



## The Effectiveness of Scratch Learning Media Using the PMRI Approach to Improving Students' Learning Outcomes

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### Abstrak

Dalam proses pembelajaran matematika, guru selalu mengusahakan agar materi yang disampaikan dapat dipahami dengan baik oleh siswa, dengan maksud agar tujuan pembelajaran dapat tercapai dengan baik. Penelitian ini bertujuan untuk menganalisis keefektifan media pembelajaran gores dengan pendekatan PMRI dalam meningkatkan hasil belajar siswa. Jenis penelitian yang digunakan adalah penelitian dan pengembangan yang mengacu pada model ADDIE. Tahap pengembangan terdiri dari 3 tahap yaitu tahap pendahuluan, tahap pengembangan, dan tahap pengujian. Instrumen pengumpulan data menggunakan lembar validasi ahli, angket respon siswa dan guru, dan soal tes. Proses keefektifan melalui validasi media pembelajaran gores dengan pendekatan PMRI dan juga mengukur kepraktisan media gores dengan pendekatan PMRI melalui angket respon siswa dan guru, sedangkan keefektifan media pembelajaran gores dengan pendekatan PMRI melalui tes yang diberikan soal. Hasil yang diperoleh menunjukkan bahwa media pembelajaran gores dengan pendekatan PMRI dinyatakan valid dengan skor rata-rata 70,28% dalam kategori valid. Media pembelajaran awal dengan pendekatan PMRI dikatakan praktis dengan skor rata-rata 82,61% dengan kategori sangat praktis. Media pembelajaran gores dengan kriteria efektif dari hasil tes pembelajaran dengan skor 2,1286 > 2,0057 yang berarti hasil belajar dengan menggunakan media pembelajaran gores dengan pendekatan PMRI lebih baik daripada hasil belajar tanpa menggunakan media pembelajaran gores dengan pendekatan PMRI, sehingga media pembelajaran gores dengan pendekatan PMRI efektif dalam meningkatkan hasil belajar.

**Kata Kunci:** Media Pembelajaran Scratch, Hasil Belajar, PMRI.

### Abstract

In the process of learning mathematics, the teacher always strives for the material presented to be well understood by students, with the intention that the objectives of learning can be achieved properly. This study aimed to analyze the effectiveness of scratch learning media with the PMRI approach in improving student learning outcomes. The type of research used was research and development referring to the ADDIE model. The development stage consists of 3 stages: preliminary stage, development stage, and testing stage. The data collection instrument used expert validation sheets, student and teacher response questionnaires, and test questions. The process of effectiveness through validation on scratch learning media with the PMRI approach and also measuring the practicality of scratch media with the PMRI approach through student and teacher response questionnaires, while the effectiveness of scratch learning media with the PMRI approach through the test given questions. The results obtained showed that the scratch learning media with the PMRI approach is declared valid with an average score of 70.28% in the valid category. Scratch learning media with the PMRI approach was said to be practical with an average score of 82.61% in the very practical category. Scratch learning media with effective criteria from learning test results with a score of 2.1286 > 2.0057 which meant learning outcomes using scratch learning media with the PMRI approach were better than learning outcomes without using scratch learning media with the PMRI approach, so that scratch learning media with the PMRI approach was effective in improving learning outcomes.

**Keywords:** Scratch Learning Media, Learning Outcomes, PMRI.

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## 1. INTRODUCTION

Fast development technology computer has felt in various sector lives not only one in sector education. Technology computer which develop in sector education very utilized as source learning is everything something which can utilized for learn something learning and learning experience in accordance with the desired goals (Sjahrudin et al., 2022; Suraweera et al., 2018). Education has an important role for human survival, with exists education man

can overcome problem life Which faced Now or later, through education a person can develop the potential of knowledge that he has. One that can be developed within the potential of knowledge possessed in each educational program is mathematics. This is supported by the opinion which argues that mathematics is one science which can improve the ability to think, argue, and give contribution in settlement problem daily (Solikah & Novita, 2022).

