

DEVELOPMENT OF SCRATCH-BASED MATHEMATICS LEARNING MEDIA TO INCREASE STUDENTS' LEARNING MOTIVATION

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ABSTRACT

This research was conducted to respond to the low motivation of students to learn due to the lack of use of technology-based learning media. Based on the results of interviews with teachers at Amanah Junior High School, Tangerang City, not a few students have low motivation to learn. One of the factors is the lack of use of learning media, especially technology-based. Technology can be used in the learning process, one of which is the creation of scratch-based learning media that can increase students' motivation to learn. Scratch-based mathematics learning media is developed by presenting flat side space building materials to produce decent, practical, and effective media in increasing students' learning motivation. This research uses the ADDIE development model and is carried out at Amanah Junior High School, Tangerang City, especially in grade VIII with a total of 30 students. Based on the results of the research, the media developed was declared valid with the results of assessments from material experts of 81% and media experts of 74% with the feasible category. The developed media also received a very good assessment based on the competency test by teachers and students who obtained a percentage score of 82.14% and 83.57% respectively with the category of "very practical". The effectiveness of media in an effort to increase students' learning motivation is considered quite effective, judging from the results of *the N-gain* test which obtained a score of 0.729 and a percentage of 72.94% with the "high" category. Thus, scratch-based mathematics learning media has proven to be feasible, very practical, and quite effective in increasing the learning motivation of junior high school students.

Keywords: mathematics; learning media; *scratch*

ABSTRAK

Penelitian ini dilakukan untuk merespon rendahnya motivasi belajar peserta didik akibat minimnya *penggunaan media pembelajaran berbasis teknologi*. Berdasarkan hasil wawancara dengan guru di SMP Amanah Kota Tangerang bahwa tidak sedikit peserta didik yang memiliki motivasi belajar yang rendah. Salah satu faktornya yaitu minimnya *penggunaan media pembelajaran khususnya berbasis teknologi*. Teknologi dapat dimanfaatkan dalam proses belajar salah satunya yaitu pembuatan media pembelajaran berbasis *scratch* dapat meningkatkan motivasi belajar peserta didik. Media pembelajaran matematika berbasis *scratch* dikembangkan dengan menyajikan materi bangun ruang sisi datar untuk menghasilkan media yang layak, praktis, dan efektif dalam meningkatkan motivasi belajar peserta didik. Penelitian ini menggunakan model pengembangan ADDIE dan dilaksanakan di SMP Amanah Kota Tangerang khususnya pada kelas VIII dengan jumlah 30 peserta didik. Berdasarkan hasil penelitian, media yang dikembangkan dinyatakan valid dengan hasil penilaian dari ahli materi sebesar 81% dan ahli media sebesar 74% dengan kategori layak. Media yang dikembangkan juga mendapat penilaian sangat baik berdasarkan uji keparaktisan oleh guru dan peserta didik yang memperoleh nilai presentase masing-masing 82,14% dan 83,57% dengan kategori "sangat praktis". Efektivitas media dalam upaya peningkatan motivasi belajar peserta didik dinilai cukup efektif, dilihat dari hasil uji *N-gain* yang memperoleh nilai sebesar 0,729 dan persentase

sebesar 72,94% dengan kategori “tinggi”. Dengan demikian, media pembelajaran matematika berbasis *scratch* terbukti layak, sangat praktis, dan cukup efektif dalam meningkatkan motivasi belajar peserta didik sekolah menengah pertama.

Kata kunci: matematika; media pembelajaran; *scratch*



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Introduction

In the world of education, mathematics is one of the subjects taught from elementary school to college. The important role of mathematics is to help each individual in solving problems in daily life (Pratiwi & Bernard, 2021). According to Ayu et al. (2021), one of the challenges in mathematics learning is that students are less responsive to mathematics subjects because they are considered boring, this has an impact on students' lack of motivation to learn. Through motivation, students will be encouraged to learn and can influence the learning process (Komariya et al., 2018). The monotonous learning process and lack of creativity tend to make students passive in the learning process. Therefore, the success of learning is highly dependent on the selection of the right learning media (Nashih, 2024).

