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THE EFFECTIVENESS OF SCRATCH ASSISTED GAME-BASED DISCOVERY LEARNING TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY

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ABSTRACT

The low mathematical problem-solving ability of students in algebraic form served as the background for this research. The objectives were to describe the effectiveness of a game-based discovery learning model using the Scratch application in enhancing students' mathematical problem-solving abilities and to analyze students' challenges in implementing learning through game-based discovery learning using the Scratch application in algebraic form. The research employed a mixed methods approach with an explanatory design and a single-group pretest-posttest design. The subjects consisted of 32 Grade VII-A students from SMP Negeri 1 Batujajar. Instruments used included test questions and student response questionnaires. Data analysis techniques included prerequisite analysis and hypothesis testing. The results showed that the game-based discovery learning model using the Scratch application was effective in improving students' mathematical problem-solving abilities, with a percentage of 62.69%. This was proved through the average n-gain obtained by students, which was 0.64, and the results of the one-sample t-test on N-Gain showed a significant value at (2-tailed) = 0.000. These test results indicate that students' mathematical problem-solving abilities were in the moderate category, indicating a difference in the mean N-Gain of students' mathematical problem-solving abilities using game-based discovery learning through the Scratch application. Several challenges were identified that students faced during learning using game-based discovery learning through the Scratch application, including understanding the material, using the Scratch application itself, and fostering student cooperation throughout the learning process.

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INTRODUCTION

Problem-solving is a fundamental cognitive skill that students can learn and develop. Mastery in mathematical problem-solving enables them to address real-world issues after completing formal education. Mathematical problem-solving abilities are considered a primary goal of mathematics education in schools in most industrialized nations. Students with strong

mathematical problem-solving skills are expected to contribute to the economic progress of their countries (Amam, 2017).

According to Matlin (Ngongo & Efendi, 2021) problem-solving is employed when aiming to achieve specific goals but uncertain about how to accomplish them. In other words, when students are trained to solve particular problems, they become skilled in providing relevant information, interpreting information, and understanding the importance of reviewing their results. Teaching students problem-solving skills can lead them to become more attentive and creative in addressing challenges encountered in daily life.

According to Mayer (Murdiana, 2015) teaching problem-solving to students is more important than simply providing routine problems that only involve a cognitive connection with predetermined solution techniques. Problem-solving is a high-level cognitive (meta-cognitive) skill that involves not only knowledge, understanding, and application but also analysis and synthesis. Therefore, problem-solving provides the following benefits: (1) Enhancing students' knowledge of the material learned, (2) Improving students' ability to apply what they have learned in various real-world situations, (3) Enhancing the ability to evaluate a problem by breaking it down into manageable parts, (4) Improving the ability to synthesize an argument in a way that produces meaningful unity (proof), (5) Enhancing language and logical intelligence, (6) Improving knowledge transfer skills, (7) Ensuring previously taught material is not quickly forgotten, (8) Establishing a connection between instructional material and real-world issues students face, thereby encouraging learning, and (9) Fostering a positive attitude towards and appreciation for mathematics among students.

According to Kharisma & Asman Aslim (2018), there are several issues related to the mathematical problem-solving abilities of students in Indonesia, including: (1) not all mathematics problems are mathematical problem-solving tasks; (2) the problem-solving abilities of students remain limited; and (3) the learning processes that could guide and train students in problem-solving do not receive adequate attention. Based on the findings of Sumartini (2016), the performance of vocational high school students in mathematics remains generally low, particularly in terms of problem-solving abilities. The data shows that as many as 73% of students still have relatively poor problem-solving skills. Based on the research by Zeni Rofiqoh (Anggraini & Lestari, 2022) problem-solving remains a challenging process for students, particularly in the planning stage, which results in not all problems being effectively solved. This aligns with the findings of Handayani & Munandar (2023) which categorize the average mathematical problem-solving abilities of eighth-grade students in algebra as low, with a score percentage of 32.25%. Meanwhile, the research results by Soniawati (2022) indicate that the subjects studied still exhibit low abilities in problem-solving. The underlying cause of these low problem-solving abilities often lies in teachers not having enough time to review the necessary skills with students, which significantly impacts student performance. These barriers lead to students finding it very challenging to solve problems presented by their teachers due to being accustomed to teacher-centered classrooms and not being accustomed to answering their own questions.

