on science technology engineering and mathematics (STEM) on junior high school students

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Abstract. This study aims to remediate science misconceptions on the concept of straight line motion using guided inquiry models assisted by Student Worksheet Based on Science Technology Engineering and Mathematics (STEM). This study uses an experimental method with one shoot case study technique. The test instrument in the form of three tiers multiple choice test questions was used to identify students' misconceptions of straight line motion concept. The results showed that students' misconceptions on straight line motion concept amounted to 47.30%. Remediation of science misconceptions through the implementation of guided inquiry models assisted by Student Worksheet Based on STEM showed the results of students' concept understanding in the conceptual understanding category of 58.58%, misconceptions of 25.49%, guessed 3.19%, and did not understand 12.75%. It was concluded that the application of the guided inquiry model assisted by Student Worksheet Based on STEM could be applied as an alternative learning model to remediate science misconceptions.

1. Introduction

Misconception is one of the aspects that causes the lack of understanding of students' concepts [1]. Students are not able to abstract concepts correctly and most students have forgotten the material they have previously learned [2]. Misconception is a basic misconception believed by students [3]. Misconceptions can be analyzed using diagnostic tests. Diagnostic tests have the advantage of being quick in implementing and getting wider data of misconceptions [4].

Diagnostic tests that can be developed and used to identify student misconceptions [5], one of which is a three-tier multiple choice test [6]. In the three-tier multiple choice test there are several levels. The first level contains multiple choice tests, the second level is a reason and the third level is the level of student confidence in answering questions. Three-tier is considered more valid giving rise to students' misconceptions, because they can detect a lack of percentage of knowledge with a level of self-confidence. Educators can analyze the initial misconceptions that occur in students. This is because if students have experienced further misconceptions, then how to evaluate them will be increasingly difficult. Tests with a three-tier multiple choice tests formats can be used to analyze [7]. Students experience scientific misconceptions including the buffer solution material [8]. No less than 48% of students in the class experience misconceptions about the concepts of speed and acceleration, where students assume speed and acceleration always have the same direction" [9].



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Misconceptions can be overcome in various ways one of which is remediation. Remediation is an activity undertaken to correct concepts that experience misconceptions [10]. This research aims to do remediation by applying the guided inquiry model. The guided inquiry model can improve students' understanding of concepts so as to reduce students' misconceptions [11]. The guided inquiry model can reduce students' misconceptions on heat transfer material [12]. The guided inquiry model can affect student learning outcomes [13]. Understanding of student concepts can be improved using guided inquiry models in harmony with learning outcomes so that misconceptions experienced by students are also reduced.

The guided inquiry model can be integrated with Student Worksheet Based on STEM (Science Technology Engineering and Mathematics). Student worksheets are a summary of material compiled in an integrated manner and cover the steps of work implementation that students must do [14]. Student worksheets that are used today do not facilitate students to develop creative thinking skills [15]. Through the application of STEM in student worksheets can improve reasoning skills, creative thinking, and understanding of concepts and critical thinking abilities of students [16,17]. This research applies student worksheet by integrating science, technology, engineering and mathematics. This study aims to analyze the effectiveness of remediation of scientific misconceptions using the guided inquiry model assisted by Student Worksheet Based on STEM.

2. Methods

The guided inquiry model can be integrating science concepts by developing student Worksheet Based on STEM. Student worksheets are a summary of material compiled in an integrated manner and cover the steps of work implementation that students must do [14]. Student worksheets that are used today do not facilitate students to develop creative thinking skills [15]. Through the application of STEM in student worksheets can improve reasoning skills, creative thinking, and understanding of concepts and critical thinking abilities of students [16-17]. This research applies guided inquiry model assisted by Student Worksheet Based on STEM, can be done by integrating science, technology, engineering and mathematics. This study aims to analyze the effectiveness of remediation of scientific misconceptions using the guided inquiry model assisted by Student Worksheet Based on STEM.

3. Result and Discussion

The research data are in the form of pre-test (identification) and post-test (remediation) values and interview recapitulation to students. The material tested was a straight motion material that had previously been taught by the teacher but it was found that the results were still incomplete and the alleged cause was science misconceptions experienced by students, especially on the concept of motion. The results of the interpretation of the combination of the pre-test and post-test answers are presented in Figure 1. In the figure 1 show the percentage of students' combined answers changed after remediation using the guided inquiry model assisted by Student Worksheet Based on STEM. Students responded with the categories of understanding concepts, misconceptions, guessing, and lack of consecutive understandings which were 58.58%, 25.49%, 3.19%, and 12.75%. This shows the guided the guided inquiry model assisted by Student Worksheet Based on STEM influences the students' understanding of the concepts.

The N-Gain calculation is used to find out an increase in students' understanding of concepts or a decrease in students' misconceptions. Table 1 shows the results of the N-Gain Pre-test and Post-test analysis.

Table 1. Results of the Pretest and Posttest N-Gain Analysis

Data	Maximum Score	Pre-test Score	Post test Score	N-Gain
Pre-test and Post-test	36	20.2	27.6	0.5

Remediation of misconceptions using the guided inquiry model assisted by Student Worksheet Based on STEM proved effective with an increase in $g = 0.5$ in the moderate category.

