JPPIPA 9(8) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Mobile Learning Based E-Module to Improve Concept Understanding and Interest Learning X Class Student in Momentum and Impulse

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Received: April 4, 2023
Revised: June 5, 2023
Accepted: August 25, 2023
Published: August 31, 2023

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DOI: 10.29303/jppipa.v9i8.3565

Abstract: This study aims to develop multiple representation-based electronic modules with the help of mobile physics learning on momentum and impulse material in class X MIPA. The research wants to test the effectiveness of e-modules based on their validity in increasing students' understanding of concepts and learning interest. The research method used is quantitative with the 4D model (Define, Design, Develop, and Disseminate). The subjects of this research were students in class X MIPA 2 and X MIPA 4 SMA Negeri 1 Kalasan. The research design used was one group pretest-posttest research design. There are two instruments used, namely test and non-test instruments, as well as data analysis techniques using Microsoft Excel. The results of the study show that the use of multiple representation e-modules assisted by physics learning cars is feasible to be used as teaching materials. In addition, the results of differences in pretest and posttest scores and interest in learning in the modeling class were 86% and in the implementation class were 88% indicating an increase in learning interest received by students.

Keywords: E-module; Impulse; Momentum; Smartphone

Introduction

Learning activities in the 21st century are a period of time where all aspects of life must adapt to technological advances that are so sophisticated and rapid, thus providing various conveniences in human activities (Ninaus et al., 2015). The current educational curriculum requires students and educators to carry out a learning process that uses and utilizes technology in learning activities such as smartphones (Kurniawan & Kuswanto, 2021). In addition, learning activities that utilize smartphones can be carried out flexibly and are not fixated on teaching that is predominantly teacher-centered, but learning can be carried out individually by students. So that learning activities can be carried out without being limited by space and time. Physics is one of the subjects whose learning activities are expected to utilize technology (Rahayu & Kuswanto, 2021). This is because learning physics contains theories, laws, mathematical equations and experiments that have their own concept of knowledge. Based on the results of direct interviews with students and physics teachers at one of the high schools, it can be seen that students have difficulty understanding concepts and are less interested in studying momentum and impulse material (Materi et al., 2019; Septarini & Kholiq, 2021). In addition, based on the results of the presentation on the official website of Indonesia's Ministry of Education and Culture, it was explained that the UNBK results from 2015 to 2019 in physics subjects were very lacking.

Momentum and impulse is one of the physics subjects in the even semester in class X for high school. This material studies the relationship between mass and the speed of a moving object (Savira et al., 2019). Based on the acquisition of interviews carried out directly to several students and physics subject teachers in several

How to Cite:
Sukmadewi, A. G. A. G., & Jumadi, J. (2023). Development of Mobile Learning Based E-Module to Improve Concept Understanding and Interest Learning X Class Student in Momentum and Impulse. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 5914–5920. https://doi.org/10.29303/jppipa.v9i8.3565

high schools, it can be seen that problems arise regarding students who have difficulty understanding the concept of momentum and impulse resulting from lack of interest in learning in students and the monotonous learning media causing lack of effective learning activities that take place. This can also be proven through the results of research conducted by Dina et al. (2017) regarding the understanding of concepts in momentum and impulse teaching materials which are still not good. Then there is also a study carried out on Rosa et al. (2018) explained the difficulties experienced by students in interpreting the fundamental concepts of physics, especially in momentum and impulse teaching materials. Likewise with the study carried out on (Sari et al., 2019; Dian et al., 2016) from this research students had difficulty interpreting the basic concepts of momentum and impulse and also students experienced a little difficulty when analyzing the concept of momentum and impulse in their daily lives. For other studies carried out from (Maya A., 2017). Regarding the highest misconception there is the concept of the conservation of energy and collisions. This results in low student learning interest in this material which will certainly have an impact on student problem-solving.

Another reason for the low interest in student learning in momentum and impulse materials is the absence of learning innovations in these materials. Because the matter of momentum and impulse is considered too mathematical. The other factor is the use of learning media that is less attractive to students. Physics learning is never separated from the media and teaching materials used, but the media and teaching materials circulating in schools are not in line with expectations (Siswoyo et al., 2020). The concept of physics in high school consists of abstract concepts that require high imagination. Submission of physics concepts will be more enjoyable if packaged in the form of pictorial visual media, such as the use of images in overcoming the limitations of space and time because not all objects or events can be brought to class (Werdani et al., 2015).