Learning media is used as a tool in conveying information from educators to students by encouraging students' feelings, thoughts, and interests in learning (Aulia et al., 2021). Learning media can support students in understanding and applying concepts (Suprihatin et al., 2025). Learning media plays a role in helping educators convey material more clearly, so that it can improve students' understanding of the topics studied. This is supported by the opinion of Yulianisa & Sudihartinih (2022), that learning media is able to make the learning process more effective and interesting, both in terms of the form, type, and tools used which are in line with technological advances which are expected to increase students' motivation to learn. The use of technology can be used to develop learning media that supports 21st-century educational skills in increasing interaction between students through an interactive learning process and students' learning needs can be met (Dewi et al., 2022). One form of learning media that utilizes technology is *scratch*.

Scratch is one of the *platforms* used as an initial introduction to learning programming, and can be used to create educational content and create learning media (Iskrenovic-Momcilovic, 2020). The design produced through *scratch* can create learning media that is tailored to the goals to be achieved in the learning process. According to Sudartinih et al. (2021), the use of *scratch*-based learning media is able to attract students' interest so that students can focus during the learning process. Therefore, the selection of appropriate learning media is one way to encourage increased student learning motivation (Febrita & Ulfah, 2019).

High motivation to learn can encourage students to be more active and consistent in achieving goals (Andeka et al., 2021). Students' enthusiasm for learning tends to increase if they have deep motivation. Therefore, one of the strategies that teachers can do to increase students' learning motivation is to utilize effective learning media (Husna & Supriyadi, 2023). This is in line with the

opinion of Wiyanto & Khabibah (2021) that effective learning media can play a role in increasing students' learning motivation.

The previous research that used the same topic was research from Yulianisa & Sudihartinih (2022) with the title "Development of Mathematics Learning Media for Algebraic Multiplication Materials Based on *Scratch* Applications". The results of the study show that the learning media that has been developed is said to be good judging from the percentage of each indicator, which is 86.2%. However, there is a weakness of this study, namely this research is only developing learning media using *scratch* applications without aiming to improve students' understanding or skills, so the researcher makes a new approach to the previous research, namely by adding the purpose of the development of the media to increase students' motivation to learn.

Based on the results of interviews with mathematics teachers conducted at Amanah Junior High School in Tangerang City, it is known that there are still many students who show a low level of motivation to learn. This condition can be seen during teaching and learning activities, where a number of students do not focus when the teacher is explaining, choosing to chat with classmates, there are still many students who are lazy to do the assignments that have been given, and rarely ask questions during the learning process. Based on the information obtained, students tend to be more active and enthusiastic when the learning process uses technology. This is in line with Hastari & Sari Saraswati (2024) that students have a high enthusiasm for learning, enthusiasm, and are interested in learning if they use technology-based media. Based on the problems that have been described and the conditions that are currently developing and utilizing a lot of technology, so the researcher is interested in conducting research by developing *scratch*-based learning media to increase students' motivation to learn.

Research Methods

Research Design and Model

The development design used is using *Research and Development (R&D)*. The research model in this study, which uses ADDIE, includes the Analysis stage which contains the researcher's analysis of the curriculum and learning needs. The study employed a Research and Development (R&D) method using the ADDIE model, which includes five phases: Analysis, Design, Development, Implementation, and Evaluation (Suprihatin et. al., 2025; Khasanah et. al., 2025). Design which contains an outline of the content of the media and the design of the media, Development which contains the development of mathematics learning media through *the scratch website*, Implementation which contains the implementation of research in the classroom, and Evaluation which contains calculations of the research results. The use of the ADDIE model is because it has stages that describe a systematic approach in instructional development (Arofah & Cahyadi, 2019).

Research Subject

The subjects in this study are 2 media experts and 2 material experts as validators, 1 mathematics teacher, Mrs. Shinta Maemanah, S.Pd, 30 students of class IX as a trial sample, and 30 students of class VIII as a research sample.

