Journal Evaluation in Education (JEE)
Vol. 4, No. 4, October 2023, pp. 151~155
ISSN: 2716-4160, DOI: 10.37251/jee.v4i4.787

Identify Students' Conceptual Understanding of Momentum Material

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Article Info

Article history:

Received Jul 03, 2023
Revised Aug 26, 2023
Accepted Sep 28, 2023
OnlineFirst Oct 21, 2023

Keywords:

Concept understanding
Momentum
Impulse
Students

ABSTRACT

Purpose of the Study: This research aims to identify the level of students' conceptual understanding of momentum material.

Methodology: The study employs a quantitative research approach, specifically descriptive quantitative methods. The research was conducted across three high schools in the United States.

Main Finding: The research results indicate a commendable level of students' understanding of momentum material. Notably, each sub-material demonstrated strong comprehension. This understanding significantly influences student learning outcomes. However, it is essential to recognize that students' understanding may evolve over time due to individual circumstances. Therefore, teachers play a crucial role in guiding students toward continuous improvement.

Novelty/Originality of the Study: This study contributes by examining the depth of understanding of concepts related to momentum and impulse, providing valuable insights for educators and researchers alike.

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1. INTRODUCTION

Education is knowledge that can be obtained in a controlled and systematic manner in accordance with scientific procedures. The implementation of science lessons is generally closer to science learning and also invites logical, scientific and critical thinking in analyzing and responding to phenomena and events that can be seen in everyday life, one of the science lessons that we often encounter in school is physics [1]. Physics is a science that is factual and mathematical and leads to the abstract, so to attract students' attention there needs to be something new or interesting in learning, something interesting can come from the teacher's teaching method or the media used [2], [3].

Momentum is one of the basic subjects and concepts in the field of physics, but in its implementation students often experience difficulties [4], [5]. Momentum and impulse are generally taught after Newton's law material because the concept of Newton's law is related to motion which is the basis of the concept of momentum. Momentum is the tendency of an object to maintain its state [6], [7]. The change in momentum of an object itself is influenced by an external force F that acts for a certain time which is called an impulse. Research on this material itself has been carried out by many experts, some students consider the concept of momentum to be very complicated, especially for implementing the concepts of momentum , impulse, work and energy.

Comprehension in general comes from the word understand, which means to understand or understand correctly or thoroughly, understanding is obtained through good direct learning experience [8], [9]. If students do not get good direct learning experience, it will cause a lack of student understanding of the material, so that in

this case students will find it very difficult to repeat the learning given [10], [11]. Students' understanding can be seen and also assessed from test results in solving questions, especially questions that contain conceptual understanding. By completing these questions students can improve their analytical and thinking skills. This can also make students not easily forget the material being studied so that it can foster attitudes and habits in students that lessons are not only memorized but also the concepts are understood [12], [13]. Students' concept understanding activities can not only be carried out in the classroom but can also be carried out outside the classroom through daily experiences. Everyday experiences allow them to see things that are new and that will later be linked to existing knowledge. Activities to understand this concept can be carried out by providing media or instruments, for example providing videos, assignments and others [14], [15]. Understanding concepts is very important for students, if students have a high and deep understanding of a material then the students' learning outcomes will be higher. This research is in line with research conducted by [16], which discusses the level of students' understanding of momentum and impulse material, but in the research is that it only involved a small sample size of 28 students from a single university, this may limit the generalizability of the findings to a larger population of students or to other educational contexts. Meanwhile, the research carried out involved three different schools, because it greatly influenced the quality of the research produced.

Student learning outcomes are a very important thing or component in teaching and learning activities, learning outcomes indicate the level of success and effectiveness of the teacher's methods or models in the teaching process [16], [17] . Learning outcomes are influenced by various factors, namely: student interests, student potential, school potential, teachers who teach, the environment around students and also student motivation in carrying out learning activities. Based on the description above, this research is aimed at identifying conceptual understanding of momentum material. This research can provide an overview of students' understanding, which of course varies for each individual.

2. RESEARCH METHOD

This research uses descriptive quantitative methods with the sampling technique used is purposive sampling. Purposive sampling is a technique research sampling where the researcher determine the sample set with certain considerations. Population is a group of people who used by researchers with special characteristics to draw conclusions after studying previously. The research subjects were from 3 high schools in the United States. The research instrument used was 30 questions regarding momentum, which were divided into 9 momentum questions, 7 impulse questions, and 14 collision questions. The distribution can be seen in the table below.

Table 1. Description of questions

Material	Question number
Momentum	1, 2, 3, 4, 5, 6, 7, 8, 9
Impulse	10, 11, 12, 13, 14, 15, 21
Collision	16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30

From these 30 statements, the category of students' level of understanding was determined. The categories can be seen in the table below.

Table 2. Categories of students' level of understanding

Intervals	Category
75.01 – 100.0	Very good
50.01 – 75.00	Good
25.01 – 50.00	Not good
0.00 – 25.00	Very not good

After the data is obtained and collected, data analysis is carried out to obtain results and draw conclusions. The procedure in this study follows the diagram in Figure 1.