Innovation in physics learning is certainly one of the most important steps that must be carried out in this era that demands full use of technology. According to a book written by Sugianto et al. (2017) modules can be transformed into electronic modules or better known as e-modules. Learning activities that utilize e-modules create learning independence for students in accordance with the 2013 curriculum guidelines (Ngurahrai et al., 2019). The media should be packed interesting learning so that students can linger study physics such as e-module (Matsun et al., 2019; Yulkifli et al., 2022). For now, currently many use e-module as a learning medium (Aziz et al., 2021; Sari et al., 2021).

Research related to the development of e-modules has been carried out several times by researchers such as (Nurmayanti et al., 2015) who has a product validation presentation of 84% through this research to create e-module products that can be used for learning. That's what was done by (Ndoa et al., 2022; Casmunah et al., 2020; Erwinsyah, 2015; Suyoso et al., 2014) who conducted e-module development research. The e-module is included in the very valid category so that it can be used in physics learning. And also like research conducted by (Sitti et al., 2015) regarding the development of e-modules whose e-module validity results reach 83%. Currently, there are various ways to apply e-modules, one of which is by using mobile physics learning (Fitri et al., 2019; Syarlisjiswan et al., 2021) which makes it easier for students and teachers to learn.

The development of e-module teaching materials shows an increase in the effectiveness of learning for students in learning activities. The practicality of the e-module involves mobile physics learning being one of the proofs of teaching materials can increase student curiosity and learning.

Method

This research was conducted using the research and development method (Borg & Gall, 1983). This research want to make a media learning and test the concept understanding also interet learning by the media. This learning media development model uses 4D which includes define, design, develop, and disseminate. Figure 1 displays the research flow:

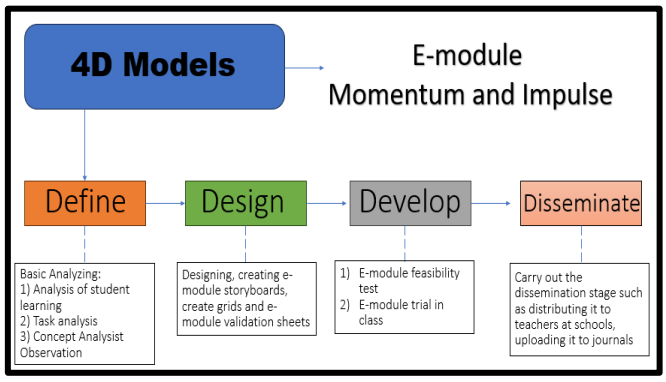

Figure 1. Research flow

The subjects of this study were students of class X MIPA at SMA Negeri 1 Kalasan. This study was carried out using qualitative methods. The study design used was the pretest-posttest control group design. The study instrument includes test and non-test instruments. This study used 2 classes, namely the modeling class and the implementation class. Researchers teach directly to the

modeling class while the implementation class directly to the teacher of the subject concerned.

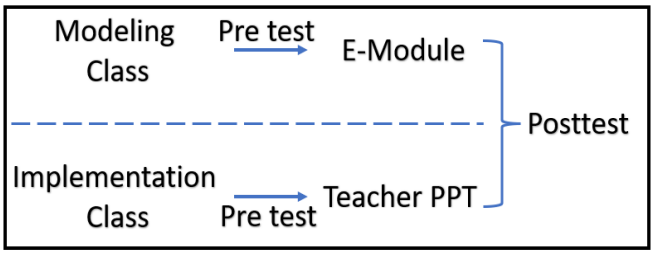

Figure 2. Pretest-posttest control group design

Instrument validation is carried out in two ways, namely RPP instruments, e-modules and understanding concepts using validators who are experts in their fields. While the validation of the interest in learning questionnaire uses V Aiken with assistance software microsoft excel. The research begins with observing schools and students to find out the right innovation development to do. Next, the development planning stages are carried out which are validated by the validator and then filled with the trial phase. The validation formula is as follows.

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

where:
$s = r - l_0$
n = number of assessment
l_0= minimum score by validator
c= maximum score by validator
r= total score

All scores that have been obtained are seen to be divided into four categories by comparing the value of V Aiken between 0-1 with the quality category is shown in Table 1.