Collection Instruments and Techniques

The instruments used in this study were interviews and questionnaires. The questionnaires used include media feasibility questionnaires, media practicality questionnaires, and questionnaires to measure students' learning motivation before and after media use. Data collection techniques are carried out through interviews, filling out questionnaires, and documentation as evidence of research implementation. The type of interview applied is a structured interview conducted with mathematics teachers at Amanah Junior High School in Tangerang City to find information about learning needs. The media feasibility questionnaire was given to two material experts and two media experts with the aim of evaluating the feasibility of the developed media. The practicality questionnaire aims to assess the practicality of media use assessed by teachers and students. Meanwhile, the student learning motivation questionnaire was used to find out changes in the level of students' learning motivation before and after using the media.

Data Analysis Techniques

The assessment of media feasibility, media practicality, and filling out motivational questionnaires before and after media use was carried out using a *likert scale* which has a score range from 1 to 4, where a score of 4 indicates the highest assessment and a score of 1 indicates the lowest assessment. The practicality questionnaire and the learning motivation questionnaire have four answer choices, namely SS (Strongly Agree), S (Agree), KS (Disagree), and TS (Disagree). To find out the growth of students' learning motivation after using the media, it was carried out with *the N-Gain test*.

The percentage results obtained in the questionnaire are categorized as Tables 1, 2, and 3 below to find out the criteria related to the feasibility, practicality, and effectiveness of the media.

Table 1. Learning Media Eligibility Criteria

Percentage	Eligibility Level
$81\% \leq Skor \leq 100\%$	Highly Worth It
$61\% \leq Skor \leq 80\%$	Proper
$41\% \leq Skor \leq 60\%$	Quite Decent
$21\% \leq Skor \leq 40\%$	Not Eligible
$\leq 20\%$	Very Unworthy

Source: (Muhsan et al., 2022)

Table 2. Criteria for Practicality of Learning Media

Interval	Criterion
$81,25\% < Skor \leq 100\%$	Very Practical
$62,50\% < Skor \leq 81,25\%$	Practical
$43,75\% < Skor \leq 62,50\%$	Quite Practical
$25\% < Skor \leq 43,75\%$	Less Practical

Source: (Rahmania et al., 2023)

Table 3. Categories N-gain Effectiveness

No.	Percentage (%)	Criterion
1.	$90\% \leq Skor \leq 100\%$	Highly Effective
2.	$80\% \leq Skor \leq 89\%$	Effective
3.	$65\% \leq Skor \leq 79\%$	Quite Effective
4.	$55\% \leq Skor \leq 64\%$	Less Effective

5. $0\% \leq Skor \leq 54\%$ Ineffective
Source: (Fitra & Maksum, 2021)

Results and Discussion

Analyze

The first step taken in this study was to analyze the curriculum and learning needs at the research site, namely Tangerang City Amanah Junior High School. Based on the results of the interview, it is known that the school tersebut menerapkan kurikulum Independent, so this research is adjusted to the curriculum. In addition, the results of the interviews show that the research can be carried out in grade VII in even semesters with the topic of building a flat-sided room. Based on the needs analysis, information was obtained that teachers still rarely use technology-based learning media. The learning process only uses media such as package books and worksheets, then continues with practice questions to measure students' understanding. The lack of variety of learning media, especially technology-based learning media, causes a decrease in student participation in mathematics learning. This causes students to have low motivation to learn. This is in line with the opinion (Utami et al., 2023) that students' low motivation to learn is caused by the lack of appropriate use of technology-based learning media in the learning process. In addition, it is still found that money students do not pay attention to the teacher's explanations, do not complete assignments on time, and there are students who joke and chat during learning. Information was obtained that students have a tendency to be active and enthusiastic when the learning process uses technology. Based on the analysis that one of the current learning needs is technology-based interactive learning media, which can help students be active in the learning process and can increase learning motivation.