In the process of learning mathematics, the teacher always strives for the material presented to be well understood by students, with the intention that the objectives of learning can be achieved properly (Astriyani & Zahra, 2021; Rahmawati & Permata, 2018). This goal can be achieved if the teacher can manage the course of learning mathematics well. In addition to the teacher having to make efforts so that the material presented can be well received, students have problems when learning mathematics. Based on the results of interviews with teachers, it was stated that some students made mathematics a difficult subject so that many of the students had low learning outcomes. This statement is reinforced by the average value of daily tests, especially in the material for the flat side of the prism. Lack of students' understanding of the material taught by the teacher, students often even feel they forget is also a factor that makes student scores low (Rahmawati et al., 2021; Rohaeti & Bernard, 2018). Mathematics learning problems experienced by students because students do not understand the concepts that have been studied. The lack of students' level of understanding is because mathematics is a subject that is axiomatic and abstract deductive in nature, making it difficult to understand.

In addition to material that was difficult to understand, the results of the interviews also added that the learning process was still carried out teacher-centered, even though it was known that the school had established the 2013 curriculum in which the learning process had to be student-centered, while the teacher was only a complement. In addition, the method used is still lectures and only using printed books in schools as learning resources. This is due to the lack of teacher creativity in managing learning and there are no math teachers who want to try to take advantage of the times, which results in not only low learning outcomes, but also results in learning that feels boring and does not interest students in learning. One of the factors causing student learning outcomes to decrease is due to the teacher's method which is not attractive to students (Sa'ida, 2021; Tasya & Abadi, 2019). The implementation of learning must be carried out interactively, inspiring, and can motivate students to be able to play an active role. So, teachers must choose learning media that can attract student interest and can improve learning outcomes. However, in reality at school there are still many teachers who have not utilized existing facilities such as computers at school and also smartphones for learning purposes (Fitriarningsih et al., 2023; Vargo et al., 2003).

Based on the problems above, to minimize what is faced, it is necessary to update the learning process, teachers can use new innovations in learning mathematics that are not the same as learning in general, by using computers. Computer give chance on learners to present inputs Which in response computer or vice versa. The next process response can be used as new stimulus so that further responses are possible strengthens memory learners about draft which presented. One of the learning media that can be used is scratch. Scratch is a visual programming language learning environment that allows beginners, teachers, students, or parents to learn to program without having to think about program line syntax. Scratch really helps students to think creatively and systematically (Nuraenahfisah & Toheri, 2013; Skaraki et al., 2018). Previous study state that Scratch has advantages as following: (1) Scratch has a small size compared to other programming languages. (2) Deliver advance (interfaces) which very simple and easy used for children. (3) Children more easy Study logic programming without must complicated with writing. (4) Syntax in Language programming on generally. (5) Scratch helped children in make story interactive, animation and games.

(6) Scratch allows everyone easily combine picture, voice nor videos. (7) Without must own ability special in field programming. (8) Animation can formed, run And controlled (Nuraenahfisah & Toheri, 2013).

In addition, a learning media is needed to support learning effective, a learning approach is needed. Realistic Mathematics Education Approach Indonesia (PMRI) is a related approach to learning mathematics with life daily man. Apart from being associated with everyday life, PMRI is more directed at student learning activities (Faot & Amin, 2020; Khotimah et al., 2020). The teacher's role in this approach is only as a facilitator or moderator, while students as centers in active learning to think. Learning by using instructional media is expected to support students' learning outcomes in learning mathematics (Agustiningsih, 2015; Ivanović et al., 2013). This learning media can be used in learning because it is effective in improving student learning outcomes in accordance with the results of research that has been conducted by previous study as well as using the PMRI approach can make students the center of learning so that varied learning occurs (Sodik, 2018). Learning media designed and developed in accordance with the conditions of the learning activities encountered. The use of learning media with the PMRI approach can make students excited about learning and explore their abilities in learning mathematics. The aim of this study is to analyze the effectiveness of scratch learning media with the PMRI approach in improving student learning outcomes.