Table 1. Quality Criteria

Score Range	Category
$\mathbf{0.2 < V \leq 0.4}$	Not enough
$\mathbf{0.4 < V \leq 0.6}$	Enough
$\mathbf{0.6 < V \leq 0.8}$	Good
$\mathbf{0.8 < V \leq 1}$	Very good

This development was also carried out to determine the effectiveness of the e-module to determine the ability to understand concepts and students' learning interest in learning momentum and impulses. Students are given a posttest after the end of learning and then a questionnaire to find out the responses/responses and the development of students' knowledge after using the developed module. The pre-test and post-test data were processed using excel by calculating the average pretest and posttest values. The response data obtained were then analyzed using the following formula.

$$POA = \frac{R}{SM} \times 100\% \quad (2)$$

where:
POA = percentage of student responses questionnaires
R = average of students voted agreed
SM = the number of students

Then the student response data is categorized based on the criteria in Table 2.

Table 2. Responses Student Criteria (Riduwan, 2011)

Interval Criteria	Category
0% - 20 %	Very unattractive
21% - 40 %	Less attractive
41% - 60 %	Enough
61% - 80%	Interesting
81% - 100%	Very interesting

Result and Discussion

The results of this development research are electronic momentum and impulse modules with the law of conservation of momentum and collisions using the help of the mobile physics learning application which can be accessed using a smartphone. The research that has been carried out has been analyzed into four parts according to the method used, namely, first; The define stage describes the results of curriculum analysis with core competencies and basic competencies that are in accordance with momentum, impulse, law of conservation of momentum and collisions. Then the breakdown of the analysis is used as the basis for learning objectives. Through the definition stage, the next stage is the second stage, namely the design stage. The design stage is carried out to obtain e-modules of momentum, impulse, law of conservation of momentum, and collisions to increase students' understanding of concepts and learning interest. The design consists of several menus, namely cover, concept map, introduction, material, sample questions, and practice questions. Furthermore, the third stage is the develop stage which is obtained through module validation data and development test results data. Validation was carried out by 3 expert lecturers, with the form of validation instruments in the form of a check list. Data from the check list by expert lecturers were analyzed using the average calculation. The scale used is the Likert scale.

The result of this research can be seen in Table 3. Table 3 displays the assessment indicators for the e-module product along with the eligibility value. The results of development research validation can be seen in Table 3.

Table 3. E-Modul Validation Result

Indicator	Percentage score validation %		
	Validator 1	Validator 2	Validator 3
Content eligibility	91.67	87.50	83.33
Language	83.33	83.33	91.67
Presentation	87.50	91.67	87.50
Graphic media	100.0	83.33	87.50
Mean validator assessment	90.62	86.45	87.50
Overall average			88.19
Validation category			Very good

Based on the validation that has been carried out by the three expert validators, the overall validation average for the feasibility of the momentum and impulse e-modules is 88.19%. This shows that the development product is very valid and falls into the appropriate category to be given to students in studying momentum, impulse, law of conservation of momentum, and collisions.

Effectiveness data is obtained by comparing the mean pretest and posttest values. The students' posttest scores were higher than the pretest scores given to students as shown in Table 4.

Table 4. Pretest Posttest Concept Unstanding Result

Class	Pretest average	Posttest average
Implementation	65	95
Modeling	62	99.5

Table 4 data displays different pretest and posttest results in measuring students' understanding of the concepts of momentum, impulse, law of conservation of momentum, and collisions. This is due to several factors such as students' memory abilities, the learning media used, the learning atmosphere in the classroom, and students' motivation when learning takes place.

The next development test data is data on student learning interest obtained through a student response questionnaire in the use of momentum and impulse e-modules. This response questionnaire is given after the learning process takes place, as shown in Table 5.

Table 5. Student Response

Class	Percentage of Agreement %	Category
Implementation	86	Very interest
Modeling	88	Very interest

Student interest in learning can be seen through the response questionnaire instrument distributed to experimental class students, as in previous research Hamdunah (2015) that based on the questionnaire, the developed module is categorized as feasible if the value ranges up to 80%. Analysis of the data on student learning interest that has been disseminated obtained values of 86% and 88%, therefore student learning interest is included in the very interesting category of using e-modules in studying momentum and impulses.

Product development e-modules momentum, impulse, law of conservation of momentum and collisions are displayed as shown below.

