Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

January 2023. Vol. 11, No. 1
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 53-62

Development of Impulse and Momentum Teaching Materials Using the Inquiry-Discovery Learning Model to Train Students' Creativity

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Received: December 2022; Revised: December 2022; Published: January 2023

Abstract

This research is motivated by the importance of creativity abilities based on the objectives of the 2013 Curriculum. Therefore, the purpose of this study is to describe the feasibility of impulse and momentum teaching materials using the inquiry-based discovery learning model to train students' creativity. This type of research is research and development with the ADDIE model. Data were obtained through an instrument validation sheet, a lesson plan implementation sheet, and THB. Data were analyzed descriptively qualitatively, averagely, and N-gain. The results showed: (1) teaching materials were valid because the validity of the lesson plans was 3.44; teaching materials of 3.46; LKPD of 3.45; and THB of 3.42 in the very valid category, (2) teaching materials including practical because the RPP component can be implemented in a very practical category, (3) teaching materials including effective because the N-gain value is 0.69 in the medium category. Thus, the teaching materials of the inquiry-discovery learning model that have been developed are feasible to train students' creativity and can be applied in physics learning.

Keywords: creativity; impulse and momentum; inquiry-discovery learning, teaching materials

How to Cite: Rahmah, S., Mastuang, M., & Dewantara, D. (2023). Development of Impulse and Momentum Teaching Materials Using the Inquiry-Discovery Learning Model to Train Students' Creativity. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 11*(1), 53-62. doi:https://doi.org/10.33394/j-ps.v11i1.6606

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INTRODUCTION

South Kalimantan Provincial Regulation Number 3 of 2010 Article 3 states that education in the region is part of national education, which functions to develop capabilities and shape the character and civilization of the nation that is useful in the context of educating the nation's life, and aims to develop the potential of students to become good human beings. have faith and fear of God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. This goal is mainly on the subject of creativity which directs creative values as things that generate new ideas by individuals or small groups (Munandar, 2009). In line with (Kurnia et al., 2016; Nursisto, 2000) creativity is defined as the general ability to create something new, as the ability to provide new ideas that can be applied in problem solving or the ability to see new relationships between elements. that existed before. Therefore, with creative thinking we can find and determine new things when solving problems. The ability to think creatively will emerge when various efforts or exercises to be creative are carried out. The ability to think creatively is not something that stands alone, or is not only one's advantage.

The creative ability of students gets the main attention in the 2013 Curriculum, but in its implementation it is still not maximized (Biazus & Mahtari, 2022). The creativity of

students is hampered not solely because of one system, but there are several factors that must be considered. So far, most educators still carry out teaching with the lecture method with the understanding that educators know better than students. In fact, if you look at the current era, it is not impossible for students to know more about what educators don't know thanks to increasingly modern technological advances. It's just that most of the activities of the learning and teaching process which are limited to the lecture method given by educators, cause the purpose of learning to increase the creativity of students to not be achieved properly.

Based on the analysis of the results of TIMSS in the science field in 2007 and 2011, it is known that Indonesian students have quite low abilities in (1) understanding complex information, (2) theoretical reasoning, analysis and problem solving, (3) using tools, and procedural, and (4) conducting an investigation. In addition, most students are only able to work on questions up to the intermediate level such as remembering, but at the level of reasoning new problems students have difficulty If this study is related to the level of creativity of students, there are several studies that examine the level of creativity of students in three junior high schools in East Java, where the results show that more students are identified as uncreative (Richardo et al., 2014). This is in line with the preliminary study at SMA Negeri 12 Banjarmasin. It was found that the test results in the form of students' creative thinking skills on the fluent thinking indicator got an average score of 46.66%, flexible thinking got an average score of 40.00%, original thinking got an average score of 26.66%, and detailed thinking get an average value of 13.33% which means that the creative thinking ability of students is still relatively low. As a result, this becomes a problem in learning that uses the 2013 curriculum, where almost all basic and core competencies require students to experiment. Therefore, learning is very necessary and can train students' creative abilities.

