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[Research Article]

PHYSICS LEARNING MEDIA TO BUILD HIGH SCHOOL STUDENT'S UNDERSTANDING OF MOMENTUM MATERIAL

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ABSTRACT

For most students, physics is boring subjects and difficult specially in momentum topic. Therefore, the researcher considers the need for supporting learning media as an alternative to physics learning media on the concept of momentum, as well as testing the feasibility of media to support learning. The method used by researchers in research and development by Borg and Gall. Meanwhile, data collection was carried out by distributing instruments in the form of questionnaires and worksheet to measure learning achievement and student responses. Based on the results of the study, all questionnaire scores scored almost four in the good category, and all students were able to answer the worksheet. Therefore, with the media students can construct an understanding of the concept of momentum. Students who previously did not know the concept of momentum became aware of it even to the point of being able to formulate its meaning mathematically. With the existence of learning media, learning physics on the concept of momentum becomes more fun, interesting, and can increase students' learning motivation.

Keywords: Physics, Momentum, Learning Media

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1. INTRODUCTION

Education is said to have quality when it can develop the potential and knowledge possessed by students. The learning process that takes place in the classroom, especially when face-to-face is limited, has always placed students as recipients of various information in accordance with several learning achievements that cannot be said to be small. This of course causes the communication to take place only in one direction, namely between teachers and students.

The development of science and technology increasingly encourages efforts to improve the quality of education by utilizing the results of technology in learning. Improving the quality of education in the learning process cannot be separated from the role of educators or teachers (Nasution, 2018; Pratiwi et al., 2019). Teachers are required to have the ability to innovate in learning, one of the learning innovations is the development of learning media (Badriyah et al., 2018).

Media is an intermediary or messenger from the sender to the recipient of the message (Septarini & Kholiq, 2021; Yuningsih et al., 2018). Learning media can be interpreted as a tool used in the learning process. With the media that is intended to facilitate the delivery of teaching materials from teachers to students, so that students can easily and efficiently achieve learning objectives.

Media also functions for individual learning where the position of the media fully serves the learning needs of students. The use of teaching media in the teaching and learning process can generate new desires and interests, generate motivation and stimulation of learning activities, and even bring psychological effects on students (Wulandari, 2020).

Quality learning media are media that can increase learning motivation, are practical and easy to use, stimulate and attract students' attention, and can provide feedback, feedback includes encouraging students to practice learning correctly (Peranti et al., 2019). The use of learning media at the learning orientation stage will greatly help the effectiveness of the learning process and delivery of messages and lesson content at that time. In addition to generating student motivation and interest, learning media can also help students increase understanding, present data attractively and reliably, facilitate data interpretation, and condense information (Guterres et al., 2018).

In addition, the role of learning media in the learning process includes: (1). Clarify the presentation of the material so that it is not only verbal (in the form of written or written words). (2). Overcome the limitations of space, time, and senses. (3). The use of appropriate and varied media can overcome the passive nature of students. (4). Avoid misunderstanding of an object and concept. (5). Connecting the real with the unreal (Tafonao, 2018).

Physics is the knowledge that contains facts, concepts, and principles. Physics is also a science that can help students to understand their natural surroundings scientifically. Therefore, students need to learn physics at school (Chusni et al., 2021; Maulidiansyah & Hamdani, 2018). However, for most students, physics is one of the boring subjects and is considered difficult, because students think that physics is only in the form of formulas, and the monotonous presentation of physics learning makes students bored and uninterested, besides that the textbooks used in class use sentences that are stiff and uncommunicative so that it makes students bored or depressed. Physics does not only contain the knowledge to be memorized, but in physics, it is more emphasized on the process of forming knowledge and mastering concepts in the minds of students in the teaching and learning process (Nasution, 2018).

One of the materials that are still presented theoretically so that students are less able to analyze it is the momentum material (Chusni et al., 2018; Fadholi et al., 2018). The concept of momentum is included in the concept of physics

whose phenomena tend to be abstract because this concept cannot be observed with the naked eye, this is in line with the opinion of Purwaningsih (Purwaningsih et al., 2020) who states that the concepts of momentum and impulse are considered simple when in fact they are complex concepts. Therefore, in his research, Sutrisno stated that students' understanding of the momentum material was still low (Sari et al., 2019).

