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STUDENT CONCEPTS ON MOMENTUM AND IMPULSE MATERIALS IN PROBLEM BASED LEARNING LEARNING MODELS AIDED BY THINKING MAP

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ABSTRACT

Abstract: The ability to master concept can be developed with the Problem Based Learning model assisted by Thinking Map. The purpose of this study is to find out how the Problem Based Learning model assist by Thinking Map influences the mastery of the concept of high school students on momentum and impulse. This research was conducet at SMAN 1 Bombana class X, the subject of this study were 30 students. This research is mixed method embedded experimental model. The test of mastery of concepts in the form of multiple choice as many as 25 items with the Cronbach's alpha value was 0.715. Data analysis using t-test and obtained a value of 0.000 which shows that there is an influence between mastery of concept and problem based learning assisted by thinking map.

INTRODUCTION

Education in the 21st century requires students to have the skills to use technology, be able to innovate, and be able to think creatively (Henriksen, Mishra, & Fisser, 2016). In 21st-century skills, students must be able to identify and solve challenges (Byer et al., 2007). Therefore, classroom instruction must be student-centered. Students are given the opportunity to develop their knowledge through experiential learning, exploration, and the courage to communicate their thoughts and information.

Mastery of concepts is essential to learning since concepts may be utilized to transfer a variety of problem-solving elements (Silaban, 2014). All aspects of physics education, including the study of theories, phenomena, and the application of formulas, necessitate the use of useful concepts to avoid misunderstandings (Jamilah, Mulyaningsih, and Bhakti, 2020). Cao, Y., Kurbanova, AT, and Salikhova, (2017) stated that physics is a natural science that serves as a foundation for the study of phenomena. Each student's representation of a reality, particularly a physics notion, will differ since there is information acquired through participation in learning and there is experience-based knowledge (Nurzhimi, 2019).

Impulse momentum is an example of a topic in physics that has daily applications. Impulse momentum is one of the most difficult fundamental notions in physics to comprehend (Adimayuda, Aminudin, Kaniawati, Suhendi, and Samsudin, 2020). Momentum and impulse are two of the most abstract concepts in physics (Ergül, 2013; Samsudin et al., 2014). Most students struggle to solve problems involving momentum and impulse due to a lack of comprehension of the link between force, acceleration, and velocity (Saifullah & Wisodo, 2017). One-third of 192 students could accurately explain the notion of momentum, but less than one-quarter could correctly explain the idea of impulse (Muller & Sharma, 2007). According to research (Amalia et al., 2019), 16.07 percent of students had conceptual mistakes about momentum, 6.55 percent regarding impulses, and 28.57 percent regarding the link between momentum and impulses. This demonstrates that momentum and impulse are difficult concepts to comprehend and that misunderstandings are common.

Sugiana, Harjono, and Sahidu's (2016) research indicates that mastery of the notion of impulse and momentum material can be enhanced by the application of generative learning aided by virtual laboratory media, but the improvement is not optimal. This is due to the fact that the momentum and impulse materials contain C3 to C6 level thinking components. In addition, the worksheets provided to pupils do not correspond with signs of subject knowledge. According to Kaniawati's (2017) research, students' grasp of the idea of momentum and impulse after being taught using computer simulation learning falls within the moderate range. Impulse momentum is an abstract term, which is among the explanations. In addition, mathematics competence is a necessity for tackling concept mastery tasks, thus students must possess this skill.

On the basis of these facts, a learning model that helps pupils comprehend the concepts of momentum and impulse is required. Problem Based To gain new knowledge, a learning learning paradigm requires pupils to examine problems. Students must work collaboratively or cooperatively to complete this task. This requires a great deal of independent study on the part of the students (Prince, 2004). An key aspect of problem-based learning is that the problems presented are not based on past knowledge imparted by the teacher through lectures and handouts. So that PBL can enable students to develop answers to their own difficulties, the challenges must be real and relevant to the students' life (Mundilarto, Ismoyo, 2012). Problem-based learning, which is defined by difficulties, becomes the beginning point for teaching students in problem comprehension. (Hmelo-silver, 2014)

Students can utilize Thinking Map to improve their comprehension and mastery of learning materials (Long, Carlson, Long, Francis, et Elementary, 2011). The usage of Thinking Map gives a chance for students to carefully comprehend subject teachings, connect and visualize lesson topics, enhance student collaboration, encourage students, and engage in process scientific experiments (Al-naqa & Abu-owda, 2014). Thinking Map can be used to represent the thinking process (Omar, 2016).