Design

At this stage, the researcher determines the learning method, namely *the Project Based Learning* method with a differentiated learning strategy that uses scratch-based learning media as a learning medium to increase students' learning motivation. This is in line with the opinion of Bulu (2023) that the use of differentiated learning methods can increase students' activeness and motivation to learn. In addition, the researcher also prepares learning objectives that will be used where students can distinguish the elements of building a flat-sided space and can determine the surface area and volume of building a flat-sided space (cubes, beams, prisms, and pyramids). Furthermore, the researcher makes a design of learning media to be developed. The design consists of compiling media concepts and media designs such as the use of elements, displays, and materials that will be used in the creation of scratch-based mathematics learning media to increase students' learning motivation.

Development

At this stage, the researcher begins to develop a media that has been designed based on a *previously designed* flowchart.

Product Development

The first step taken by the researcher was to create a design using *the Canva Studio website*. *This website* is used to design the media to be used, such as the required images, backgrounds, and elements needed in the development of the

media. After the media to be developed has been designed through *the Canva Studio website*, then this media can be directly developed through the *scratch website*.

Initial Views

The learning media starts with a start view that contains the start button, instructions, and settings. This display is also accompanied by an opening background sound that will be heard when the media user starts accessing the media. The initial view can be seen in Figure 1 as follows.



Figure 1. Initial Views

Pengaturan

The settings section contains a button that directs the media user to a profile regarding the profile of the creator of the learning media as well as an explanation of the media. In the profile section of the learning media creator, photos, names, study programs, and universities are displayed. Meanwhile, in the section about learning media, the year the media was created and the purpose of developing the learning media. The settings can be seen in Figure 2 as follows.



Figure 2. Settings

Instructions

Before starting to use learning media, it is recommended to open the instructions section first to make it easier to use media. The display of the instructions can be seen in Figure 3 as follows.



Figure 3. Instructions

Main Menu

After that, users can press the start button to access the main menu which contains learning objectives, learning outcomes, building materials, and practice questions. The main menu display can be seen in Figure 4 as follows.



Figure 4. Main Menu

Learning Outcomes and Objectives Menu

The learning outcomes menu contains competencies that are expected to be achieved in accordance with the material in the learning media. Meanwhile, the learning objectives menu contains objectives that are in line with the learning outcomes in the flat side room building material. The display of the learning outcomes and objectives menu can be seen in Figure 5 as follows.

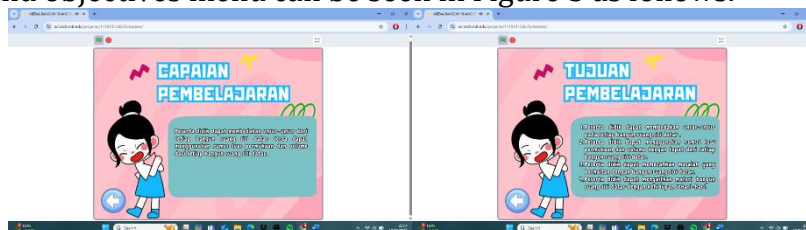


Figure 5. Learning Outcomes and Objectives

Menu of Building Materials

The space building material menu displays four flat-sided space buildings, namely cubes, beams, prisms, and pyramids. This learning media presents complete material that includes lighter questions, definitions, formulas for surface and volume, and sample questions. The display of the flat side space building material menu can be seen in Figure 6 as follows.



Figure 6 Space Building Materials

Practice Question Menu

The practice question menu contains work guides, questions, and displays scores after all questions are completed. In addition, there are congratulations and motivational sentences when media users have completed the practice questions. The display of the practice question menu can be seen in Figure 7 as follows.

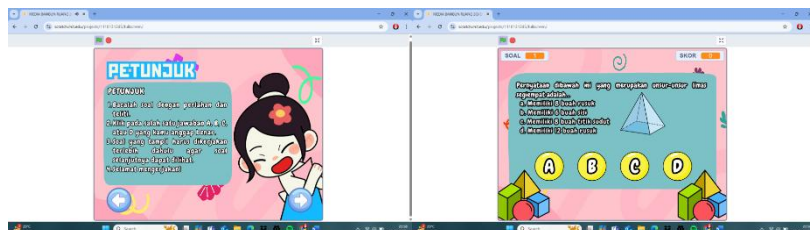




Figure 7. Practice Questions

Validation Stage

The finished product is then assessed for feasibility by examiners, material experts, and media experts, as many as two people each. Assessment by material experts covers aspects of subject matter, content suitability, and language. The results of the feasibility test calculation from the two subject matter experts received a score of 56 out of a total score of 72 with a percentage of 81% in the category of "very feasible". The results can be seen in Table 4 as follows.