The low mathematical problem-solving abilities of students can be observed from the results of TIMSS (Trends in International Mathematics and Science Study) in 2018. Indonesia's scores in several participations have consistently been below the average score set at or below 500. PISA (Program for International Student Assessment) scores are one method for measuring students' mathematical problem-solving abilities. The results of the 2022 PISA, revealed on December 5, 2023, show that 82 percent of 15-year-old Indonesian students do not understand

mathematics, scoring at level 2 or lower compared to levels 5 or 6. A similar issue is observed in the results of the mathematical problem-solving ability assessment for eighth-grade students at SMPN 1 Batujajar during the second semester of the 2023/2024 academic year in the subject of algebra. The results indicate a student mastery percentage from the average score of mathematical problem-solving ability tests at 62.34%. This is detailed in the following Table 1:

Table 1. Recapitulation of Completion of Indicators of Students' Mathematical Problem-Solving Abilities

No	Indicator	Percentage
1	Understanding the problem	67,06 %
2	Making a problem-solving plan	63,09 %
3	Executing calculations	61,18 %
4	Reviewing the solutions	58,04 %
	Average	62,34 %

According to the criteria at SMP Negeri 1 Batujajar, the Minimum Passing Criteria (Kriteria Ketuntasan Minimal, KKM) for mathematics is 75. Based on Table 1, the test results for the mathematical problem-solving skills instrument for eighth-grade students at SMP Negeri 1 Batujajar show that many have not yet reached the KKM. To address this challenge, adjustments must be made in mathematics education.

Many interconnected factors influence students' mathematical problem-solving abilities, especially those involving higher-level thinking. These factors can originate from within the student (internal) as well as from external sources. Internal factors include inadequate mastery of the taught material, reluctance to ask questions to the teacher, and a lack of initiative to seek help from peers who may understand better. External factors include teaching techniques employed by teachers, the level of difficulty of tests used, and an unsupportive learning environment (Sriwahyuni & Maryati, 2022).

Current educational approaches require active student involvement to test their understanding, rather than merely presenting information to them. Guided discovery learning is one method that enhances students' mathematical problem-solving capabilities. This teaching method aids students in developing their problem-solving skills, uncovering mathematical patterns and structures through teacher-led group discussions. The guided discovery model also encourages active participation in learning, with the teacher acting as a facilitator. Discovery Learning is expected to provide solutions to these challenges (Bakara, 2022). According to Akbar & Ulya (2022), the advantages of the Discovery Learning model include: 1) assisting students in developing, preparing, and mastering skills during the learning process; 2) students receive highly personal information that remains deeply ingrained in them; 3) motivating students to learn; 4) allowing students to grow and excel based on their abilities; and 5) strengthening and enhancing students' self-confidence.

The game-based Discovery Learning model has been proven to enhance students' mathematical problem-solving abilities, consistent with the research results by Maimunah & Sulistyorini (2022), which indicate that students participating in mathematics learning activities using Teams Game Tournament based on Discovery Learning exhibit strong mathematical problem-solving skills. TGT helps students learn mathematics more effectively, improve their critical and creative thinking abilities, and develop crucial collaboration skills. This aligns with the results by Herawati et al. (2018) demonstrating that the use of Construct 2 games based on Discovery Learning significantly improves students' mathematical problem-solving abilities, as evidenced by significant differences between pretest and posttest results. The use of Construct

2 games in spatial geometry education makes the material easy to understand and delivers it engagingly and uniquely, without requiring complex programming to create.

