

DEVELOPMENT OF LEARNING MEDIA FOR SQUARE TOPICS USING SCRATCH PLATFORM FOR GRADE VII

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Abstract

This research aims to develop teaching materials for quadrilateral topics assisted by Scratch with valid, practical, and effective quality based on the stages of geometry skills using the Research and Development (R&D) method. The subject of this study involved a limited trial conducted at Sumur Bandung Junior High School in Cililin, with 10 students from 7th grade. A broader trial was conducted at Sumur Bandung Junior High School in Cililin, with 45 students from 7th grade. The final product was tested at Sumur Bandung Junior High School in Cililin, consisting of two classes: an experimental class (VII-A) and a control class (VII-B), each comprising 22 and 23 students, respectively. Data collection techniques employed were observation, interviews, and documentation. The data analysis involved descriptive statistics and inferential statistics. The instruments used in this study were reasoning ability tests based on mathematical reasoning indicators and interview questionnaires. The research findings indicated that the use of Scratch-assisted teaching materials had a positive impact, enhancing students' mathematical reasoning ability to an excellent category. Students who learned with the Scratch-assisted materials demonstrated better mathematical reasoning ability compared to those who received conventional instruction. Therefore, the Scratch-assisted teaching materials were considered valid and effective for instructional purposes.

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INTRODUCTION

The students' paradigm towards mathematics as a challenging and less-liked subject is a common misconception. According to Afriansyah (2022), students perceive mathematics as unrelated to their daily lives, resulting in a lack of understanding and misconceptions.

These initial misconceptions persist, leading to repeated misunderstandings (Sopiany & Rahayu, 2019). Such a paradigm can hinder the development of students' mathematical thinking abilities. On the other hand, if students have a correct mindset towards mathematics, they can develop independent learning skills, collaborative abilities, and critical, systematic, logical, and creative thinking. Nurhafsari (2019), states that students' learning attitudes can be measured by their thinking processes, characteristics, and perspectives, such as: 1) analyzing the needs of mathematics learning, formulating goals, and designing learning programs; 2) selecting and applying learning strategies; 3) monitoring and self-evaluating the implemented strategies.

To promote good learning attitudes and habits in students, teachers need to possess proficiency and creativity in delivering materials, such as employing high-quality teaching resources. Quality teaching resources refer to a set of learning tools designed systematically and attractively, encompassing learning materials, methods, limitations, and evaluation techniques, in order to achieve the desired goals and competencies with all their complexities. These resources aim to capture students' interest and motivation to learn. Based on these factors, there is a need for a new breakthrough that can help students understand mathematics, particularly in the topic of quadrilaterals, which many students find confusing. Quadrilaterals are fundamental concepts that students must comprehend as they are closely related to daily life. By studying quadrilaterals, students can solve problems they encounter in everyday situations, such as classifying objects into quadrilateral types and measuring the perimeter and area of various objects like land, fields, and other items. According to Syah & Sofyan (2021), quadrilaterals serve as a prerequisite for students when studying further geometry topics, such as cubes, cuboids, prisms, and pyramids.

Quadrilateral topics are closely connected to geometry. Kriswandari et al (2020), mention that in learning quadrilaterals, students need to acquire geometry skills as they aid in understanding geometry concepts effectively. According to Susanto & Mahmudi (2021), Hoffer proposes five indicators of geometry skills, namely: (1) visual skills, (2) descriptive skills, (3) drawing skills, (4) logical skills, and (5) applied skills.

Given the issues discussed above, a creative solution is required, and one such solution is the use of applications that can facilitate the design of mathematics learning processes. One essential teaching resource for both teachers and students is the Scratch application. Scratch is a new programming language that enables everyone to create interactive stories, games, and animations. According to Scaffidi cited in Satriana (2019), the use of Scratch in education is relatively new. Scratch is easily accessible through the internet and can be operated by beginners when creating programs. Another interesting aspect is highlighted in a study that states using Scratch in mathematics instruction can enhance students' interest in learning (Yulianisa & Sudihartinih, 2022). Scratch has several advantages in the learning process. According to Akhlis et al (2019), Scratch application enhances students' conceptual understanding, engagement, critical thinking, and creativity. Based on the above discussion, the researcher will develop teaching materials assisted by Scratch to enhance students' mathematical reasoning abilities in the topic of quadrilaterals.