The selection of appropriate learning materials can also help to train students' creativity and encourage students to be more active in their learning (Bilad et al., 2022). Based on the research of (Hidayat et al., 2021) showed that impulse and linear momentum electronic teaching materials are feasible to use in learning and can improve scientific literacy. In line with this, the digital impulse and linear momentum teaching materials developed are able to practice problem solving skills and are suitable for use in learning activities (Noviyanti et al., 2021). Based on previous research, there has been no research that has developed impulse and momentum teaching materials to train students' creativity, where most of the research conducted leads to science process skills in this case such as research conducted by research (Maharani et al., 2017) with the development of teaching aids to improve students' science process skills. As research (Mawaddah et al., 2015) found that the use of the Discovery Learning, learning model with a metacognitive approach increased creative thinking skills in the mathematical field, while(Fatmasari et al., 2021) the effect of the Discovery-Inquiry learning model on the ability to think creatively in physics.

One way to train students' creativity is to develop teaching materials using the inquiry-discovery learning (IDL) model (Septaria & Rismayanti, 2022). Several studies relate to the use of the inquiry-discovery learning model in the learning process. (Ulfiyani, 2012) shows that the inquiry-discovery learning model has made students give positive and enthusiastic responses so that they can improve student learning outcomes. The inquiry-discovery learning model is also applied because it has a positive effect on reducing misconceptions and students' learning achievement in physics (Suryawan & Sudarma, 2020). The learning activity of students in terms of determining concepts in groups affects learning outcomes by utilizing the inquiry-discovery learning model in learning (Nurizka et al., 2016). The improvement of students' creative thinking skills in physics material also has an effect when using the inquiry-discovery learning model (Fatmasari et al., 2021). Several studies above prove that the inquiry-discovery learning model is an effective model for increasing activity, the achievement of a skill, and the creative ability of students. According to (Kurnia, 2014; Roestiyah, 2008; Sani, 2015) by using the inquiry-discovery learning model, learning will

continue to process until it reaches learning objectives and directs students to actively find ideas and get meaning from a concept, so that students become actors. dominant in the application of the model syntax in learning activities. This learning is very suitable for high school students, where students are already at the stage of developing formal operations (Mu'min & Aisyah, 2013).

An alternative solution to existing problems related to the low level of student creativity is to develop teaching materials that are able to train students' creative abilities using the inquiry-discovery learning model. Several previous studies have examined impulse and momentum material, but none has been related to the level of creativity of students. So it is hoped that this teaching material can increase their enthusiasm for learning and train students' creativity. Therefore, the purpose of this study is to describe the feasibility of teaching materials on impulse and momentum using the inquiry-discovery learning model to train students' creativity. The results of the development are assessed from the validity, practicality, and effectiveness of the teaching materials made to train students' creativity.

METHOD

Research and development is a process or a research step used to produce a product, as well as test the effectiveness of the product (Sugiyono, 2013). Development research in the field of education seeks to create products that are useful and can help improve the quality of education. The creation of these products can be in the form of preparing learning models, learning media, textbooks or practical materials or software that can help improve the quality of learning (Prasetyo, 2015). According to (Waryoto, 2016). there are several development research models, one model that can be used in a development research is the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation). Stages of the ADDIE model development procedure.

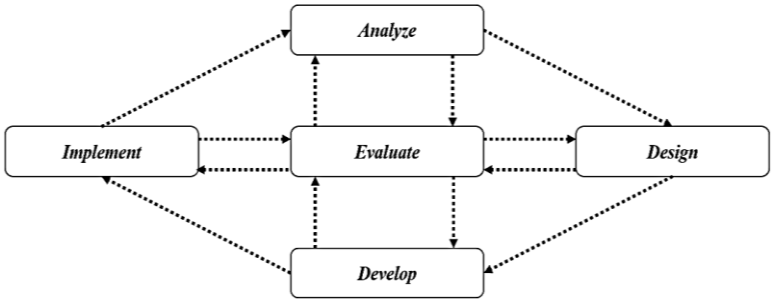

Figure 1. ADDIE development model (Anglada, 2007 in (Tegeh et al., 2015)