Several research studies on PBL have concluded that the PBL paradigm helps enhance students' comprehension of physics concepts (Muslim, Halim, and Sahatri, 2015). Using the PBL model, students can construct concepts by solving problems (Prima & Kaniawati, 2004). Using thinking maps, students can master concepts via the process of learning (Febrinita & Puspitasari, 2018).

METHOD

This research employed a mixed method research with embedded experimental design (Creswell & Creswell, 2018) . The research subjects were students of SMAN 1 Bombana class X semester II for the 2019/2020 school year with a total of 30 students. The stages of the PBL model include**d** five learning syntaxes in which at several stages of learning students are asked to answer questions by making a Thinking map . Students were given questions before receiving treatment and after treatment.

The research instrument was a multiple-choice test. The test used was developed by the researcher based on the concept mastery indicators according to Anderson & Krathwohl (2001), namely at the cognitive level C1-C6. A total of 32 questions were made to determine the level of mastery of students' concepts. The results of the validation from the lecturer, 32 questions of mastery of the concept were declared valid with a moderate assessment score and were declared in accordance with the indicators of mastery of the concept to be measured. From the results of the validation of the lecturer, then the validity test was carried out on the students. Based on the validity test, of the 32 questions given, 25 questions were declared valid. The results of the reliability test, Cronbach 's alpha value of 0.715 which indicates that 25 items are declared reliable.

Analysis of students' conceptual mastery after being given treatment was carried out by quantitative analysis consisting of different tests, normalized gain (n-gain) and effect size. Qualitative analysis was carried out by collecting data, reducing data, presenting data, and drawing conclusions. Qualitative data is presented in the form of narrative text.

RESULTS

Mastery of the student's concept of momentum and impulse can be seen from the statistical description in Table 1.

Table 1. The results of descriptive statistical calculations of *pretest* and *posttest scores*

Descriptive statistics	Pretest	Posttest
Maximum	17	22
Minimum	8	18
mean	12.63	20.56
Std.deviation	2.41	1.38
skewness	0.428	0.104
Std.Error of Sweakness	0.427	0.427

The results of the statistical analysis of students' conceptual mastery showed the minimum score at the pretest is 8, while the maximum value at the pretest is 17. The average pretest of 12.63 and the minimum value at posttest obtained 18 while the maximum value during the posttest was 22. The average value of the posttest was 20.56. can be seen through the mean and std. which indicate that there was an increase in the deviation of the pretest and posttest . This means that the posttest value is higher than the pretest value .

The prerequisite test carried out is the normality test of the data. The results of the normality test can be seen in Table 2.

Table 2. Normality Test Results *Pretest - Posttest*

	Shapiro-Wilk		
	Statistics	df	Sig.
Pretest	0.180	30	0.077
Posttest	0.177	30	0.063

Based on the table, the significance level of the pretest data normality test is 0.570 > 0.05. This means that the pretest data is normally distributed. Posttest data obtained a significance level of 0.063 > 0.05. This means that the posttest data are also normally distributed. After knowing that the data is normally distributed, then proceed with the paired t-test. The results of paired t-test can be seen in Table 3.

Table 3. Results of paired t-test *pretest* and *posttest* problem solving ability

		Paired difference					
		mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pair 1	Posttest - pretest	8,100	0.216	0.118	37.45	29	0.000

The results of the paired t test obtained a significance result of 0.000 which is smaller than 0.05, so there is a difference between the pretest and posttest after learning Problem Based Learning assisted by Thinking Map.