Momentum can be viewed as a measure of the difficulty of settling a particle. In another sense, momentum can be interpreted as the tendency of a moving object to continue its motion at a constant speed (Denny et al., 2020). For example, a truck that has a heavier mass has more momentum than a lighter car that is moving at the same speed. And a car that has the same mass, when traveling at a high speed will have more momentum than a car traveling at a slow speed. A greater force is required to stop the truck than the car in a given amount of time (Giancoli, 2010).

Momentum is a quantity possessed by a moving object (Denny et al., 2020). The amount of momentum will depend on the mass and speed of the object, the greater the mass of an object, the greater its momentum, as well as the greater the velocity of the object, the greater the momentum. Momentum is a vector quantity because its magnitude depends on velocity, and velocity is a vector quantity. The direction of the momentum is the same as the direction of the velocity.

Momentum is denoted by p. Mathematically, momentum is the product of mass and velocity vector, so momentum can be written as (1):

$$p = mv \qquad (1)$$

where p is the momentum (kg m/s), m is the object's mass (kg), and v is the object's velocity (m/s).

Based on literature studies and case studies conducted by researchers, students' understanding of momentum material is still low, students consider momentum material difficult to understand and abstract. Based on these facts, teaching aids have the function of visualizing things or events that are difficult for students to see in physics learning so that they can explain a phenomenon or phenomenon during learning. Therefore, researchers consider the need for teaching media to support physics lessons as an alternative media for learning physics on momentum material, as well as testing the feasibility of media to support learning (Setyawan & Atapukan, 2018).

2. METHOD

2.1 Activity Implementation

The research activity was carried out in one of the Madrasah Aliyah in Bandung Regency with 15 students with Momentum material in class X, where these students have not received and studied Momentum material, but students already have basic abilities, namely Newton's law material. The number of students who took part in the learning was only 15 people, due to the limited face-to-face learning activities (limited teaching and learning). Meanwhile, the time for the learning implementation will be on November 20, 2021.

2.2 Experiment Tool Design

After determining the topic of the problem in physics learning, the researchers jointly design the momentum experiment tool that will be made. The design is made curved to facilitate the movement of objects without the influence of external forces, the tool becomes the trajectory of the movement of objects. The design of the momentum experiment tool that we will be testing can be seen in Figure 1.

2.3 Tools and Materials

The tools and materials needed to test the momentum experiment are: a) A set of momentum experiment tools; b) Stopwatch (to measure collision time); c) Balance (to measure

the mass of the object being tested); d) Ruler (measures the displacement of the object after the collision); e) Stationery; f) Bekel ball; g) Baseball; h) Golf ball; and i) Ping-pong ball.

Figure 1. Tool Design: Momentum Trajectory

2.2 Research Methods and Data Collection

The method used by the researcher is research and development (Research and Development) is a research method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2011). The R&D research procedure used is to follow the Borg and Gall stages. Borg & Gall (1983) stated that the development research procedure consists of two main objectives, namely: (1) develop the product, and (2) test the effectiveness of the product in achieving the objectives. The research stages consist of several steps, namely: research and information collecting, planning, developing preliminary form of product, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision, and dissemination and implementation.

In this study, not all steps could be taken by the researcher due to limited manpower and time. The steps taken by the researcher include determining the potential and problems, as well as collecting information carried out at the beginning of the study by observing the students that each researcher has taught, then the researcher concludes on the material that students experience difficulties in the learning process, the difficulty is due to the difficulty of students visualizing abstract material and the absence of learning media in each of these schools.

After determining the problem, the researcher jointly designs the teaching aids that will be made, then consults and validates the design to the lecturer in charge of the course, improve the design, and make a tool, the making the tool was carried out for more than one week, then the researcher tested the tool at one Madrasah Aliyah in Bandung Regency in class X who had not studied and received momentum material.

The product resulting from this development research is in the form of teaching aids or learning media. This learning media product was created and designed by the researcher himself, to be able to be used as a teacher's tool in conveying momentum material.

The method of data collection was done by distributing the instrument in the form of a

questionnaire to media experts and students. The first questionnaire was aimed at testing the feasibility of media to media experts which consisted of several questions such as "media developed following the momentum material, learning media developed were able to explain/define momentum" and so on. The second questionnaire was used to measure learning achievement which consisted of several questions such as "identifying the relationship between mass and momentum. Able to identify the relationship between velocity and momentum, able to analyze experiments and the relationship between momentum, object mass, and object velocity". The third questionnaire is a student response questionnaire consisting of several questions such as "the design of the learning media used is interesting, learning using learning media is a new experience for me, learning media is easy to use, learning media can motivate me to learn momentum material" and so on.