METHOD

In this research, the researcher employed the Research and Development (R&D) method with the aim of developing and evaluating the feasibility of teaching materials assisted by Scratch for the topic of quadrilaterals in enhancing the mathematical reasoning abilities of 7th-grade junior high school students. The researcher followed the development stages using the Borg and Gall model Aka (2019), as illustrated in the diagram below:

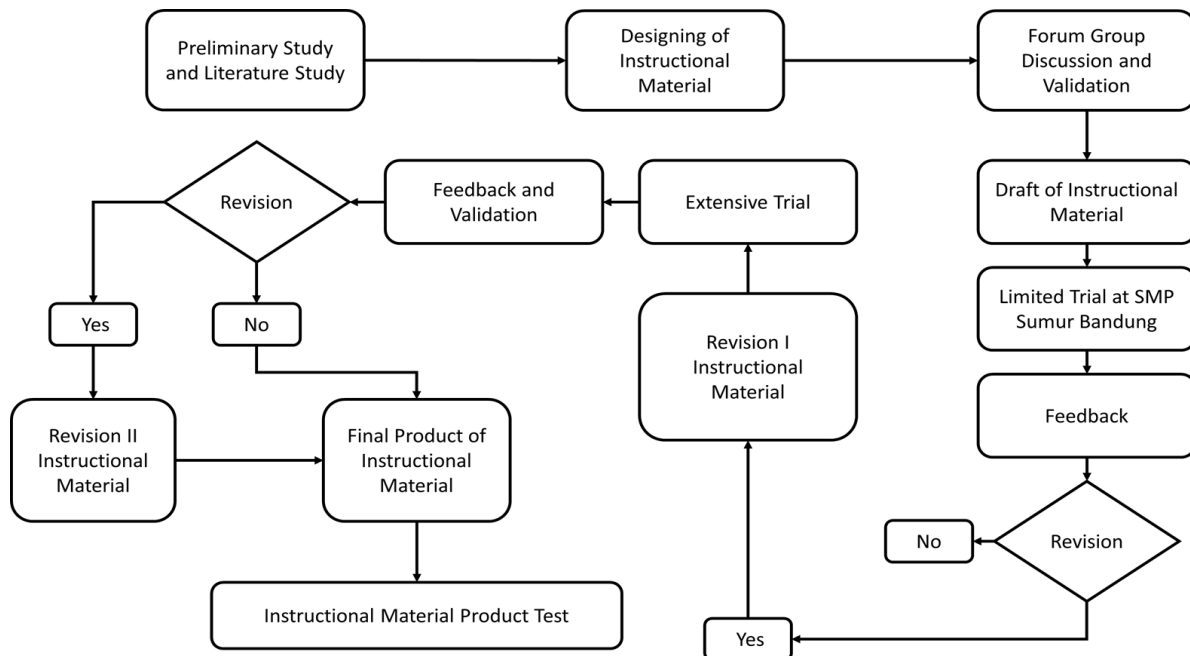


Figure 1. Steps of R&D in the Borg & Gall Model

Preliminary study and literature review, Research and Development (R&D) can begin with the identification of potential and problems in the field, obtained through direct observation or based on existing research reports, to maximize the research to be conducted. Designing teaching materials, after completing the preliminary study with field observations or reviewing research findings that support our research, the next step is to design the instructional material product we will create. Forum group and discussion validation, this focus group discussion (FGD) is conducted to determine the instructional materials that will be created in collaboration with validators, to ensure the development of suitable and effective teaching materials based on usability and effectiveness aspects. Draft of teaching materials, in the draft stage of teaching materials, the product is compiled for the validation of its feasibility and its usability in the field, considering several aspects such as didactic, constructive, and technical aspects.