## 2. METHODS

The research used was a type of research and development. Development research is research conducted to improve existing products or produce new products that can be accounted. Research and development is also a process of developing educational tools which is carried out through a series of research using various methods in a cycle that passes through various stages (Zainal, 2012). The development method used is the ADDIE development method. The ADDIE development procedure includes: (a) Analysis, the analysis phase is carried out by needs analysis and literature study. (b) Design, there are stages of theoretical preparation. (c) Development, prototype preparation stage. (d) Implementation, there is a small class product trial stage. (e) Evaluation, there is a large class trial stage of scratch learning media (Lee, William & Owens, 2004).

The research was conducted at Fatumfaun State Middle School using a control class as well as an experimental class. Data was collected through interviews, observations, expert validation sheets, student and teacher response questionnaires, and test questions. Interviews and observations were conducted with class teachers to find out problems in the school environment and learning in class. The validation sheet is used to measure the validity of the media before being tested.

Student and teacher response questionnaires were used to assess practicality while test questions in the form of pretest and posttest were used to measure the effectiveness of scratch learning media with the PMRI approach in improving student learning outcomes on prisma material (Khairani & Febrianal, 2016b). Data for testing the effectiveness of learning media were obtained from the results of the pretest and posttest, the values obtained were then analyzed using the normality test, homogeneity test, balance test and t test on the hypothesis using the excel program.

### 3. RESULTS AND DISCUSSION

#### Result

##### *Preliminary Study Results*

The results of the preliminary study through needs analysis and literature study. In the needs analysis obtained from the results of interviews and observations, mathematics learning which is still teacher-centered, only using textbooks and also self-made teaching materials whose final results can be seen from unsatisfactory test scores. In addition to the results of the needs analysis, a literature study was carried out which functions to determine the need for learning media, materials and indicators of the material to be studied.

##### *Product Development*

Activities carried out at the development stage include the preparation of theoretical products, preparation of prototypes, and trials of scratch mathematics learning media products with the PMRI approach. The design stage is ADDIE development model. The design stage is the stage carried out to design the media which is the most important stage in making media. The activities carried out are the preparation of theoretical products including scratch learning media with the PMRI approach. The selection of media and approaches is adapted to the needs of students during the learning process; learning using scratch media is associated with the characteristics of PMRI by using interactive computers, laptops, and cellphones. At this stage the results of the design that has been made on scratch have been applied. Making scratch learning media with the PMRI approach is show in [Figure 1](#).

[Figure 1](#) displayed the title of the learning media developed. In this section there is a "start" button that is used to display the main menu section. Besides the "start" button, there is also a "music" button which is used to turn the music on and off. Menu section is show in [Figure 2](#).

[Figure 2](#) contained 6 sections that will be displayed on the media scratch learning includes "basic competencies and indicators", "learning objectives", "materials", "quizzes", "profiles", and "instructions. In this section there is a button that if pressed will return to the opening section. Competence base and indicator is show in [Figure 3](#).



**Figure 1.** Opening Section



**Figure 2.** Menu Section



**Figure 3.** Competence Base and Indicator

Figure 3 displayed the basic competencies and indicators will achieve student on material prism Which will studied. Learning objective is show in Figure 4. Figure 4 displayed the learning objectives will achieved student on material prism which will studied. The instruction is show in Figure 5. Figure 5 displayed learning instructions based on PMRI characteristics. Then the material is show in Figure 6. Figure 6 displayed the choice of material according to the indicators that will be discussed. If one of the "material" buttons is pressed it will display learning materials which will studied. Quiz section is show in Figure 7. Figure 7 displayed a column which addressed for student fill in identity. Furthermore, students can press the "start" button in order start do question quiz which amount 10 question. Question which done in the form of multiple choice. If one obscene is pressed it will automatically proceed to the next question and will show the provisional score. In section end from part quiz will displayed identity student which has work on the questions, the final score obtained, and the report to results which obtained. If student want to do repeat question the so student can press knob "play again". The profile is show in Figure 8. Figure 8 displays displayed identity from developer media learning scratch with the PMRI approach material class VIII junior high school prism.