Table 4. Media Eligibility Assessment by Material Experts

Material Expert		Aspects	Value	Total Value	Percent
Subject Matter 1		Subject Matter	18	24	75
		Content Suitability	8	8	100
		Language	4	4	100
Subject Matter 2		Subject Matter	17	24	70,83
		Content Suitability	6	8	75
		Language	3	4	75
Overall Value			56	72	81

The assessment by the material expert includes aspects of presentation, appearance, and compatibility. The results of the feasibility test calculation by the two media experts received a score of 108 out of a total score of 146 with a percentage of 74% in the "feasible" category. The following can be seen in Table 5 as follows.

Table 5. Media Eligibility Assessment by Media Members

Media Member	Aspects	Value	Total Value	Percent
Media Member 1	Serving	18	25	72
	Display	26	32	81,25
	Compatibility	13	16	81,25
Media Member 2	Serving	15	25	60
	Display	25	32	78,13
	Compatibility	11	16	68,75
Overall Value		108	146	74

Based on the Table of media feasibility assessment by material experts and media experts, it can be concluded that the developed media is suitable for use for research seen from every aspect assessed by the validator. This is in line with research (Sembring et al., 2022) that scratch-based learning media is suitable for use in research. Rani & Wintarti (2022) stated that scratch-based learning media is suitable for use in learning.

Product Revision

The validated products are then revised based on suggestions from experts. This can be seen in Table 6 as follows.

Table 6. Product Revision

Validator	Suggestion	Revisions made
Material Expert	Sentence improvements in the definition section Addition of lighter questions	Fix sentences in the definition section Provide additional lighter questions on each flat side room build.
Media Member	Add media user activities to be more interactive in using media	Adding a trigger question to each flat side space build

The suggestions and inputs provided by the validator experts are improving sentences in the definition section so that they have an unambiguous meaning and adding media user activities by adding trigger questions to each flat-sided space building.

Trial

The media that has been developed and validated by experts will be tested on 30 students in grade IX of SMP Amanah Tangerang City to find out the students' response whether the media can be used properly and given a learning motivation questionnaire before and after the use of scratch-based learning media for the calculation of validity tests and reliability tests. The trial was carried out by providing a motivational questionnaire before the use of media to students. Furthermore, students are allowed to see the media that has been developed. Then a motivational questionnaire was given after students used scratch-based mathematics learning media. The results of the validity test and the reliability test of the instrument can be seen in Tables 7 and 8 as follows.

Table 7. Validity Test Results

Statement Item	Information
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18	Valid
16	Invalid

Table 8. Reliability Test Results

<i>Cornbach's Alpha</i>	r_{tabel}	Information
0,801	0,361	Reliabel

Based on the validity test Table, 17 items of motivational questionnaire statements were said to be feasible and 1 statement item was said to be inappropriate because the statements were too general to be used as a consideration for increasing students' learning motivation, so question item 16 was not used in the research. The results of the reliability test on the learning motivation questionnaire stated that it was reliable because the *value of Cronbach's Alpha* was greater than the Table, so it was concluded that the learning motivation instrument was reliable and could be used in research.

Implementation

Media that has been developed, validated by experts, and tested is declared feasible for use in research. The use of scratch-based mathematics learning media aims to observe the increase in students' learning motivation during the learning process. The implementation of this media was carried out in grade VIII of Tangerang City Amanah Junior High School consisting of 30 students. The study lasted for one week with two meeting sessions.

At the first meeting, students were given a motivational questionnaire before the use of media. Then students can enter the learning material through scratch-based mathematics learning media. At the second meeting, students were asked to do practice questions in scratch-based learning media. Then group work was carried out by doing project tasks to make a framework for one of the flat-sided rooms. Furthermore, students were given a practicality questionnaire and a learning motivation questionnaire after the use of media. In addition, mathematics teachers were also given a media practicality questionnaire in response to scratch-based mathematics learning media.