Furthermore, testing the increase in students' conceptual mastery using N-Gain. From the calculation results, the N-Gain value of 0.64 is included in the medium category. And for students' mastery of concepts after learning Problem Based Learning assisted by Thinking Map , an Effect Size value of 1.03 is obtained which is included in the strong category.

Mastery of students' concepts is measured by using 25 items. Mastery of students' concepts related to the concept of impulse momentum is found in items numbered 1 to 11, while the concept of the law of conservation of momentum is found in items number 12 to 18 and the concept of types of collisions is found in questions number 19 to 25.

The increase in the value of the pretest and posttest of mastery of concepts on 25 items is presented in Figure 1.

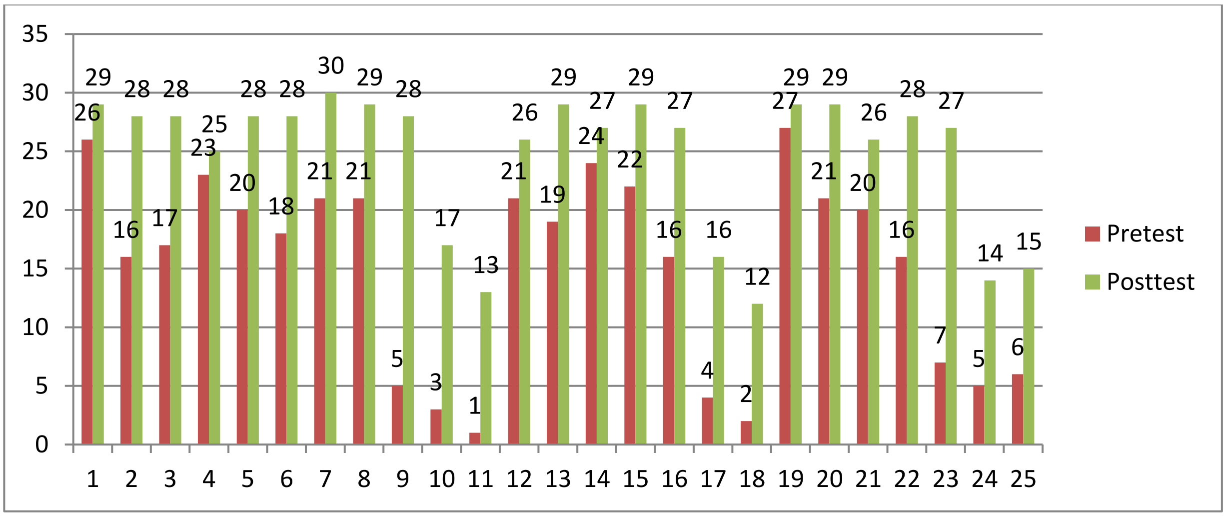

Figure 1 . Mastery of Concepts on 25 items of Impulse and Momentum

Based on Figure 1, it can be seen that there is an increase in students' mastery of the impulse momentum material concept from pretest to posttest on each item. It can be seen in question number 11 about experiments using the concept of momentum and impulse, only 1 student answered correctly, question number 19 about the law of conservation of momentum only 2 students who answered correctly but during the posttest there were many questions that the students were able to answer correctly. Overall, the mastery of concepts in each item has increased .

The improvement of concept mastery in 30 students of impulse momentum material using Problem Based Learning assisted by Thinking Map can be seen in Figure 2.