Figure 4. Learning Objectives



Figure 5. Instructions



Figure 6. Material

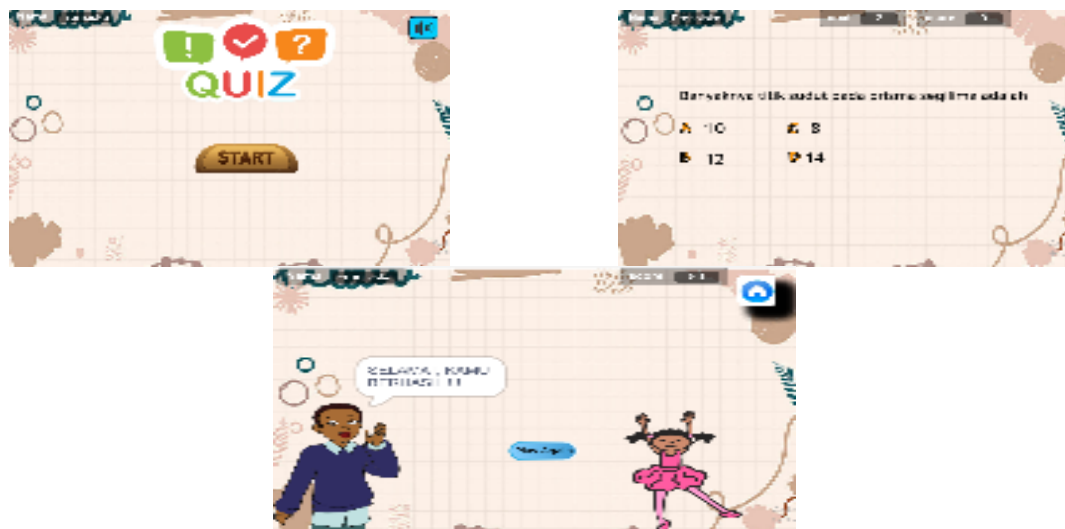


Figure 7. Quiz





Figure 8. Profile

### Expert Validation Results

The validation results from media experts and material experts stated that the scratch learning media with the PMRI prisma approach was valid for testing. The validation results are in Table 1.

Table 1. The Validation Results of Scratch Learning Media by Experts

Aspect	Expert	Score	Ket
Media	Expert 1	79.67%	Valid
Material	Expert 2	68.3%	Valid
	Expert 3	62.88%	Valid
<b>Average</b>		<b>70.28%</b>	<b>Valid</b>

Based on the average results of the three validators in Table 1, the scratch learning media with the PMRI approach is said to be valid according to the interval guidelines. Interval score is show in Table 2.

Table 2. Interval Score Validation of Scratch Learning Media by Experts

Score	Category
$80 < P \leq 100$	Very Valid
$60 < P \leq 80$	Valid
$40 < P \leq 60$	Valid Enough
$20 < P \leq 40$	Invalid
$\bar{P} \leq 20$	Invalid

### Product Trials

Product trials are the implementation stage of the ADDIE development model. The trials carried out in this study were trials of scratch learning media in small classes. This trial was carried out after the scratch learning media was declared valid by the validator. At this trial stage, the researcher explained in outline the scratch learning media. After that, the researcher gave a response questionnaire to 6 students and 2 math teachers. The average percentage results obtained from student and teacher response questionnaires were 78.09% and 87.14% which were in the very good category. These results are in Table 3.

Table 3. Results Questionnaire Response Student and Teacher

No.	Instruments	Mark	Category
1	Student response questionnaire	78.09%	Very Practical
2	Teacher response questionnaire	87.14%	Very Practical
<b>Average</b>		<b>82.61%</b>	<b>Very Practical</b>

Base on Table 3, so from second score the state media learning practical scratch. For used according to the score interval. Questionnaire score intervals is show in Table 4.

**Table 4. Questionnaire Score Intervals Response Student and Teacher**

Score	Category
$80 < P \leq 100$	Very Practical
$60 < P \leq 80$	Practical
$40 < P \leq 60$	Pretty Practical
$20 < P \leq 40$	Less Practical
$\bar{P} \leq 20$	Impractical

### Product Testing

Product testing is an evaluation stage in the ADDIE development model. Before calculating the effectiveness of scratch learning media by testing the hypothesis, first carry out a prerequisite test including a normality test, homogeneity test, and also a balance test. Pretest normality test for the experimental class and the control class, the data shown in Table 5 was obtained.