Limited trial, after validation, the instructional material product can be tested in a limited trial with a selected number of students who have studied the material in the developed teaching materials. Revision 1 of teaching materials, after the limited trial, the researcher can assess the responses of students and practitioners to the teaching materials, and make the first round of revisions to the instructional product.

Extensive trial of teaching materials, following the revision stage, the teaching materials can be used to assess their development based on the responses of students in a larger

trial with a larger number of students, using the same strategy as in the limited trial, testing it on students who have studied the material covered in the teaching materials. Revision 2 of teaching materials, based on the extensive trial, the researcher can identify any remaining shortcomings in order to create the final product. However, if the calculated development and student response criteria are met, the instructional product can be directly tested on students.

Testing the product and final product, in this stage, the product is tested using the final version that has undergone limited and extensive trials. It is tested on students who have not yet studied the material, in order to measure the effectiveness and success of the developed teaching materials. The procedure to be followed by the researcher includes the validation steps for the product. The first validation is conducted by the researcher with expert lecturers, while the second validation of the product is conducted by users of the teaching materials, in this case, mathematics teachers in junior high school and the target audience, namely 7th-grade students.

RESULTS AND DISCUSSION

Preliminary study is the initial stage of research and development of instructional materials. In this stage, the researcher conducts observations and collects data, including variables, using the Student Worksheets (LKPD) as instructional materials in schools. The steps taken by the researcher in this preliminary study are observations and interviews to accurately identify all the problems occurring in the school. Additionally, the researcher aims to gather information about the school's efforts to improve student learning outcomes, conducted by teachers and relevant institutions. The chosen school for this study is Sumur Bandung Cililin Junior High School, which will also serve as the location for further research. The strategic steps taken in this preliminary study will contribute to the main study.

The initial analysis involves interviewing teachers at Sumur Bandung Cililin Junior High School to gain an understanding of the school's situation and conditions, specifically regarding the research and development of instructional materials. The school's facilities are inadequate due to its recent establishment, resulting in the school still being in the developmental stage. The lack of instructional media is due to teachers' limited ability to create effective teaching materials for classroom learning. Some teachers still rely on lecture-based teaching methods for mathematics. There is no use of Student Worksheets (LKS) or the Student Worksheet (LKPD) as teachers solely rely on textbooks. The limited ability of students can be observed from their learning outcomes. Students are not familiar with the use of instructional media in the teaching and learning process.

The analysis of students focuses on the use of Scratch-assisted instructional materials, which is a new approach for them. The development of instructional materials is intended for 7th-grade students in Sumur Bandung Cililin Junior High School, aged between 12 and 15 years. The characteristics of the students analyzed are those of the 2023/2024 academic year. Based on previous daily assessments and teacher evaluations, the students in Class VII A, consisting of 45 students, have an average score below the minimum passing criteria.

The design of instructional materials with Scratch assistance begins with the arrangement of content that aligns with the school's educational competencies and learning objectives.

The use of Scratch as the basis for these instructional materials is in line with the goals of developing the materials. The instructional design includes the preparation of lesson plans (RPP), the creation of test items and non-test instruments. The instructional material draft includes a cover, content, activities, and practice questions. The Scratch-assisted instructional materials consist of main menus, primary selection menus, educational competencies and learning objectives menus, content menus, and practice and quiz menus. These instructional materials are then validated by two expert validators, two ICT experts, and two practitioners. The validation results are presented in the table below:

Table 1. Results of Media Expert and Content Expert Validity

No	Validators	Phase 1		Phase 2	
		Score	Category	Score	Category
1	Expert validator 1	80%	Very valid	84%	Very valid
2	Expert validator 2	62%	Reasonably Valid	88%	Very valid
3	ICT Validator 1	85%	Very valid	90%	Very valid
4	ICT Validator 2	45%	Reasonably Valid	80%	Valid
5	Practitioner 1	76%	Valid	88%	Very valid
6	Practitioner 2	76%	Valid	86%	Very valid
Average Total Score		70,7%	Valid	86%	Very Valid

