DEVELOPING THE GAME MASTER OF MATHLAND TO INCREASE PROBLEM-SOLVING FOR GRADE FOUR OF ELEMENTARY

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ABSTRACT

Practicing problem-solving in mathematics is key to understanding word problems and solving real-life situations. This study aims to develop a board game, called "Master of Mathland", for grade four elementary students using basic operations by assessing its effectiveness, validity, and practicality to increase students' problemsolving. This research was conducted in grade four of SDN Tanjung 01, Central Java, using the Borg Gall et al research and development method through the six steps, combined with the ADDIE development model. The data was gathered through observation, interviews, questionnaires, tests, and documentation. The product validity results from the media expert is 92.39%, categorized "Highly Valid" and the material expert is 94,32, categorized "Highly Valid". Besides, the teacher's response sheet for the practical test is 79,00% stated "Advantageous" for learning. The effectiveness of the media is "Very Effective" with 90,36%, through the student's response sheet. The product's effectiveness in increasing problem-solving was tested through the Wilcoxon T-Test, resulting in Asymp.Sig. (2-tailed) is 0.00, meaning the product increases problem-solving in grade four of elementary. Therefore, the game "Master of Mathland" is valid, advantageous, effective, and can improve grade four students' problem-solving.

Keywords: problem-solving, mathematics, Master of Mathland

A. Introduction

Mathematics is one of the subjects that has an impact on the achievement of individual potential. According to Amalia et al (2019), an individual's logical, analytical, critical. systematic. and creative abilities are the role of mathematics. Mathematics also prepares students to have the skills of the 21st century, one of which is the ability to problemsolve. Problem-solving became an important skill to solving real-life problems. Mathematics and problemsolving are two interrelated things, according to Sapitri et al (2019), problem-solving provides an understanding of the relationship between mathematics and real-life problems. This means mathematics is one of the ways to practice problemsolving. Polya (1973) explains there are 4 steps of problem-solving: 1) understand the problem, 2) make plans, 3) carry out the plan, and 4) look back.

However, students perceive mathematics as difficult and complex.

observations the During of mathematics learning process, students were found unfocused, talking to each other, and playing with their pen or book, or had their head down on the table while the teacher was explaining. Students tend to always wait for teachers' direct instruction, especially in completing word problems. The media used in these conditions also plays a role in engaging students' focus, as well as the skill to solve problems.

One of the mathematic learning objectives is to solve mathematical problems that require the ability to understand the problem, design a solution model, solve the model, and interpret the solution obtained (Ministry of Education in Shadiq, 2014,). This point is in line with Polya's (1973) steps in problem-solving, namely understanding the problem, devising a plan, carrying out the plan, and looking back. Hence the objectives of learning mathematics in elementary school are focused on formulating a solution related to solving problems in everyday life. Therefore, problem-solving is important to balance 'what they know' and 'what they can do'. Supported by Căprioară (2015) opinion that

problem-solving is a real way to realize and use mathematics, intellectually and beyond.

In reality, students often face difficulties in mathematical subjects. Hijrilliawanni et al (2023) explain one of the difficulties is understanding word problems because students need a deep understanding, accuracy, and ideas. Damavanti (2023) argues that carrying out the plan tends to be mostly difficult part, the about inaccuracy and incompleteness of numbers. Besides, Asmar & Delyana categorized (2022) understanding concepts, applying, and problemsolving as difficulties in mathematics. Hence, innovation to help students' problem-solve is needed.

According to Bergen et al (2016), elementary schools age often uses concrete media that can be touched and moved, or things that require an active response, and tend to play games with rules. Hence, games help learning become interactive. Setiawati et al (2019) also explain learning while playing can be created through games. Besides, Kim et al (2018) argue, that games in learning have a lot of impacts, which increase learning performance and goals, provide real-time progress

through activity, allow students to progress in reflections, and increase collaboration skills. Smaldino et al (2014) explain games that require students to solve problems, are highly motivating, and provide a challenging environment. On the other hand, Jääskä & Aaltonen (2022) explain the disadvantages of game-based is timeconsuming and can frustrate students during the learning process. However, Tafonao (2018) argues media plays a role, and the quality of learning is supported by the learning media. availability Nevertheless, the of mathematical learning media is still limited at school, especially in increasing students' problem-solving.

Therefore. this research develops the game "Master of Mathland" as a board game to increase grade four students of elementary problem-solving. This game includes mathematic material with word problems; and four steps of problem-solving according to Polya: understanding the problem, developing a plan, implementing the plan, and looking back which can be played independently by students. This game also checked its validity, practicality, and effectiveness. This research also can be used as a

reference for future research, especially in problem-solving and learning media innovation.