**Table 5. Pretest Normality Data Test Results**

Class	L count	Critical Area	Test Decision
Experiment	0.168	$\{L L > 0,173\}$	H <sub>0</sub> accepted _
Control	0.154	$\{L L > 0,161\}$	H <sub>0</sub> accepted _

Based on Table 5, it can be said that both the experimental class and the control class have normally distributed data. Posttest normality test for the experimental class and the control class, the data shown in Table 6 was obtained.

**Table 6. Posttest Normality Data Test Results**

Class	L count	Critical Area	Test Decision
Experiment	0.167	$\{L L > 0,173\}$	H <sub>0</sub> accepted _
Control	0.158	$\{L L > 0,161\}$	H <sub>0</sub> accepted _

Based on these data as show in Table 6, it can be said that both the experimental class and the control class have normally distributed data. Pretest homogeneity testing of the experimental class and control class, the data is shown in Table 7.

**Table 7. Pretest Homogeneity Data Test Results**

Data	dk quantifier	dk denominator	$\alpha$	F count	F table	Test Decision
Pretest	24	29	0.05	1.57	1.90	H <sub>0</sub> Accepted

Based on Table 7, it can be said that both the experimental class and the control class have homogeneous data. Posttest homogeneity test of the experimental class and the control class, the data shown in Table 8 was obtained.

**Table 8. Posttest Homogeneity Data Test Results**

Data	dk quantifier	dk denominator	$\alpha$	F count	F table	Test Decision
Postets	29	24	0.05	1.08	1.94	H <sub>0</sub> Accepted

Based on Table 8, it can be said that both the experimental class and the control class have homogeneous data. After the requirements have been met, a hypothesis test regarding the two means can be carried out to find out whether the pretest  $t$  values of the control class and the experimental class are balanced or not. From the test results of the two pretest average values, the results are obtained in Table 9.

**Table 9. Balance Data Test Results**

Data	$t_{obs}$	Critical Area	Test Decision
Pretest	0.6284	$\{ t  < -2,00575 \text{ atau } t > 2,00575\}$	H0 accepted

Based on Table 9, it can be said that the pretest scores of the experimental class and control class are balanced.

### Hypothesis testing

Based on the prerequisite test that had been carried out, it was obtained that the sample came from a normally distributed population, the two populations were homogeneous and the two populations were balanced. After that, a hypothesis test was carried out to determine the effectiveness of scratch mathematics learning media with the PMRI approach. The statistical test used was the one-tailed  $t$  test. The data obtained was shown in Table 10.

**Table 10. Hypothesis Results**

Data	$t_{obs}$	Critical Area	Test Decision
Postets	2.12860	$\{ t  > 2.00575\}$	H1 accepted

Based on Table 10, the posttest scores of the experimental class and the control class obtained  $t_{obs}$  were 2.12860 and  $DK = \{|t| > 2,00575\}$ . From these results it can be seen that  $t_{obs} \in DK$ , then the test decision  $H_1$  is accepted. From these results it can be concluded that the average learning outcomes of the experimental class were better than the average learning outcomes of the control class, so that the learning media for scratch mathematics fulfilled the aspect of effectiveness.

### Discussions

This research is a type of research and development. The aim of this study was to develop scratch learning media with the PMRI approach on prism material and improve student learning outcomes. The development model used is the ADDIE development model which consists of five stages, analysis, design, development, implementation and evaluation, based on valid, practical and effective criteria (Nasution et al., 2015; Winarni et al., 2022). The results of the preliminary study were the analysis stage of the ADDIE development model. Preliminary study results through needs analysis and literature study. The analysis phase was a stage of gathering information that can be used as a material for making products. Needs analysis was carried out by interviews and also observation with the aim of collecting data and information accurate as supporters in development media so that media Which produced will be in accordance with the requirements required. The results of the interviews and observations were that mathematics learning was still teacher-centered, only using textbooks and self-made teaching materials, the final results of which can be seen from unsatisfactory test scores. In addition to the results of the needs analysis, a literature study was carried out which functions to determine the need for learning media, materials and indicators of the material to be studied.