Figure 3. E-Module menu

Figure 3 displays the menu contained in the e-module. The menu is divided into an introduction, a concept map containing KD and learning objectives, material containing the subject of momentum and impulse, plus a menu of sample questions and practice questions for students to work on.

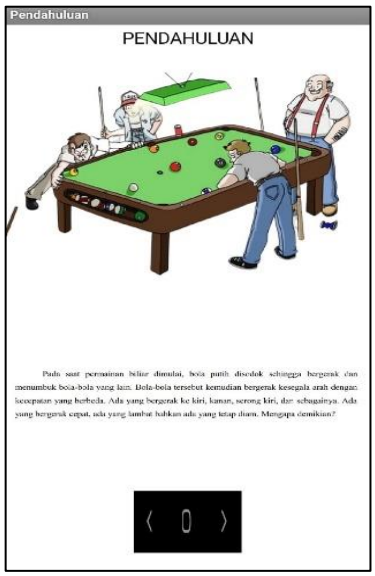

Figure 4. Introduction e-module

Figure 4 displays an introductory menu that displays images, because the module has a multiple representation model so that the e-module contains

representations of material contents such as images, videos, and verbals.

Figure 5. Point of e-module

Figure 5 displays the contents of the material from the momentum and impulse. The e-module has been designed using a physics learning mobile application. This menu also displays a bibliography of the material references contained in the e-module.

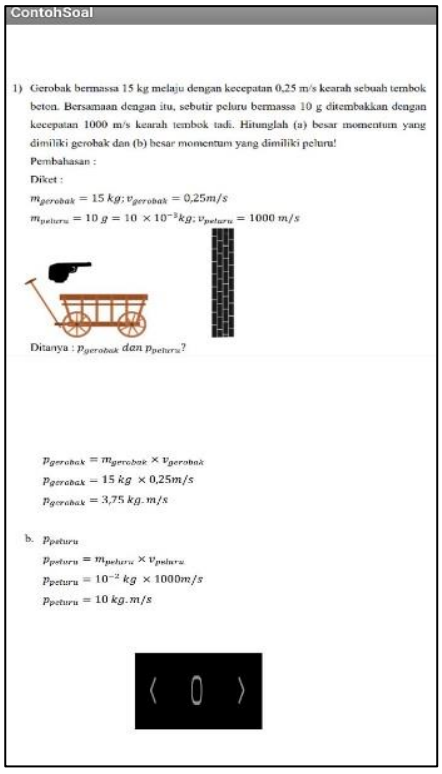

Figure 6. Exercise momentum and impulse

Figure 6 is a display of the example question menu. In this menu students are invited to study independently through examples of existing questions with detailed and coherent explanations of the physics problems in the questions.

In the final stage of this research, product dissemination was carried out using the relations of physics teachers in several Yogyakarta high schools and dissemination was carried out by sending articles to journals. Based on the analysis of the data that has been described, it can be concluded that this momentum and impulse e-module can increase the understanding of concepts and learning interest of high school students.

Conclusion

Based on the research that has been done, it can be concluded, first, the development of Assisted E-Modules Mobile Physics Learning In Momentum and Impulse To Provide an increase in understanding of concepts and Learning Interests of Class X students it is appropriate to be used as a medium for teaching momentum and impulse in class X. This is proven through the results of the e-module validation being categorized as very feasible. Second, through assisted e-modules mobile physics learning it can be seen that there is a significant difference in value between the pre-test and post-test values. This shows that after being given the treatment, students gain an increased understanding of the concept of momentum and impulse material. Third, the learning interest of the identified students is in the very good, good, and quite good groups. So from that the Development of Assisted Representation E-Module Mobile Physics Learning Momentum and Impulse to provide increased understanding of concepts and learning interest for Class X students of SMA Negeri 1 Kalasan can be used to provide increased interest in learning.

Acknowledgements
We respectfully express our gratitude to the honorable the headmaster and physics teacher of SMA N 1 Kalasan for the opportunity and support to carry out this study.

Author Contributions
Angela designed and conceptualized the research to be carried out, such as drafting concepts and drafting learning product designs, designing learning activities, analyzing the data obtained, finding and selecting schools for research, and taking care of all research administration and saving funds. Jumadi oversees product development to research to research supervision, validates media products, and review draft articles. All authors have read and agreed to the published version of the manuscript.

Funding
This research did not receive external funding from other parties.

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