Generation Z is a generation familiar with electronics such as gadgets or smartphones and games. As we know, young people enjoy games, and Generation Z particularly prefers innovative, beneficial activities, and engaging activities, including learning activities. Game-based learning is a system applied in the educational process where educators can adopt games to cater to cognitive interests and learning motivation (Vusić et al., 2018). Meanwhile, Connoly (Stiller & Schworm, 2019) argues that game-based learning involves using games in an educational context to achieve educational goals. Game-based learning plays a crucial role in influencing student motivation, making students feel happy, more enthusiastic, challenged, and fostering cooperation among peers (Anjani et al., 2016).

Game-based discovery learning is a teaching model that combines educational games with guided discovery approaches to create engaging and effective learning experiences. This approach can be applied in mathematics education using various types of games and activities, thereby catering to the diverse learning needs and interests of students. Therefore, the use of game-based discovery learning is a highly suitable choice for educational media in the current digital era.

Pratiwi & Bernard (2021) argue that Scratch is a programming language designed to illustrate computer programming concepts in a manner understandable to individuals from all backgrounds. The user interface of Scratch is basic and simple, unlike text-based programming languages, educating children about programming logic through visual means. This research builds on previous studies like the one by Bernard & Setiawan (2020), titled "Development of a Mathematics Game Using the Scratch Application," which found positive effects and an improvement in solving mathematical context problems using Scratch, based on a decrease in student difficulty indicators.

Based on the above issues and supported by previous research, the researchers will conduct an experimental study titled “The Effectiveness of Implementing Game-Based Discovery Learning Model Using Scratch to Enhance Students' Mathematical Problem-Solving Abilities”. The focus on algebraic forms in this study stems from the importance of algebra as a prerequisite for advancing to higher-level materials.

METHOD

The method employed in this study was a mixed-methods approach, incorporating both a One Group Pretest-Posttest Design and The Explanatory Sequential Design. In this research, the game-based discovery learning model using the Scratch application was the independent variable, while the mathematical problem-solving ability served as the dependent variable. The population for this study comprised 32 students from SMP Negeri 1 Batujajar. A random selection was made within this population, with class VII-A chosen as the sample**.**

Quantitative data collection techniques involved the use of pretest and posttest items to assess students' mathematical problem-solving abilities. These tests consisted of five descriptive questions on the topic of algebraic forms. The data were then processed using SPSS version 22. Before performing the main analysis, prerequisite tests such as the normality test were conducted; if the data distribution was normal, further analyses with two-sample dependent tests and one-sample t-tests were carried out. Qualitative data were collected through surveys on students' learning challenges and analyzed using descriptive analysis. The indicators of problem-solving ability used in this study, according to Polya (2004), are listed in the following Table 2:

Tabel 2. Indicators of Mathematical Problem-Solving Ability

No	Indicator
1	Understanding the problem
2	Developing a plan for solving the problem
3	Executing the calculations
4	Reviewing the correctness of results and solutions

To determine whether the implementation of a game-based discovery learning model through the Scratch application effectively enhances students' mathematical problem-solving abilities, the following hypotheses were established:

H_0: There is no difference in students' mathematical problem-solving abilities before and after the implementation of the game-based discovery learning model through the Scratch application in seventh-grade students. H_1: There is a difference in students' mathematical problem-solving abilities before and after the implementation of the game-based discovery learning model through the Scratch application in seventh-grade students.

H_0: There is no improvement in students' mathematical problem-solving abilities before and after the implementation of the game-based discovery learning model through the Scratch application in seventh-grade students. H_1: There is an improvement in students' mathematical problem-solving abilities before and after the implementation of the game-based discovery learning model through the Scratch application in seventh-grade students.