As well as distributing student worksheets as learning tools. The student worksheets made contains eight questions. student worksheets is made as a guide for students to carry out activities so that students acquire the knowledge and skills that need to be mastered in the material being studied (Permatasari et al., 2018; Subarkah et al., 2018).

Questionnaires obtained from each student will be analyzed and the results will be categorized according to the Likert Scale to see the responses obtained from each student on learning achievement and the media developed. The Likert scale is a measurement scale developed by Likert in 1932. The Likert scale has four or more questions that are combined to form a score or value that represents individual traits, such as knowledge, attitudes, and behavior.

3. RESULT AND DISCUSSION

Before testing the media to schools, a media feasibility test was first carried out by expert lecturers. The results of the questionnaire were then analyzed and adjusted for categories using a Likert scale which resulted in several 3.85 in the "enough" category and close to 4 in the "good" category.

Then the test is carried out in schools. In the initial activity, the teacher in this case the researcher asked the students about momentum, and all students did not know what momentum was and how. Then students are given a stimulus in the form of a video about problems related to everyday life, such as the phenomenon of a collision between two cars. After students explore the problem, students are directed to make hypotheses about the relationship between the variables they analyze based on the videos they have watched. Then, to prove the student's hypothesis, each group representative came forward to do a demonstration of the props.

Group learning is carried out to improve students' communication and collaboration skills (Ni'mah et al., 2018). The test is done by varying the mass and speed of the ball. The results of the observations are in the form of qualitative data, where students see the effect that is produced when two objects collide by varying one of the masses and the velocity of the object.

After testing the tool that the researcher designed on fifteen students of class tenth Mathematics and Natural Sciences at one Madrasah Aliyah in Bandung Regency. Based on the results of observations from learning activities carried out using momentum learning media, students (respondents) have been able to: a) identify the relations between mass and momentum, and relate it in graphical form; b) identify the relationship between velocity and momentum, and relate it in graphical form; and c) analyze experiments as well as the relationship of momentum, object mass, and object velocity.

The data was taken from the instrument in the form of filling out the student worksheet and the distribution of questionnaires related to student assessment of the teaching aids made by the researcher. The results of the two learning

instruments indicate the achievement of learning objectives. For filling out the student worksheet, the following is an example of the questions and the results of the answers to the student worksheet filled in by students as shown in Figure 2.

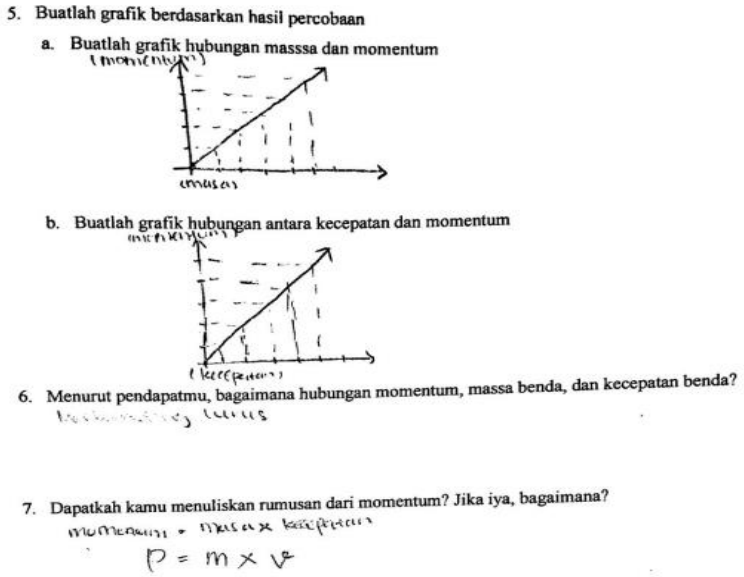

Figure 2. Student worksheet questions and student answers

Figure 2, shows that students already understand the basic concept of momentum, students who initially still wonder what momentum is because they have not studied and received the material, after getting teaching aid-based learning made by the researcher, students can fill out the student worksheet without being told by the teacher, in this case, the researcher. In learning the teacher only acts as a facilitator.

Based on the student's answers, it can be seen that students can conclude the relationship between momentum, mass, and velocity in the form of a graph, students can determine which is the dependent variable and the independent variable, and state that the relationship between the three variables is directly proportional. In addition, students can express the concept of momentum they have learned in mathematical equations, where previously students did not know the meaning of momentum and how the mathematical equation was.