B. Research Method

This research was implemented in SD Negeri Tanjung 01. Combining Borg Gall et al (2003) research and development method: 1) research information collecting, 2) planning, 3) developing the preliminary product, 4) preliminary product test, 5) main product revision, and 6) main product test; and the ADDIE development model: 1) analyze, 2) design, 3) development, 4) implementation, and 5) evaluation, by Branch (2009), this study aims to develop a mathematical board game by assessing its effectiveness, validity, and practicality.

This research uses methods 1) interview, 2) observations, 3) closedended questionnaire, and 4) test. Each instrument used Smaldino's (2014) criteria to assess the media which were then simplified into aspects visual, content, usability, and maintenance & practical. Besides, the problem-solving aspect uses Polya's steps which are understanding the problem, planning, carrying out the plan, and looking back. The validity product used a validity sheet and was grouped as follows:

Table 1 Likert Scale		
Score	Category	
4	Strongly Agree (SS)	
3	Agree (S)	
2	Disagree (TS)	
1	Strongly Disagree (STS)	

The validity instruments were collected through media and material expert validation instruments. Then will be categorized through criteria as follows:

Table 2 Va	Table 2 Validity Criteria		
Interval	Criteria		
1% - 20%	Highly invalid		
21% - 40%	Invalid		
41% - 60%	Moderately valid		
61% - 80%	Valid		
81% - 100%	Highly valid		

Besides, the product effectiveness is collected through students' response sheets, observation, and interviews. The effectiveness is categorized through these criteria as follows:

Table 3 Effectiveness Criteria		
Interval	Criteria	
1% - 20%	Highly ineffective	
21% - 40%	Ineffective	
41% - 60%	Moderately Effective	
61% - 80%	Effective	
81% - 100%	Highly Effective	

The practicality data of the product will be collected through teacher response sheets as the observer and categorized through this table.

Table 4 Practical Criteria		
Interval	Criteria	

1% - 20%	Highly Disadvantageous
21% - 40%	Disadvantageous
41% - 60%	Moderately Advantageous
61% - 80%	Advantageous
81% - 100%	Highly Advantageous

C. Result and Findings

This research results in a board game "Master of Mathland". A physical board game to increase grade four problem-solving elementary that combines Borg Gall et al research method and development method and ADDIE model. The first step is information collection and analysis, conducting interview and an observation related to grade four learning media, mathematical learning process, and problem-solving skills in grade four of SDN Tanjung 01. The is students result were found unfocused, talking to each other or laying their heads down. Students cannot solve word problems. Proven when the students tend to ask the teacher about what they should do, write random answers, and not check their final answer. Another reason for low problem-solving skills was that the students barely practiced by themselves, and the reading level was different for each student to understand word problems. In line with Hijrilliawanni et al (2023) research, students' reading level also takes part understanding in word problems.

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Moreover, the teacher also rarely uses mathematics learning media that engages students' attention and improves problem-solving during the learning process, which is related to the lack of mathematical learning media availability at the school.

The second step is planning and designing, this research gathers inspiration for the game, and choosing the name of the game. The third is to construct the game material to support problem-solving. Then the last is to buy and print all the components. The components are 8 cm x 32 cm guideline instructions that were printed with art paper, one game board from impraboard laminated with chroma stickers, one 17 cm x 14 cm counting board from laminated BC paper, 80 question cards with size 6 cm x 7,4 cm (20 cards each color), one marker, four pawns, 32 houses (eight houses each color), one dice, and one game box size 16 cm x 31 cm x 5 cm. Therefore, the game "Master of Mathland" components picture as follows:



Figure 1 Guidelines Instructions



Figure 2 Question Cards



Figure 3 Pawns, Houses, Dice



Figure 4 Game Board

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Figure 5 Counting Board and Markers



Figure 6 Game Box

The third step is to develop the preliminary form of the product & development. This step is carried out product validation test through media experts, the result is 92.39% which falls into the "Highly Valid". Also, the material expert validation result was 94.32% which fell into the "Highly Valid". The results of media expert and material expert validation of the "Master of Mathland" game in detail are as follows:

Table 5 Media Validation Result		
Aspect	Media Expert %	Category
Visual	93,75	Highly valid
Content	91,67	Highly valid
Usability	90,00	Highly valid
Maintenance and Practically	93,75	Highly valid

Packaging	87,50	Highly valid
Problem-Solving	95,00	Highly valid
Average %	92,39	Highly valid

Table 6 Material Validation Result			
Aspect	Material Expert %	Category	
Visual	93,75	Highly valid	
Content	95,83	Highly valid	
Usability	100,00	Highly valid	
Maintenance and Practically	100,00	Highly valid	
Problem-Solving	85,00	Highly valid	
Average %	94,32	Highly valid	

The fourth step was the preliminary product test, involving 12 students of SDN Tanjung 01 in Central Java, who were divided into three groups. This step used observation and interview methods. Students excitement to discuss show or cooperate with their friends during the gameplay. Students can perform each step of Polya's problem-solving. The game took 45 minutes, but no group had a winner. This is one of the limitations of the game "Master of Mathland", which requires a long game duration. Therefore, this study collected suggestions through interviews that some words were unfamiliar to students. Furthermore, question cards that had very long sentences seemed uninteresting. At least three out of 12 students said they become unmotivated just by seeing long problems, like the mixed basic operation cards. Besides, the question cards that used mixed basic operations took a long time to solve. On the other hand, the game helped students to review their steps if they gave a wrong answer. So, the students said that they could do better on the next turn. Therefore, the next revision stage focuses on the question card component, which contains sentences and basic operations.