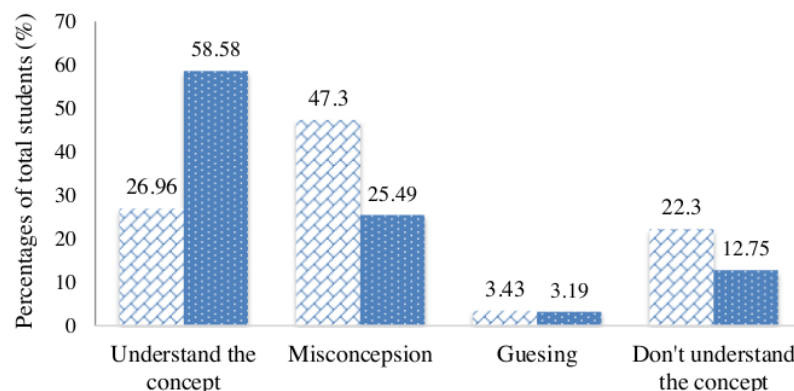


Figure 1. Interpretation of the Combination of Student Answers (Pre-test and Post test Data)

Understanding of students' concepts increases because through the guided inquiry model facilitates students in cognitive conflict and the investigation of concepts through experiments so that students can correct misconceptions experienced [12]. The guided inquiry model can affect student learning outcomes [13]. Understanding of student concepts can be improved using guided inquiry models in harmony with learning outcomes so that misconceptions experienced by students are also reduced.

The guided inquiry model assisted by Student Worksheet Based on STEM guides students to be able to think critically during the learning process. The application of the STEM vision to student worksheets facilitates active students in practicing reasoning skills, creative thinking, understanding concepts and critical thinking abilities of students [15-17]. The implementation of STEM in student worksheets encourages students to learn the concepts of learning with the integration of science, technology, engineering, and mathematics [18].

Significance test is used to determine the significance of students' understanding of concepts in straight motion material. Significance test results based on pretest and posttest data can be seen in Table 2.

Table 2. Results of Pretest and Posttest Significance Analysis

Data	N	Md	X ² d	t _{count}	t _{table}
			359	11.	
Pretest and Posttest	34	20.67	8.629	54	1.7

Determination of the significance of research data was analyzed by looking at $t_{\text{count}} > t_{\text{table}}$. The price of the table with a significance level of 5% and $N = 34$ is 1.7. So it can be stated that the increase in the value of Pretest and Posttest in the significant category. Significance test of pretest and posttest data was proven significant with $t_{\text{count}} = 11.54$ which means that the data had significant differences. The results of the analysis prove that this remediation is effective in reducing students' misconceptions on straight-motion material.

In detail for the percentage of misconception decrease data for each concept in the straight motion chapter can be seen in Figure 2. In the Figure 2 shows that the misconception of each concept has decreased misconception. Misconceptions that were categorized as being after being remediated decreased and entered into the low category. The more students' misconceptions decrease, the understanding of students' concepts also increases.

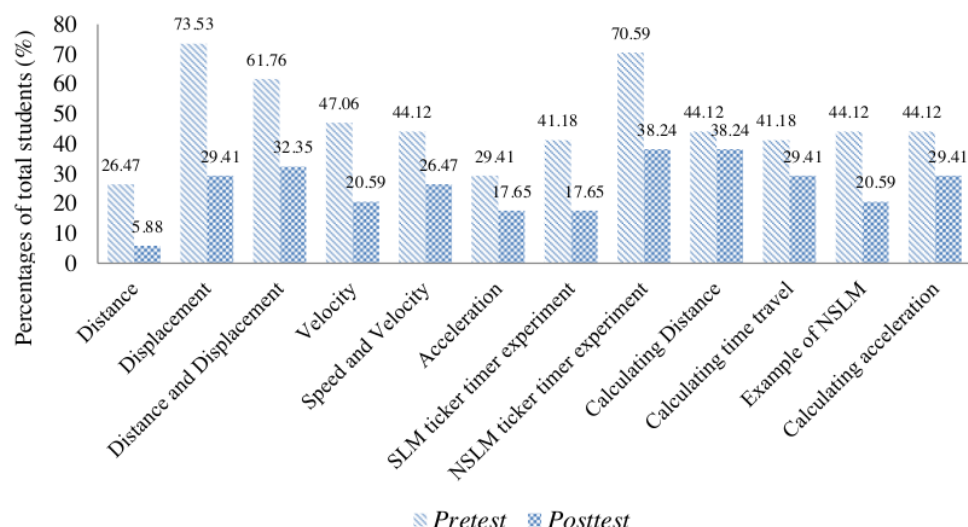


Figure 2. Percentage of Decreased Misconception of Each Concept

Students experience a decrease in misconception after remediation using the guided inquiry model assisted by Student Worksheet Based on STEM [19,20]. Understanding of students' concepts has increased as measured using N-Gain in the medium category. This is due to at least two things that become obstacles when conducting research, namely: (1) Students have diverse initial abilities in understanding concepts and the level of scientific misconceptions experienced, the more confident students are with the wrong concepts the more difficult it is to accept new concepts which is in accordance with the understanding of scientists in general, (2) Remission time is not all the normal class hours, some students feel that they lack the time to work on the problem of misconception perception postings in a hurry and not serious.

4. Conclusion

It was concluded that the application of the guided inquiry model assisted by Student Worksheet Based on STEM could be applied as an alternative learning model to remediate scientific misconceptions. Students experience a decrease in misconception after remediation. Understanding of student concepts has increased in the medium category. There are still obstacles during the research, namely: (1) Students have diverse initial abilities in understanding concepts and the level of scientific misconceptions experienced, the more confident students are with the wrong concepts, the more difficult it is to accept new concepts that are in accordance with scientific understanding in general, (2) Remedial time is not as normal as normal class hours, some students feel they are short of time working on post-identification misconception questions in a hurry and not serious.

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