While filling out the questionnaire, we got fifteen data for filling out the questionnaire. The questionnaire consists of ten questions, where for filling in the questions students must choose a scale of 1-5. The greater the value is chosen, the better the tool according to student assessments.

In addition, the concepts of momentum and impulse are abstract (Oktasari et al., 2019). Not only in terms of concepts, but students must also have good mathematical skills to solve problems related to problems of mastering the concept of momentum (Mahardika et al., 2021). The calculation results are shown in Table 1.

Based on table 1, the highest score was obtained by question number four, the almost good mean was 3.93. With the criteria of questions regarding the relationship of media with increasing students' learning motivation. From these questions, the use of media in the momentum learning process has been good in increasing students' learning motivation. In addition, it can be seen from the enthusiasm of students during the learning process, all students play an active role during learning and all students are enthusiastic about trying to use the tool.

Tabel 1: Questionnaire Score Distribution

No	Initials Name	No 1	No 2	No 3	No 4	No 5	No 6	No 7	No 8	No 9	No 10
1	HH	4	5	4	5	4	5	4	4	4	4
2	HFAM	4	4	4	4	4	4	4	4	4	4
3	ACM	4	4	4	4	4	4	3	4	4	4
4	HA	4	3	2	4	4	4	4	4	4	4
5	IPS	4	4	4	4	3	3	3	4	4	4
6	MYH	4	4	4	4	4	4	3	3	3	4
7	DNR	3	3	3	4	3	3	3	3	3	3
8	AA	4	4	4	4	4	4	3	3	3	4
9	DAF	4	3	4	5	4	4	4	4	4	4
10	MFA	4	4	4	4	3	3	2	2	2	4
11	DRF	4	3	4	3	3	4	3	4	4	3
12	NNA	4	3	4	4	3	4	3	3	3	4
13	BF	2	2	2	2	2	2	3	3	3	3
14	FM	4	3	3	4	3	3	3	3	3	3
Average		3.79	3.5	3.57	3.93	3.43	3.64	3.21	3.43	3.43	3.71

Student responses also show that learning using media is very interesting and fun, where the question is question number five with a mean of 3.43 with a category more than adequate. These results show that the use of media no longer makes students bored and uninterested, but students state that the learning is interesting and fun, thus making learning more meaningful (Sailin & Mahmor, 2018; Widodo, 2018; ZUBAEDİ et al., 2021). However, some students stated that the use of media was not new to them, in other words, most students had used learning media in previous lessons.

Based on the questionnaire, the researcher also wanted to know the students' understanding of the concept of momentum after learning was carried out, as well as students' understanding of the relationship between mass, velocity, and momentum values. The results are shown by the number eight, nine, and ten questions. Where question number eight is related to the relationship between mass variation and momentum, question number nine is related to the relationship between object speed and momentum, and question number ten is related to the concept of momentum and mathematical formulation. The results show that students are more than adequate in understanding the concept of momentum and understanding the effects of mass, velocity, and momentum. Where the results are quite good for students who have not studied the momentum material with a fairly short learning time (Hew et al., 2020; Oktasari et al., 2019).

However, the results of increasing mastery of the momentum concept in this study were in the category of more than adequate and good, there were no results that showed more than good or very good, namely a value of more than 4 or even 5. This is because the momentum material is a new concept taught at the high school level so the prerequisite concepts must also be mastered well by students (Malik et al., 2018; Wirjawan et al., 2020).

The categories of questions in the questionnaire show that the use of learning media in momentum material is very helpful in continuing learning and making momentum learning more meaningful for students. In addition, with the existence of learning media, students become more enthusiastic in the learning process, so that learning physics is no longer monotonous and boring (Misbah et al., 2018; Ngurahrai et al., 2019).

4. CONCLUSION

The instructional media designed are sufficient to meet the learning objectives, namely to assist students in defining and formulating the momentum equation. This is based on the results of filling out student worksheet and questionnaires given to students. These results indicate the achievement of the learning objectives designed by the researcher. All groups of students were judged to be able to fill out the student worksheet well, judging from the answers given. The results of the questionnaire also show that all aspects of the learning media are sufficient and provide new experiences for students and are easy to use. With the learning media, learning physics becomes more fun, interesting, and can increase students' learning motivation. However, we will provide some improvements such as sloping and extending the trajectory that we made so that the effect of speed can be more varied and extending the trajectory so that when using media, other collisions do not go off the track.

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