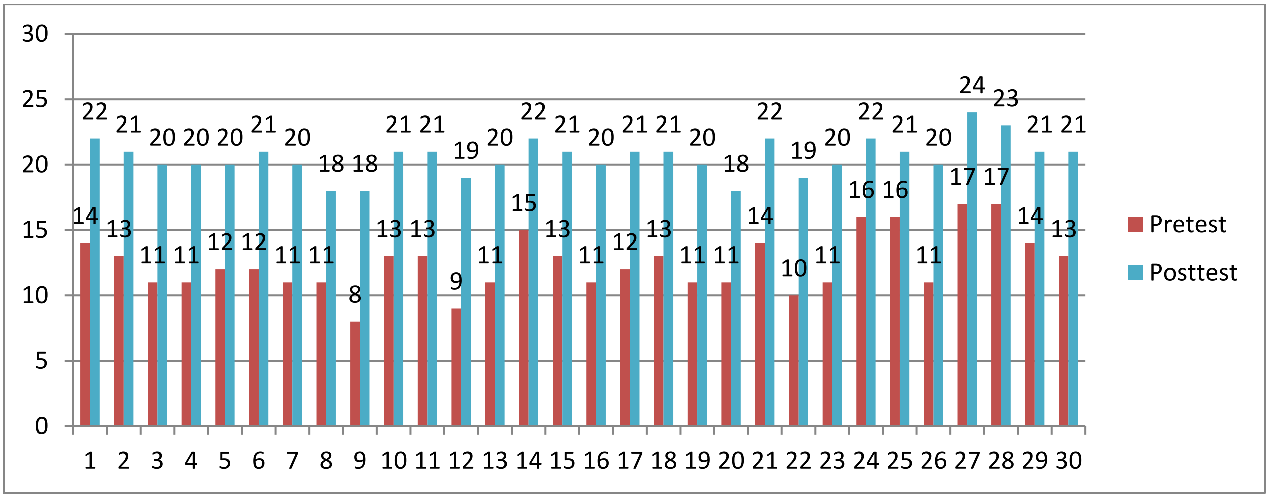

Figure 2. The results of the answers to the pretest and posttest of mastery of concepts in 30 students

In Figure 2. It can be seen that the increase in students' conceptual mastery from the pretest and posttest increased significantly in each individual. Some experienced a significant increase. It can be seen that some students with maximum scores, namely students with serial numbers 27 and 28 with scores 24 and 23. However, if we look at the increase in the pretest scores to posttest scores, students with serial numbers 9 and 12 have increased with a difference of 10 points. Meanwhile, 9 students have increased with a difference of 10. value 8. A total of 11 students experienced an increase with a value of 9. Students with serial number 25 experienced an increase with a difference in value of 5. And students with serial number 24 experienced an increase in the value difference of 6.

DISCUSSION

Increase in conceptual mastery between the pretest and posttest was demonstrated by the results of the data analysis achieved by attaining an N-Gain of 0.64. An increase from the pre-test to the post-test by an average of 7.39 points. (Kuhn, 2014) argues that PBL-based syntax instruction can enhance students' conceptual knowledge and their ability to apply the concepts they have learnt.

The activity of presenting the problem and allowing students the opportunity to analyze the phenomena supplied by the teacher is the role of PBL learning on concept mastering. Observation can train students' cognitive abilities. This is because observing students who exercise thinking skills reveals a cognitive conflict. According to Prima and Kaniawati (2004), PBL learning stresses student engagement. Students are permitted to develop their own knowledge.

Thinking maps can facilitate interactive learning, higher-order thinking, and metacognitive thinking (Costa & Kallick, 2017). Thinking maps can assist pupils in relating each subject. Research (Long et al., 2011) indicates that by creating a Thinking map, it is simpler for students to comprehend previously learnt topics than by writing conventional notes.

Research (Hanim, Susilo, & Yuliati, 2020) indicates that the application of the Thinking Map-assisted PBL learning approach can enhance students' knowledge of ideas. Research (Yusofa & Yuliati, 2019) demonstrates that the usage of Thinking Map in Problem-Based Learning enables students to be more engaged in their work and to contribute concepts for problem-solving.

CONCLUSION

Based on the results of the study, it was concluded that there was a difference between students' mastery of concepts before learning and after learning was carried out after applying the Problem Based Learning learning model assisted by Thinking Map on momentum and impulse material (0.00 > 0.005). That is, students have increased scores at the time the posttest was conducted. Further researchers can use other learning models to conduct research on improving students' conceptual mastery or can use other materials.

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