Evaluation

At the evaluation stage, a comprehensive assessment was carried out which included the implementation stage, namely by evaluating the results of the media literacy questionnaire filled out by students and mathematics teachers, as well as the results of the students' learning motivation questionnaire before and after using the media. The results of the assessment of the practicality of the media of students and teachers can be seen in Table 9 as follows.

Table 9. Results of Media Practicality Assessment by Students

Indicator	Score	Presentase	Criterion
Ease of Use	202	84,17	Very Practical
Time Effectiveness	202	84,17	Very Practical
Benefits of Use	298	82,78	Very Practical
Total		702	
Presentase		83,57	
Category		Very Practical	

In addition to the results of the assessment of media practicality by students, there is an assessment of media practicality by mathematics teachers presented in Table 10 as follows.

Table 10. Results of Media Practicality Assessment by Teachers

Indicator	Score	Presentase	Criterion
Ease of Use	6	75,00	Very Practical
Time Effectiveness	7	87,50	Very Practical
Benefits of Use	10	83,33	Very Practical
Total		23	
Presentase		82,14	
Category		Very Practical	

Based on Table 10, it was concluded that scratch-based mathematics learning media was "very practical" by getting a score of 83.57% by students and 82.14% by mathematics teachers. Based on each aspect, scratch-based mathematics learning media is said to be "very practical" in terms of ease of use, time effectiveness, and benefits of use. This indicates that scratch-based learning media is easy to use, can be accessed anywhere and has benefits in increasing students' learning motivation. The mathematics teacher of Tangerang City Amanah Junior High School also stated that the media that has been developed by the researcher is very helpful in terms of delivering material and making it easier for teachers in the learning process. This is in line with the research of Khalil & Wardana (2022) that mathematical learning media using *scratch* applications is very practical to use in the learning process. In line with the research of Nurhayati et al. (2023) That scratch-based learning media is very practical to use.

The N-Gain test was also carried out to see an increase in students' learning motivation when using scratch-based mathematics learning media. The test was carried out using a questionnaire on students' learning motivation before and after the use of media. The following are the results of the N-Gain test can be seen in Table 11 as follows.

Table 11. Results of the N-gain Test for Learning Motivation

Information	Score
Average <i>pre-nontest score</i>	45,37
Average <i>post-nontest score</i>	61,87
Score Maximum	68
<i>N-Gain</i>	0,729
Percentage	72,94
Interpretation	Quite Effective

Based on the results of the calculation, the results of the learning motivation questionnaire for grade VIII students of Tangerang City Amanah Junior High School obtained an n-gain score of 0.73 with a percentage of 73%. These results indicate that scratch-based mathematics learning media is quite effective in increasing students' learning motivation. This is in line with the opinion of Bagus Hardiansyah et al. (2023) that the use of *scratch* applications in learning can increase students' motivation to learn. Luthfiyyah et al. (2023) stated that 90

scratch-based learning media can have an influence on increasing student learning motivation. In addition, the increase in students' learning motivation can be seen from the results of observation when the research takes place, namely that many students are more focused and active in learning when the learning process uses scratch-based mathematics learning media. Students are also more enthusiastic in learning and have high enthusiasm when given practice questions listed on scratch-based mathematics learning media.

Conclusion and Suggestion

Based on the research, it can be concluded that scratch-based mathematics learning media to increase students' learning motivation was declared feasible for use in the study with an assessment of 81% by material experts and 74% by media experts. Scratch-based mathematics learning media to increase students' learning motivation was declared practical with an assessment of 83.57% by students and 82.14% by teachers. Scratch-based mathematics learning media is quite effective in increasing the learning motivation of junior high school students with an N-gain value of 0.729 with a percentage of 72.94%. So it can be concluded that scratch-based mathematics learning media can increase the learning motivation of junior high school students.

The suggestion from the researcher for the next research is to develop a scratch-based mathematics learning media by using materials other than building a flat-sided space and adding a sound feature to explain the material in order to maximize the media produced.

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