The improvement in students' mathematical problem-solving abilities can be observed through the n-gain score or the comparison between pretest and posttest scores. The N-Gain criteria according to Hake (1999) are as follows:

Table 3. Classification of Gain Index

Average (G)	Criteria
G > 0,7	High
0.3 ≤ g ≤ 0.7	Medium
G < 0,3	Low

The categories for interpreting the effectiveness of learning gains according to Hake (1999) are as follows:

Table 4. Categories for Interpreting the Effectiveness of N-Gain

Percentage (%)	Interpretation
< 40%	Ineffective
40-55%	Less Effective
56-75%	Moderately Effective
>75%	Effective

RESULTS AND DISCUSSION

Results

This study was conducted over six sessions, consisting of one pretest, four treatment sessions, and one posttest with the students of class VII-A at SMP Negeri 1 Batujajar. The effectiveness of the game-based discovery learning model through the Scratch application in enhancing the mathematical problem-solving abilities of seventh-grade students is evident from the

achievements, improvements, and completion of student learning outcomes, as shown in the following table:

Table 5. Statistical Description of Students' Mathematical Problem-Solving Abilities

Statistic	Pretest	Posttest	N-Gain	% Effectiveness	N
X_{min}	14.29	65.71	0.49	62.69%	32
X_{max}	44.29	85.71	0.77		
Total	967.14	2400	20.50		
Mean	30.22	75.00	0.64		
KKM			75		
SMI			100		

Table 5 indicates that the average pretest and posttest scores of class VII-A show distinct results, with the pretest average score at 30,22 and the posttest average score at 75,00. The average posttest score is higher than the pretest score. The difference between the posttest and pretest scores is 44,78, showing a significant shift from the pretest to the posttest values. The percentage of effectiveness of the game-based discovery learning model through the Scratch application in enhancing students' mathematical problem-solving abilities is 62,69%, which falls into the 'Moderately Effective' category.

The results for achievements and improvements in the students' mathematical problem-solving abilities can be seen in Table 5 above, where the average posttest score obtained by the students of class VII-A on the algebra material is 75. Furthermore, the percentage of students achieving the Minimum Passing Criteria (KKM) is 53%, with 17 students completing and exceeding the KKM.

The increase in students' mathematical problem-solving abilities is indicated by the n-gain scores, with the smallest n-gain score being 0,49 and the highest being 0,77, with an average n-gain of 0,64. Based on the classification index gain from Table 3, the n-gain of the mathematical problem-solving abilities of class VII-A at SMP Negeri 1 Batujajar falls into the 'Medium' category. The categorization of the N-Gain posttest results for students' mathematical problem-solving abilities is presented in Table 6 as follows:

Table 6. Categorization of N-Gain for Students' Mathematical Problem-Solving Abilities

Average N-Gain	N-Gain Criteria	Number of Students
0.49 - 0.70	Medium	22
0.71 - 0.77	High	10

As shown in Table 6, the average N-Gain for students ranging from 0,49 to 0,70 is categorized as 'Medium' for 22 students, and the N-Gain range from 0,71 to 0,77 is categorized as 'High' for 10 students.

Given that the data on the achievement and improvement of students' mathematical problem-solving abilities are normally distributed, the analysis proceeds with a two-sample dependent test. The decision-making criterion is as follows: If the Sig. value $\geq 0,05$, then H_0 is accepted; if the Sig. value $< 0,05$, then H_0 is rejected.

Table 7. Results of Two Sample Dependent Tests for Pretest and Posttest Data on Students' Mathematical Problem-Solving Abilities

	Mean	N	Std. Deviation	Std. Error Mean
Pretest	30.2231	32	7.60363	1.34415
Posttest	74.9991	32	6.36896	1.12588

As detailed in Table 7, the average pretest score is 30,2231 and the average posttest score is 74,9991. Since the posttest score is greater than the pretest score, this indicates a difference in the average values. This difference will be further examined to determine whether it is statistically significant through the subsequent statistical analysis.

Table 8. Correlation Results of Two Sample Dependent Test for Pretest and Posttest Scores in Mathematical Problem-Solving Abilities

	N	Correlation	Sig.
Pair 1: Pretest and Posttest Scores	32	.266	.142

According to Table 8, the correlation coefficient is 0,266 with a significance (Sig.) value of 0,142. Since the Sig. value is greater than 0,05, it suggests that there is no relationship between the pretest and posttest variables.