In the first and second validation stages, there was an improvement as evidenced in Table 1. The overall average score in the first stage was 70,7%, categorized as valid, while in the second stage, it was 86% with a highly valid category. After the first stage validation, the instructional materials were tested with 240 students using a student response questionnaire. The student response results are presented in the table below:

Table 2. Students' Responses to Teaching Materials in the Limited Trial Phase

Score	Number of Responses	Score x Number of Responses
1	5	5
2	55	110
3	76	228
4	104	416
Total	240	699

Table 2 shows that the total score obtained is 699 from 10 students. In this stage, there are several suggestions and inputs, such as changing the layout and replacing unclear images in the student worksheets (LKPD). Therefore, the researcher made some revisions before conducting another test with students through the extensive trial phase. Subsequently, Table 3 below presents the results of student responses during the extensive trial:

Table 3. Students' Responses to Teaching Materials in the Comprehensive Trial Phase

Score	Number of Responses	Score x Number of Responses
1	7	7
2	222	444
3	274	822
4	577	2308
Total	1080	3581

The data obtained in Table 4, the researcher tested this instructional material with 45 kstudents, resulting in a total score of 3581. This means that there was an improvement from stage one to stage two after making revisions to the instructional material. The next stage is the Product Test stage, which was conducted in one classroom with students using a set of teaching aids that were created by the researcher.

Table 4. Students' Learning Achievement Results Based on Geometry Ability Profile

No	Indicatore	Persentase	Category
1	Providing Explanation with Models	80, 18%	Effective
2	Providing Explanation with Models	72, 58%	Effective
3	Creating Analogies	66, 17%	Effective
4	Creating Analogies	68, 70%	Effective
5	Using Patterns to Analyze Mathematical Situations	70, 50%	Effective
6	Drawing Conclusions in Mathematics Education	64, 70%	Effective
Average		70, 48%	Effective

Furthermore, the pretest and posttest scores were compared using a T-test to determine their effectiveness, and the following results were obtained:

Table 5. T-test Result

		Paired Differences					
		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pair 1	Pretest Posttest	-11,463	44	,000	-11,463	44	,000

The T-test results in Table 5 showed a significance value (2-tailed) of 0,000. Based on Table 5, the obtained significance value (2-tailed) is 0,000. If a one-tailed test is desired, the significance value would be halved, resulting in a significance value of 0,000. Since sig. < 0,05, the null hypothesis (H_0) is rejected, indicating that the average posttest score is significantly better than the average pretest score.

The development of instructional materials begins with field analysis. Consequently, preliminary studies and field observations provide alternative means for researchers to analyze the conditions and situations that occur in the field through interviews with mathematics teachers. When researchers obtain information and analyze the preliminary study, concrete steps are taken to design the product to be developed, implementing the first phase in accordance with the development steps outlined by Borg and Gall from

(Saadah et al, 2022). Information gathering, such as potential and problem analysis, is a scientific step that can be taken to empirically determine the strengths and weaknesses in the field for development purposes.

The stage of creating a draft instructional material involves the development of teaching materials, learning tools, and assessment instruments. The process begins with the compilation of content in line with the Core Competencies (KI) and Basic Competencies (KD), followed by designing the content scheme of the Student Worksheets (LKPD) using a scientific approach and including practice questions to enhance understanding of the material. Scientific approach, as one of the teaching approaches, focuses on the application of scientific methods. According to Widiani (2016), scientific methods involve a series of activities such as data collection through observation or experimentation, data processing and analysis, hypothesis formulation, and testing. The scientific approach in learning activities not only develops students' competence in conducting observations or experiments but also cultivates critical and creative thinking skills, encouraging innovation and creativity. The scientific approach can develop students' attitudes, knowledge, and skills. With the advancement of technology and design applications like Canva, the packaging of LKPD can feature high-quality and visually appealing graphics and illustrations, thereby enhancing students' interest and enthusiasm for learning. According to Astria et al (2022), the implementation of the scientific approach in teaching requires the support of appropriate instructional materials.