The subject of this study is impulse and momentum teaching materials with the inquiry-discovery learning model to train students' creativity. The object of research is the feasibility of teaching materials on impulse and momentum with the inquiry-discovery learning model to train students' creativity. The test subjects in this study were students of class X MIPA 1 at SMAN 12 Banjarmasin for the 2021/2022 academic year. Data collection techniques in the form of validation, observation, and tests. Validation was carried out by 2 academics and 1 practitioner using validation sheets. Observations were made on the characteristics of the observations, namely the implementation of the lesson plan which was observed by 3 observers with the assessment aspects on the observation sheet of lesson plan implementation to determine the practicality of developing the teaching materials being tested. The field trial design that will be used in this study comes from (Setyosari, 2013) where in this study a one-group pretest-posttest design was used by comparing the results of O_1 and O_2 measurements. The effectiveness of teaching materials is measured by comparing the values of O_1 and O_2. If O_2 is greater than O_1 then the teaching materials developed are effective.

The assessment of the validity of teaching materials was validated by 2 academic experts and 1 practitioner expert with a score range of 1 to 4. Then calculate the average, and then it will be adjusted according to the following Table 1.

Table 1. Criteria for the validity of teaching materials

Interval Determination	Score	Category
$X > \overline{X_I} + 1{,}8 \times sb_i$	$X > 3{,}4$	Very good
$\overline{X_I} + 0{,}6 \times sb_i < X \leq \overline{X_I} + 1{,}8 \times sb_i$	$2{,}8 < X \leq 3{,}4$	Good
$\overline{X_I} - 0{,}6 \times sb_i < X \leq \overline{X_I} + 0{,}6 \times sb_i$	$2{,}2 < X \leq 2{,}8$	Enough
$\overline{X_I} - 1{,}8 \times sb_i < X \leq \overline{X_I} - 0{,}6 \times sb_i$	$1{,}6 < X \leq 2{,}2$	Poor
$X \leq \overline{X_I} - 1{,}8 \times sb_i$	$X \leq 1{,}6$	Very poor

Adaptation (Widoyoko, 2019)

The reliability criteria measured using the Cronbach Alpha test are adjusted according to the following table. The reliability criteria used can be seen in the following table:

Table 2. Reliability Coefficient

Reliability Coefficient	Reliability Criteria
0,80 < r > 1,00	Very good
0, 60 < r ≤ 0,80	Good
0,40 < r ≤ 0,60	Enough
0,20 < r ≤ 0,40	Poor
r ≤ 0,20	Very poor

Adaptation (Arikunto, 2016)

The practicality of the developed teaching materials can be seen from the lesson plan implementation sheet. In this study, data on the practicality of teaching materials included the ease of using teaching materials, the benefits of teaching materials, and the efficiency of learning time when using the developed teaching materials. Then adjusted according to the following Table 3.

Table 3. Criteria for the practicality of learning teaching materials

Interval Determination	Score	Category
$X > \overline{X}_i + 1{,}8\ x\ sb_i$	$X > 3{,}4$	Very good
$\overline{X}_i + 0{,}6\ x\ sb_i < X \leq \overline{X}_i + 1{,}8\ x\ sb_i$	$2{,}8 < X \leq 3{,}4$	Good
$\overline{X}_i - 0{,}6\ x\ sb_i < X \leq \overline{X}_i + 0{,}6\ x\ sb_i$	$2{,}2 < X \leq 2{,}8$	Enough
$\overline{X}_i - 1{,}8\ x\ sb_i < X \leq \overline{X}_i - 0{,}6\ x\ sb_i$	$1{,}6 < X \leq 2{,}2$	Poor
$X > \overline{X}_i - 1{,}8\ x\ sb_i$	$X \leq 1{,}6$	Very poor