Table 9. Results of Two Sample Dependent Tests for Pretest and Posttest Scores in Mathematical Problem-Solving Abilities

	Sig. (2-tailed)
Pair 1: Pretest and Posttest Scores	.000

As shown in Table 9, the Sig. (2-tailed) value is 0,000, which is less than 0,05. Hence, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. This confirms that there is a significant difference in the mean scores between the pretest and posttest, indicating that the use of the game-based Discovery Learning model through Scratch has a significant impact on improving students' mathematical problem-solving abilities.

Table 10. Results of One Sample T-Test for N-Gain in Mathematical Problem-Solving Abilities

	t	df	Sig. (2-tailed)
N-Gain	8.674	31	.000

Table 10 reveals that the Sig. (2-tailed) in the one sample t-test is 0,000, which is less than 0,05. Consequently, the null hypothesis (H_0) is rejected. This indicates a significant difference in the average N-Gain of students' mathematical problem-solving abilities when using the game-based Discovery Learning model through Scratch. The average N-Gain of the students exceeds 0,5, signifying a substantial improvement.

The completion, determined based on the Minimum Passing Criteria (KKM) set by the school, which is 75, and the learning completion results for students' mathematical problem-solving abilities using the game-based discovery learning model through the Scratch application, can be seen in the following Table 11:

Table 11. Completion Rates of Students' Mathematical Problem-Solving Abilities

	Pretest	Percentage of Students	Average Percentage	Posttest	Percentage of Students	Average Percentage
Complete	-	-	-	17	53%	80.17%
Incomplete	32	100%	30.22%	15	47%	69.14%
Total	32	100%		32	100%	

From Table 11, it is evident that the average percentage of posttest scores for students who meet the Minimum Passing Criteria (KKM) or are complete is 80.17%. This completion rate is categorized according to the following criteria:

Table 12. Criteria for Completion of Students' Mathematical Problem-Solving Abilities

Percentage %	Criteria
$p > 80$	Very Good
$60 < p \leq 80$	Good
$40 < p \leq 60$	Satisfactory
$20 < p \leq 40$	Poor
$P \leq 20$	Very Poor

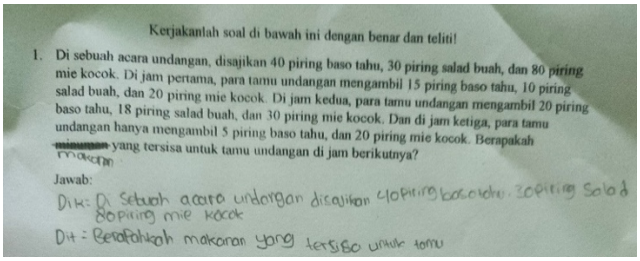
According to Table 12, the completion of the mathematical problem-solving abilities of class VII-A students at SMP Negeri 1 Batujajar falls into the 'Very Good' category. A one-sample t-test will next be conducted on the posttest data for students' mathematical problem-solving abilities.

Table 13. Results of One Sample T-Test for Posttest Scores of Students' Mathematical Problem-Solving Abilities

Posttest Score	Test value = 75		
	t	df	Sig. (2-tailed)
	-.001	31	.999

As indicated in Table 13, the Sig. (2-tailed) value from the one-sample t-test is 0,999. Since the Sig. (2-tailed) value is much greater than 0.05, the null hypothesis (H_0) is accepted. This implies that there is no significant difference in the completion of learning outcomes in improving the mathematical problem-solving abilities of students who used the game-based Discovery Learning model through the Scratch application in seventh grade. The average learning outcome score of the students is less than or equal to 75.

The analysis of students' difficulties in working through items of the mathematical problem-solving instrument reveals that students frequently make errors, particularly in identifying what is known, developing mathematical models, solving these models, and presenting final solutions. These issues are exemplified in the following student response illustrations:


Kerjakanlah soal di bawah ini dengan benar dan teliti!