The researcher proceeds to the stage of creating instructional materials based on Scratch programming, which relates the use of instructional materials to learning. Although instructional materials are only aids in this research, standards and guidelines still need to be adhered to, including the suitability of the media to the content, the utility of the media for learning, and the effectiveness of their use. The creation of these instructional media using the BASIC (Beginners All-purpose Symbolic Instruction Code) programming language facilitates the researcher, as it works on top of other applications. Eventually, the development needs, such as instructional materials, Scratch media, and other learning tools, are satisfactorily met in accordance with clear rules.

All developed instructional products are tested extensively before being widely used in school learning. Therefore, the validity of the developed instructional materials is evaluated by lecturers from IKIP Siliwangi and practitioners or mathematics teachers in accordance with their respective fields and competency criteria. This stage and implementation align with Numan (2019), recommending that the validation process involving expert validators is crucial to determine the appropriateness of instructional materials for use. Hence, a two-stage validation process with the same validators and assessment indicators is conducted. This is done to gauge the progress of the LKPD instructional material product. In the first validation stage, the LKPD under development receives a valid category, indicating that the Scratch-assisted instructional materials are suitable for use with minor revisions. Therefore, the researcher tests this instructional material product through a limited trial and revises it based on feedback and suggestions. In the strategic steps taken, the second validation stage involves the second round of revisions and a limited trial. In this second validation stage, the validator's assessment of the revised instructional material product and its trial yields positive results, indicating a significant improvement in the assessment of the instructional material.

This can be seen from the progression of the first to the second validation stage, resulting in an overall assessment that the instructional material is highly valid or suitable for implementation in classroom learning. The appropriateness

of the instructional material can also be directly observed from the students' responses during two separate meetings with different sample participants. When using the instructional material and Scratch media, the students expressed interest due to the novelty factor, making mathematics lessons less monotonous and tedious. This aligns with R & Susanti (2019), explanation that direct field trials are essential to assess the suitability of the instructional material under development based on student responses.

After determining that the instructional material developed by the researcher is suitable and can be implemented in learning, a trial is conducted with students who have not yet learned about quadrilaterals. This trial aims to assess the effectiveness of the instructional material in the learning process. Therefore, all learning tools, including the instructional material, instructional media, and assessment instruments, are prepared for this trial. The trial is carried out over eight sessions according to the planned learning implementation, which has been consulted with the validator.

As in the limited and extensive trials, the students responded positively to the use of the instructional material and Scratch media, and they were able to follow the instructions provided in the LKPD, which integrated the grand design of the scientific approach, starting from observing the presented problems, questioning the context of the problems, attempting solution practices using Scratch media integrated into the LKPD, and finally, communicating or summarizing. After conducting the learning process according to the carefully prepared methods, approaches, and tools, the final session involves a test to evaluate the effectiveness of the learning process using the instructional material. This test assesses the students' mathematical reasoning skills and aims to measure the impact of the instructional material on their learning outcomes (Maskar et al., 2020). With above-average results from the effectiveness test, it can be concluded that the instructional material used is effective.

CONCLUSION

Based on the findings and discussion of this conducted research, the following conclusions can be drawn. It is noteworthy that the effectiveness test results indicate that students are still categorized as low in the indicator of checking results and processes. The analysis reveals that students feel deceived by the presented questions, and many of them are unable to accurately check the results or processes of the given problems. Additionally, in the indicator of completing plans, most students are able to create correct plans but are still unable to produce correct outcomes or create complete plans. However, in the end, it can be stated that the use of this instructional material is effective for learning.

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