After the analysis was carried out, the product development process will be carried out. The product development process consists of the preparation of theoretical products, preparation of prototypes, and product trials. The preparation of theoretical products is the design stage of the ADDIE development model. The design stage is carried out to prepare the media and is one of the most important parts (Widyastuti, 2019; Yeh & Tseng, 2019). The purpose of this section is to obtain a theoretical product in the form of designing scratch learning media. The activities carried out are the preparation of theoretical products including scratch learning media with the PMRI approach. The selection of media and approaches is adapted to the needs of students during the learning process, learning using scratch media is associated with the characteristics of PMRI by using interactive computers, laptops, and cellphones.

After the theoretical arrangement has been made, prototype preparation is carried out which is the development stage of the ADDIE development model. At this stage, the design results that have been made on scratch have been applied. After the media has been produced, it will be given to be validated by media expert validators and material experts. Previous study argues that validation is an activity to assess product development rationally by presenting several experts to assess the product being developed (Sugiyono, 2012). From the results of the validation of the media and material, it was obtained that the average score was 70.28% where the score was at intervals  $60 < P \leq 80$  which means scratch learning media with the PMRI prism approach valid and testable.

After the scratch learning media has been validated and declared valid, a product trial is then carried out which is the implementation stage of the ADDIE development model. Trials were conducted in small classes viz the researcher explained in general about the scratch learning media. The trial was carried out with the aim of knowing the practicality of scratch learning media. The practicality of a product was carried out on student response questionnaires and teacher response questionnaires in limited trials (Khairani & Febriana, 2016a; Winatha et al., 2018). The trial was carried out by giving a response questionnaire to 9 students and a mathematics teacher. The average result obtained from the student and teacher response questionnaire was 82.61% which was in the very practical category.

After the scratch learning media was declared valid and practical, product testing is an evaluation stage in the ADDIE development model. Product testing was carried out to determine the effectiveness of scratch learning media. The scratch learning media in this study is said to be effective if there is an increase in student learning outcomes after being studied using the developed media (Kurniawan et al., 2020; Tosun & Mihci, 2020). Effectiveness can be seen from the results of the pretest and posttest in classes taught using the developed media. After obtaining the learning outcomes, calculations will be carried out using the t test to obtain the effectiveness of the developed media. From the results obtained  $t_{count} > t_{table}$  with a value of  $2.1286 > 2.0057$  which means that learning outcomes using scratch learning media with the PMRI approach are better than learning outcomes not using scratch learning media with the PMRI approach.

The effectiveness of learning media makes it easier for students to understand learning material, and the existence of this learning media causes an increase in student learning outcomes in learning. This is of course inseparable from the appearance of the media being developed. Media that is interesting both in terms of material and ease of use will make students more interested in using it and students will be interested in learning the material in it (Krüger & Bodemer, 2022; McCrudden & Rapp, 2017). In addition, interesting media will directly impact student motivation in the learning process. High learning motivation will produce high learning outcomes as well. From the results of existing research, it showed that scratch learning media research with the PMRI approach has succeeded in meeting the criteria of validity, practicality and effectiveness.

Based on the results of the conclusions, several suggestions can be given: 1) for teachers, the results of the development of scratch learning media with the PMRI approach can be used as a learning resource or reference for mathematician prisma. 2) for students, scratch learning media with the PMRI approach can be used as a facility for independent learning and it is hoped that students can understand it. 3) For other researchers, the results of this development can be used as a reference so that they can make learning media according to the needs of the school.

#### 4. CONCLUSION

Scratch learning media with the PMRI approach on prisma material for class VIII students to improve learning outcomes said to be very practical with the average score of student response questionnaires and teacher response questionnaires means category "very practical". Besides that, media learning scratch with the PMRI approach to class VIII student prism material which means that the learning outcomes using scratch learning media with the PMRI approach are better than learning outcomes not using scratch learning media with the PMRI approach.

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