Adaptation (Widoyoko, 2016)

The effectiveness of the teaching materials developed is based on the results of the student learning outcomes given in tests (pre-test and post-test). In determining the effectiveness of learning outcomes, it is calculated using the N-gain equation (Normalized-gain). The results of the calculation of the learning outcomes achieved by students are then adjusted to the following assessment criteria: high ≥ 0.7; 0.7 > medium ≥ 0.3, and 0.3 > low (Hake, 1998). The assessment which is the main goal of this study is the assessment of students' creative thinking skills or creativity, which can be calculated using the following equation (Kunandar, 2015).

$$Score = \frac{gain\ score}{maximum\ score} \times 100 \quad (1)$$

The score obtained is then adjusted to the range of categories of students' creative thinking abilities or creativity based on the following creative thinking indicators.

Table 4. Categories of creative thinking indicators

Score	Category
$\langle x \rangle \geq 80$	High
$65 \leq \langle x \rangle < 80$	Medium
$\langle x \rangle < 65$	Low

Adaptation (Mufidah, 2014)

RESULTS AND DISCUSSION

This research succeeded in developing a product, namely teaching materials using the inquiry-discovery learning model to train students' creativity in impulse and momentum material that is valid, practical, and effective so that it is feasible to use. The teaching materials developed are designed according to the characteristics of the impulse and momentum material as well as the characteristics of class X MIPA 1 students at SMAN 12 Banjarmasin. Teaching materials have sub-materials, namely the concept of impulse and momentum, the law of conservation of momentum, and types of collisions. Teaching materials developed include learning implementation plans, teaching materials, student worksheets, and learning achievement tests.

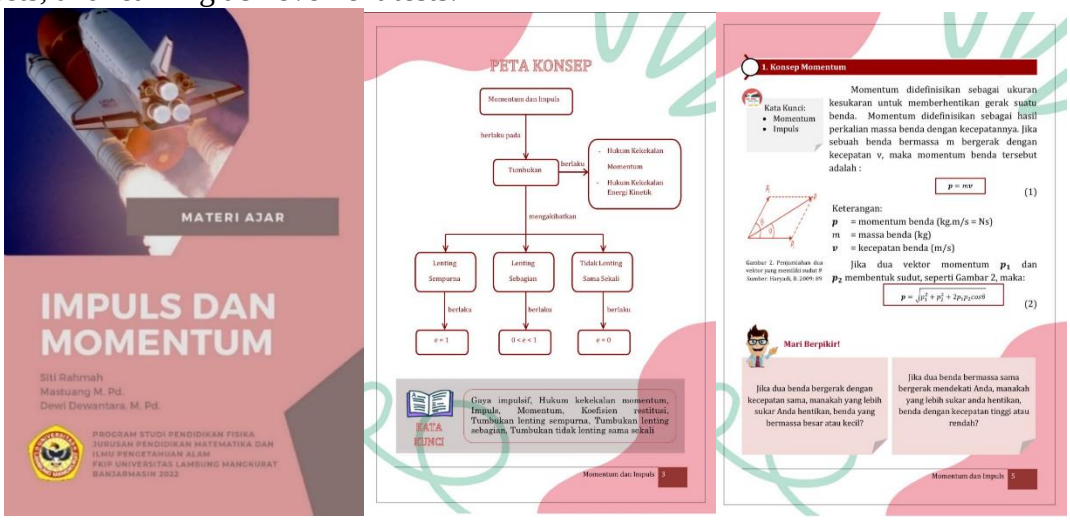

Figure 2. Display of teaching materials

Validation of Teaching Materials

The advantages obtained from the developed teaching materials are that these teaching materials can be used independently by students. Teaching materials have self-instruction characteristics, namely teaching materials developed are able to make students learn themselves (Lilis et al., 2019). This teaching material has been validated by three validators, namely 2 academic experts from physics education lecturers and 1 practitioner from a physics teacher in terms of several aspects. The following is a recapitulation of the validation results of teaching materials.