1. Di sebuah acara undangan, disajikan 40 piring baso tahu, 30 piring salad buah, dan 80 piring mie kocok. Di jam pertama, para tamu undangan mengambil 15 piring baso tahu, 10 piring salad buah, dan 20 piring mie kocok. Di jam kedua, para tamu undangan mengambil 20 piring baso tahu, 18 piring salad buah, dan 30 piring mie kocok. Dan di jam ketiga, para tamu undangan hanya mengambil 5 piring baso tahu, dan 20 piring mie kocok. Berapakah ~~minuman~~ yang tersisa untuk tamu undangan di jam berikutnya?

Jawab:

Dik: Di sebuah acara undangan disajikan 40piring bakso tahu. 30piring Salad 80piring mie kocok

Dit : Berapakah makanan yang tersisa untuk tamu

Figure 1. Misunderstanding the Problem

Figure 1 illustrates the student's error in understanding the problem from the given question. In the section identifying what is known, the student merely writes down that 40 plates of tofu balls, 30 plates of fruit salad, and 80 plates of shaken noodles are served at an event. The student should have detailed the amount of each dish taken by guests in the first, second, and third hours.

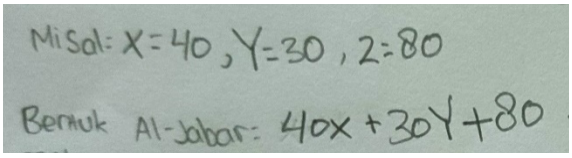


Figure 2. Errors in Creating a Mathematical Model

Figure 2 shows the student's mistake in forming a mathematical model from the given problem. In the example section, the student answers x = 40, y = 30, and z = 80. The student should have named the variables after the menu items served, such as x = tofu balls, y = fruit salad, and z = shaken noodles. A similar error lies in the algebraic modeling section, where the student has not written the algebraic model correctly, completely, and comprehensively, only answering with 40x + 30y + 80. The correct response should be 40x + 30y + 80z – 15x – 10y – 20z – 20x – 18y – 30z – 5x – 20z.

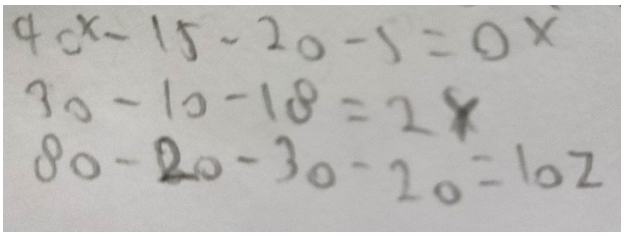


Figure 3. Errors in Solving the Mathematical Model

Figure 3 above shows the student's mistake in solving the mathematical model, where the student answers that the remaining amount of tofu ball dishes is 40x – 15 – 20 – 5 = 0x. The student groups the same variables first before performing the calculations, but the numbers are still not written out completely with their variables. If the result is zero, it is unnecessary to write it with the variable, and the calculations would be easier combined with the fruit salad and shaken noodles as:

$$(40x - 15x - 20x - 5x) + (30y - 10y - 18y) + (80z - 20z - 30z - 20z) = 2y + 10z$$

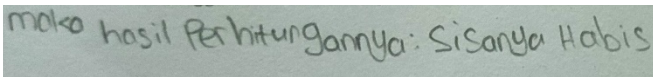


Figure 4. Errors in the Final Answer

Figure 4 above displays the student's error in the final answer, where the student responds that the remaining menu items served are all gone. The correct final answer should be a breakdown of the results from the calculation 2y + 10z, considering the variable y is the fruit salad menu and z is from the shaken noodles. Thus, the final answer should be from the calculation above, the remaining food for the guests at the next hour consists of 2 portions of fruit salad and 10 portions of shaken noodles.