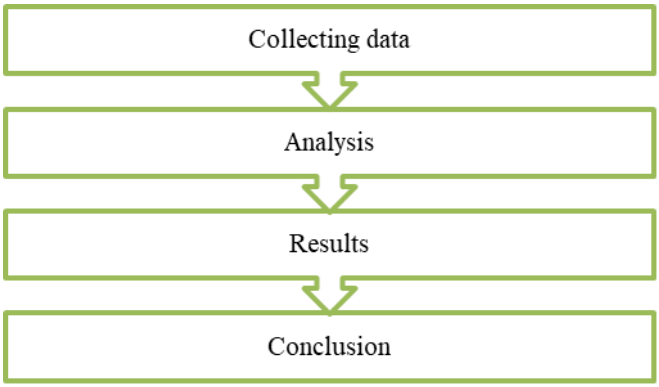

Figure 1. Research procedure

3. RESULTS AND DISCUSSION

In research conducted with distributed a questionnaire containing 30 questions regarding momentum and impulse. The 30 questions are divided into 3 sub-materials, namely momentum, impulse and collision. Detailed information regarding the questions can be seen in table 3.

Table 3. The level of students' understanding of momentum and impulse material

	Intervals	Category	F	%		
Union Country Magnet High School	75.01 – 100.0	Very good	10	33.33	Mean	59.18
	50.01 – 75.00	Good	20	66.67	Median	57.75
	25.01 – 50.00	Not good	0	0.00	Max	85.80
	0.00 – 25.00	Very not good	0	0.00	Min	36.30
Staten Island Technical High School	75.01 – 100.0	Very good	7	23.33	Mean	60.18
	50.01 – 75.00	Good	23	76.67	Median	54.75
	25.01 – 50.00	Not good	0	0.00	Max	84.80
	0.00 – 25.00	Very not good	0	0.00	Min	39.30
Northside College Preparatory High School	75.01 – 100.0	Very good	24	80.00	Mean	59.18
	50.01 – 75.00	Good	6	20.00	Median	59.75
	25.01 – 50.00	Not good	0	0.00	Max	83.80
	0.00 – 25.00	Very not good	0	0.00	Min	32.30

The table above shows the overall data, from the data the average value obtained is in the good category. Then specifically per subchapter of material, students' understanding of concepts can be seen in the table below.

Table 4. Level of student understanding based on sub-material

School	Sub material	Mean	Median	Minimum	Maximum
Union County Magnet High School	Momentum	61.11	66.66	11,11	100
	Impulse	58.57	57.14	14.28	100
	Collision	59.52	57.14	14.28	100
Staten Island Technical High School	Momentum	60.31	65.35	12.50	100
	Impulse	59.00	59.30	13.82	100
	Collision	59.89	56.29	13.35	100
Northside College Preparatory High School	Momentum	61.76	58.43	13.22	100
	Impulse	57.81	60.67	12.90	100
	Collision	59.63	61.84	13.55	100

From the table it can be concluded that in each sub-material the average student has a poor understanding of momentum and impulse material, in the momentum sub-material the average is 61.11, in Impulse material it is 58.57, and in collision it is 59.52. The results show that at Union Country Magnet High School there are students who have a good understanding of the material being taught . From the table it can be concluded that in each sub-material the average student has a fairly good understanding of momentum and impulse material, in the momentum sub-material the average is 60.31, in Impulse material it is 59.00, and in collision it is 59.89. The wide range of scores shows that At Staten Island Country High School there are students who have a good understanding of the material being taught. From the table it can be concluded that in

each sub-material the average student has a fairly good understanding of momentum and impulse material, in the momentum sub-material the average is 61.76, in Impulse material it is 57.81, and in collision it is 59.63. The wide range of scores shows that at Northside College Preparatory High School there are students who have a good understanding of the material being taught.

Understanding concepts is the ability to provide information or explanation of a situation verbally and also provide a solution or conclusion using related media such as graphics, and so on. The research line with Rosa et al, [16], misunderstanding can arise because the material that has been taught not associated with its application in daily life and not presented in various form of representation. The results of this research can be used as a reference for lecturers to determine the appropriate strategies that improve students' understanding of momentum and impulse [16]. Causes of students' difficulties in understanding the concept can be classified into five aspects. The aspects are students' preconception, wrong intuition, wrong conception, misunderstanding in verbal representation, and factual misunderstanding. Students already have preconception before following the lectures. This preconception is usually obtained from their parents, friends, previously learning, and experiences in the environment. Preconception sometimes makes students difficult to receive the new knowledge. Wrong intuition also causes misunderstanding. Students usually spontaneously express their assumption based on their intuition. Misunderstanding on concept arises when students are taught about scientific information that does not guide them to discover their knowledge through the scientific process. Understanding concepts is a very important thing in the learning process, because by understanding concepts, students will better understand the material being taught [18]-[23]. People who master the concept are able to abstract the objects they encounter so that these objects can be classified into certain groups [24]-[27]. A concept is an idea or idea based on relevant experience and can be generalized to form a concept [28]-[31]. Thus, students' mastery of concepts has a very important role in the success of learning physics because it is the basis for studying phenomena that occur in nature.

4. CONCLUSION

Understanding is one of the most important things in a student's educational process. Understanding means understanding thoroughly. The wide range of scores shows that at Northside College Preparatory High School there are students who have a good understanding of the material being taught. The results of the research can be used as a reference for educators to determine appropriate strategies to improve students' understanding of momentum and impulse. This can have implications for the development of teaching materials and methods that are more effective in enhancing students' scientific literacy competencies in this area. Additionally, the findings of this research can contribute to the broader field of science education and inform future research on related topics.

ACKNOWLEDGEMENTS

I would like to express a thousand thanks to all parties who have helped me in carrying out this research. Furthermore, I also thank you for your support in completing this research.

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