Table 5. Recapitulation of teaching materials validation results

Validity	Score						Average
	Format	Language	Content	Presentation	Benefit	General Construction	
Lesson plan	3.43	3.53	3.35				3.44
Teaching material	3.22	3.32	3.50	3.61	3.67		3.46
Student worksheet	3.56	3.42	3.37				3.45
Learning outcomes		3.50				3.35	3.42
Overall average							**3.44**
Category							**Very good**

Based on the results of validation by three validators, the teaching materials developed as a whole obtained an average of 3.44 in the very good category. These results indicate that

teaching materials are feasible to use in learning. Teaching materials need a little revision according to the input presented in Table 5 to produce better teaching materials. Teaching materials are developed according to the development stage starting from curriculum analysis, student analysis, and teaching material analysis to the stage of designing teaching materials and several revisions.

Table 6. Results of improving the validation of teaching materials

Components of Teaching Materials	**Improvement Sugestions**	**Before**	**After**
Lesson plan	Be careful in choosing verbs for the learning objectives of measuring and counting have different meanings and learning objectives must be formulated specifically so that they do not have double meanings especially if the meaning is not clear	Have not used the appropriate verbs and have not formulated specific learning objectives	Already using the appropriate verbs and formulating specific learning objectives
Teaching material	Notice that in some parts the text is cut off, the use of symbols is bold and not, add instructions for use and it's better to cover using real illustrations	There are some parts where the text is truncated, the use of symbols is inconsistent, and there are no instructions for use and the cover is used using illustrations that are not real	It has added sections of text that are cut off, has been consistent in the use of symbols, and has added instructions for use and has used real illustrative images for the cover
Student worksheet	LKPD 1 and 2 because they question the relationship between variables, they should be equipped with variable identification, so that in the observation table it is also necessary to add the names and quantities of the control variables above the table and in LKPD 3 the position of the ball and meter should be spaced so that there is no friction between the two and should include pictures/activity plans to make it easier to understand	There is no identification of variables, names and quantities of control variables in the observation table and no experimental design drawings	The identification of variables, names and quantities of control variables have been added to the observation table and an experimental design drawing has been added
Learning outcomes	Revise the statement of learning objectives to be more specific and review the leveling of the questions	The learning objectives are not yet specific and the level of the questions is not appropriate	The learning objectives have been made more specific and the questions have been reviewed according to their level

According to (Prastowo, 2014), good printed teaching material contain material that is structured based on basic competencies (KD) so that students are able to achieve these competencies. In addition, teaching materials have a clear and attractive appearance, the language in them is easy, they are able to test understanding, contains stimulants, is easy to read, and is instructional material. The LKPD assessment is in line with (Prastowo, 2014), that the components contained in the LKPD contain: (1) titles, (2) study instructions, (3) basic competencies/materials, (4) supporting information, and (5) tasks/steps work. In addition, according to Hendro and Jenny in (Pertiwi, 2017) the requirements for good LKPD are: (1) dictactive requirements, namely regulating the use of universal LKPD can be used well for students who are slow or clever and place more emphasis on the process of finding a concept, so that it is expected to prioritize the development of communication skills and aesthetics. (2) constructional requirements, related to the use of language, sentence structure, vocabulary, level of difficulty, and clarity in LKPD. (3) technical requirements emphasize the presentation of LKPD in the form of writing, pictures, and appearance in LKPD.

Practicality of Teaching Materials

The practicality of the teaching materials in this study can be seen from the implementation of the lesson plan, which was conducted in three meetings. The implementation of the RPP was observed and assessed by three observers for each meeting. This RPP activity step consists of an introduction, core activities, and closing. Each meeting has a time allocation of 2 x 45 minutes. The results of calculating the implementation of the RPP can be seen in Table 7.