The implementation of the game-based discovery learning model through Scratch has the potential to enhance students' mathematical problem-solving abilities. However, in practice, students may encounter several challenges. These challenges are evident from the student

response surveys administered after the learning process, as well as from direct observations and monitoring during the learning sessions. Here are the identified challenges experienced by the students:

Understanding the Material

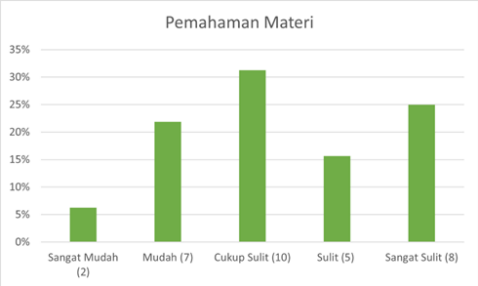


Figure 5. Diagram of Challenges in Understanding the Material

According to Figure 5, the greatest challenge in understanding the material for students of class VII-A at SMPN 1 Batujajar is in the 'Quite Difficult' category at 31%, followed by 'Very Difficult' at 25%, 'Difficult' at 16%, 'Easy' at 22%, and the lowest at 6.25% in the 'Very Easy' category.

Using the Scratch Application

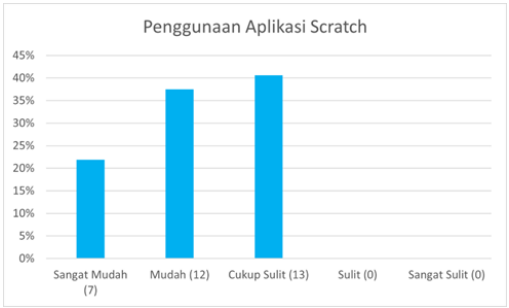


Figure 6. Diagram of Challenges in Using the Scratch Application

Based on Figure 6, the most common challenges in using the Scratch application during learning sessions occur in the 'Quite Difficult' category at 41%, 'Easy' at 38%, and 'Very Easy' at 22%.

Student Collaboration

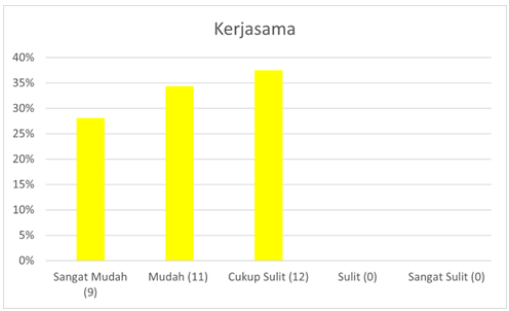


Figure 7. Diagram of Challenges in Student Collaboration

According to Figure 7, the most significant challenge in student collaboration during mathematics lessons for class VII-A at SMP Negeri 1 Batujajar is in the 'Quite Difficult' category at 38%, 'Easy' at 34%, and the lowest in the 'Very Easy' category at 28%.

Discussions

The pretest and posttest scores in mathematical problem-solving abilities, along with the number of students achieving the Minimum Passing Criteria (KKM) in these tests, demonstrate the achievement of mathematical problem-solving abilities in this study. The results indicate that the learning implemented using the game-based discovery learning model through the Scratch application was effective in achieving student competence in mathematical problem-solving. This finding aligns with the research by Sulistyorini (Susanto & Andriyani, 2024) which suggests that learning models like discovery learning can be effective in aiding the development of students' critical thinking skills.

The improvement in student learning outcomes can be observed from the n-gain scores or the comparison between the pretest and posttest scores. The study shows that the learning conducted using the game-based discovery learning model through Scratch was effective in enhancing students' mathematical problem-solving abilities. This is consistent with the findings of Wungo et al. (2021), which stated that the implementation of guided discovery learning models with problem-solving can enhance students' mathematical problem-solving skills.

Student completion refers to the percentage of students achieving the Minimum Passing Criteria (KKM) in algebra. The research reveals that the number of students whose posttest scores met the KKM was higher than those who did not meet the KKM. The 'Very Good' category indicates that the learning conducted using the game-based discovery learning model through Scratch was effective in helping students achieve completeness in their mathematical problem-solving abilities in algebra. This is in line with the research Fadila & Ramadhani (2024), which found a difference in the percentage of students' interest in learning at the beginning and end of the course, specifically an increase in students' interest after using the Scratch media.