The next step was the revision of the main product. The suggestions gathered in the previous step will be carried out. Of the 20 cards with each base color, five are mixed basic operations, while the other 15 cards use a single basic operation. Question cards that use long sentences have been shortened. In this step, all new cards were printed again six times in preparation for the main product test with 24 students of SDN Tanjung 01, Central Java.

The last step is the main product test to 24 four grades in SDN Tanjung 01, Central Java. The pre-test and post-test were analyzed through the Wilcoxon T-Test using IBM SPSS 24 to test the difference, as follows:

Table 7 Test Statistics POST-TEST - PRE-TEST

Z	-4.033 ^b

Asymp. Sig. .000 (2-tailed)

The result is Asymp.Sig. (2tailed) of 0.00 which is below 0.05. This shows that there is a mean difference between the pre-test and post-test, which is increased. This evidence is used to support the effectiveness of the game. The result is in line with Safitri's (2019) research that the board game is effective in increasing students' problem-solving. Twenty-one students experienced an increase in the post-test, but three students experienced a decrease. This decrease was because they were tired. After all, they had practiced a lot, as they said through interviews. While the 21 students said the game helps them practice and recognize the meaning of words related to the operation to be performed, for example, "buy more 5 apples", means "add 5 apples". The gameplay duration of "Master of Mathland" in this step took 30 minutes, one group found its winner, and the rest of the students had at least two houses.

The reading level becomes an obstacle during the gameplay for students. Although they faced barriers in playing the game, they still wanted to play because they could practice

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together with their friends and found the game interesting. This situation aligns with Jääskä, E., & Aaltonen (2022) that games in learning build cooperative experiences. Supported by Safitri (2019), students will have an interest in participating in learning media and studying while playing. Students stated that the game also helped them to reflect by looking at the counting board of their work so that they could give a better performance on the next turn. During the gameplay, students can identify the problem which needs to be solved. Besides, carrying out the plan became the hardest part, through the pre-test and post-test. In addition, the results of the practical test that was assessed by the teacher obtained 79% which is included in the "Advantageous" category.

Table 8 Practical Result

Aspect	Score	Category
	%	
Visual	80,00	Advantageous
Content	83.34	Highly
		Advantageous
Usability	80,00	Advantageous
Maintenance	75,00	Advantageous
and Practically		-
Problem-solving	75,00	Advantageous
Average %	79,00	Advantageous

The results of the student response sheet are 90.36% which is included in the "Very Effective" category as follows:

Table 9 Effectivity Result

Aspect	Score %	Category
Visual	94,79	Highly Effective
Content	90,28	Highly Effective
Usability	79,17	Effective
Replayability	100,00	Highly Effective
Problem- solving	91,41	Highly Effective
Average %	90,36	Highly Effective

The implementation of the board game is not only to engage students to learn mathematics, but also to practice by themselves. Even though they can ask for their friend's help, students try to do it by themselves at first, while the other students try to guide them to always make sure they input the right data and choose the correct operation. Hence, the students started to understand patterns in the word problems and the basic operations. This also helps the students build teamwork, and students who have difficulties reading also get motivated to practice reading, said a student.

Due to time limitations, this research concluded with the sixth step of the Borg Gall et al research method.

D. Conclusion

The result of media expert validation is 92.39%. This means that the game "Master of Mathland" is "Very Valid", and the material expert is 94.32% which is "Very Valid. Through

practicality test by teacher the response, the result is 79.00%, which means the game "Master of Mathland" is "Advantageous". While the results of the student response sheet are 90.36% which is categorized as "Very Effective". Furthermore. for the effectiveness test through the T-Test, the result of Asymp.Sig. (2-tailed) is 0.00, which is below 0.05. Meaning there is improvement in students' pretest and post-test. Therefore, this research approved the development of the game "Master of Mathland" which can increase problem-solving for grade four elementary students.

In the implementation, the game "Master of Mathland" can be varied in gameplay by only adding question cards, subtraction, division, or multiplication, and can be used to identify which basic operation is still weak for the students. Future research can test the effectiveness of the game "Master of Mathland" in other schools and improve its practicality. Besides, this research can be used as a reference to develop learning media, especially board games.

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