Table 7. Results of calculating the implementation of the lesson plan

Observational Aspect (Syntax)	**Meeting**					
	1		**2**		**3**	
	Score	**Category**	**Score**	**Category**	**Score**	**Category**
Provide stimulation	3.11	Good	3.56	Very good	3.60	Very good
Formulate the problem	3.67	Very good	3.33	Good	4.00	Very good
Propose a hypothesis	3.67	Very good	4.00	Very good	3.67	Very good
Collecting data	3.33	Good	4.00	Very good	3.83	Very good
Testing hypotheses	3.00	Good	3.00	Good	3.00	Good
Draw a conclusion	3.67	Very good	3.53	Very good	3.67	Very good
Overall Average	3.41	Very good	3.51	Very good	3.63	Very good
Coefficient of Reliability	0.76	High	0.65	High	0.68	High

The results obtained are in line with the opinion of (Alfianika, 2018) which explains that, it can be said to be practical if the teaching materials are easy and can be implemented in learning. The implementation of RPP can be observed in aspects that include all teacher activities during the teaching and learning process, including preliminary, core and closing activities (Safputri et al., 2016). Where, in accordance with the syntax of the inquiry-discovery learning model in its phases, the teacher identifies the availability of content from various learning sources that is relevant to the material discussed, to be studied by students or to formulate several questions related to the content and to be a reference for students in creating their own problems and used in training students' creativity (Kurnia, 2014)

Effectiveness of Teaching Materials

The effectiveness of teaching materials is seen from the N-gain score. Pre-test questions are distributed to students before carrying out teaching and learning activities using the developed teaching materials. The post-test questions were distributed to students after

carrying out teaching and learning activities using the developed teaching materials. An analysis of student learning outcomes can be seen in the following table.

Table 8. Analysis of student learning outcomes

Description	**Pre-test Score**	**Post-test Score**
The lowest score	0,00	48,00
The highest score	7,00	89,00
The average score	4,10	70,45
The number of student completed	0 (0%)	10 (50%)
N-gain	**0,69 (Medium)**	

Table 9. Achievement of creative thinking skills

Creative Thinking Indicators	**The Obtained Result**			
	Before		**After**	
	Score	**Category**	**Score**	**Category**
Smooth thinking	10,50	Poor	80,50	Very good
Flexible thinking	0,00	Poor	73,00	Enough
Original thinking	6,80	Poor	70,00	Enough
Detailed thinking	0,00	Poor	63,57	Poor

Based on the table above, it shows that the teaching materials developed are effective. Effective teaching materials are proven by increasing student learning outcomes. In line with the opinion of (Hake, 1998), the effectiveness of a lesson using the developed learning tools can be seen from the level of success or achievement in using the developed teaching materials, measured using the N-gain score. This increase in students' creativity scores was due to the fact that at each meeting, students were trained to solve problems that demanded creative thinking. Through these exercises, students will get used to working on questions before facing the final test. This is in line with (Nursisto, 2000) who explained that the ability to think creatively will emerge when various efforts or exercises to be creative are carried out. The ability to think creatively is not something that stands alone, or is not merely an advantage one has. This is supported by the results of research (Fatmasari et al., 2021), that increasing students' ability to think creatively in physics material also has an effect when using the inquiry-discovery learning model.

CONCLUSION

Based on the results and discussion above, it was concluded that the teaching material on impulse and momentum using the inquiry-discovery learning model that was developed was feasible for training students' creativity. This is known from the validity assessment which is in the very good category, the practicality is in the very good category, and the effectiveness obtained is in the moderate category, as well as the increase in creativity of the average student in the medium category.

RECOMMENDATION

In future research, it is recommended to combine IDL learning with other learning models that are able to train students' creativity in class, especially in physics learning and better manage learning time with the support of the facilities available at the school.

ACKNOWLEDGMENT

The author would like to thank Universitas Lambung Mangkurat (ULM), the Department of Physics Education ULM and SMAN 12 Banjarmasin for supporting and facilitating this research activity.

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