Based on the overall data analysis, the challenges experienced by students during learning using the game-based discovery learning model through Scratch, as reported in student surveys, include difficulties in understanding the material, using the Scratch application, and collaborating with peers. These challenges highlight areas where further support and refinement of the educational approach are necessary to enhance its effectiveness and accessibility for all students.

Students may face challenges in understanding material due to a lack of mastery of prerequisite knowledge, weak logical thinking abilities, and insufficient time allocated to grasp the content. Specifically, designing algebraic forms to solve problems is considered quite difficult for students. This aligns with the findings of Nugraha et al. (2019), which noted that a common student error in algebra is failing to understand the intent of the question or what is being asked.

Difficulties in using the Scratch application may arise from students' limited computer skills or unfamiliarity with the application, technical issues within the Scratch software, and unstable internet connections. These challenges are consistent with the research by Lenggogeni & Roqoyyah (2021), which observed that although some students faced technical challenges while using Scratch, they tended to persevere and seek help from teachers. Students appear motivated to contribute their best efforts in producing animated films using Scratch, even when it extends learning time.

The challenges in student collaboration within groups can be attributed to poor communication and coordination, inability to divide roles and responsibilities, unresolved conflicts and

disagreements, and a lack of trust and reliance on other. These obstacles align with the research by Natsir & Taufik (2020), which found that mathematics learning did not meet the required quality standards due to low student engagement in active learning activities, lack of student x enthusiasm, teacher-controlled learning processes, and insufficient collaboration among students. Similarly, research by Mulyana et al. (2018) showed that passivity within groups indicated a low level of cooperative character among students. Some students remain silent, preferring to observe their peers work alone or join other groups. Task distribution in group activities often does not fully develop students' potential, as only certain students tend to dominate, while others in the same group remain passive.

CONCLUSIONS

Based on the data analysis from the research conducted to enhance students' mathematical problem-solving abilities using the discovery learning model based on the game through the Scratch application, it can be concluded that: The implementation of the discovery learning model based on the game through the Scratch application is effective in improving students' mathematical problem-solving abilities in algebraic forms at SMP Negeri 1 Batujajar, categorizing it as Moderately Effective. This is supported by the statistical testing results using SPSS, which indicate: There is a significant difference between the pretest and posttest scores of students' mathematical problem-solving abilities using the Discovery Learning model based on game through the Scratch application in Grade VII SMP; the average n-gain of mathematical problem-solving abilities of Grade VII-A students at SMP Negeri 1 Batujajar falls within the Moderate category, thus showing a difference in the average N-Gain of students' mathematical problem-solving abilities using the Discovery Learning model based on game through the Scratch application in Grade VII SMP; and the proficiency in mathematical problem-solving abilities of Grade VII-A students at SMP Negeri 1 Batujajar falls within the Excellent category, although there is no difference in the proficiency of learning outcomes in improving students' mathematical problem-solving abilities using the Discovery Learning model based on game through the Scratch application in Grade VII SMP.

Students' difficulties in solving mathematical problem-solving items can be seen from specific errors, particularly in determining what is known, developing mathematical models, solving mathematical models, and presenting final solutions.

The challenges faced by students in implementing learning using discovery learning based on games through the Scratch application generally involve difficulties in understanding the material, using the Scratch application, and student collaboration during the learning process.

The implementation of the discovery learning model based on the game through the Scratch application can serve as a solution for teachers in classrooms, especially to enhance other mathematical abilities and other mathematical materials, particularly algebraic forms. Teachers are encouraged to guide students to collaborate effectively with their group peers to make learning more meaningful and conducive. Furthermore, teachers should allocate additional time for understanding the material and completing worksheets to ensure they are completed within the designated timeframe.

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