DEVELOPMENT OF A MAGIC BOARD TO IMPROVE THE PROBLEM-SOLVING SKILLS OF FIRST-GRADE PRIMARY STUDENTS

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ABSTRACT

The use of mathematics learning media significantly influences students' ability to solve mathematical problems. This study aims to develop a learning media called Magic Board, which can enhance problem-solving abilities in first-grade elementary school students. The research method employs six stages of R&D by Borg and Gall, namely: (1) Research information collecting, (2) Planning, (3) Develop preliminary form of product, (4) Preliminary field testing, (5) Main product revision, and (6) Main field-testing combined with ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Magic Board is a combination of an addition board with story problem cards to enhance students' problem-solving skills. Magic Board obtained very valid criteria with a percentage of 94.1% from media experts and 81.5% from content experts. Based on teacher and student response sheets, Magic Board obtained very practical criteria with a percentage of 90.1% from teacher response sheets and 96% from student response sheets. The effectiveness of Magic Board is determined through pre-test and post-test results processed through Paired Sample T Test by Wilcoxon via SPSS, yielding a significance value of 0.008 with criteria influencing students, as well as from student response sheets with a score of 98.6%, with very effective criteria in improving first-grade elementary school students' problem-solving abilities.

Keywords: Learning Media, Magic Board, Problem-solving

A. Introduction

The use of mathematics learning media is highly beneficial for primary school students especially in lower-grades. It is because lower-grades focus on concrete learning, where students can receive systematic and logical information through tangible objects (Zulfira et al., 2021). Learning media is also very useful for teachers. Teacher can use learning media to convey information that can stimulate students' thoughts, feelings, attention and interests (Hasan et al, 2021). The aim of learning media is to assist students in grasping educational concepts, no matter the different types of media utilized. According to Nurfadhillah (2021), learning media can be graphic, photographic or electronic tools to repeat the understanding process and reassemble the information obtained. Mathematics learning media can help students to solve problems. This is evidenced by research conducted by

Dini et al (2023) who created and implemented math learning media proven to be valid, practical, and effective to help third-grade students in mastering subtracting fractions material.

Based on the results of the interviews with the first-grade teachers at SD Negeri Tanjung 01, students still face difficulties in solving problems presented in addition story problem. This is because students are not interested in lengthy questions, and also because they are not yet able to understand the concept of addition in story problems. On the other hand, implementation of learning media is still limited such as manipulatives in the learning process. The strategy that can be used is by developing learning media that are suitable for first-grade primary school students. This strategy was chosen because the target subjects are lower-grade students, specifically first graders, who are interested in real objects. This is because one of the characteristics of lower-grade students is their enjoyment in directly experiencing, doing, or demonstrating something (Astini and Purwati, 2020). Additionally, the strategy is chosen to make students interested and understand the addition story problems, as we know understanding is part of problem-solving. According to Polya, there are four steps to solving a problem, including: 1) Understanding the problem, 2) Devising a plan, 3) Carrying out the plan, 4) Looking back (Astutiani, 2019). From the issue mentioned, this research develops a learning media called Magic Board to improve problem-solving skills for first-grade primary school students by knowing the levels of validity, practicality, and effectiveness of Magic Board.

B. Method

This research utilizes Research and Development (R&D) by using six steps from Borg and Gall (2003): (1) Research information collecting and (2) Planning, (3) Develop preliminary form of product, (4) Preliminary field testing, (5) Main product revision, (6) Main field-testing combined with ADDIE: Analysis, Design, Development, Implementation, and Evaluation (DeBell, 2020). This research was conducted at SD Negeri Tanjung 01 in the second semester of the academic year 2023/2024 with first-grade students as the research subjects. The Magic Board will be

assessed for its validity, practicality, and effectiveness. Validity of the Magic Board is assessed by media experts and material experts using questionnaires. Practicality of the Magic Board is evaluated through questionnaires given to teachers and students. The effectiveness of the Magic Board is evaluated through questionnaires given to students and through the comparison of pre-test and post-test scores. The results of both tests are then analyzed using the Paired Sample T Test by Wilcoxon with SPSS 25 software for Windows. The questionnaires for media experts, material experts, and mathematics teachers' responses use a Likert scale ranging from 1 to 5: strongly disagree (1), disagree (2), Partially Agree (3), agree (4), and strongly agree (5). The questionnaires for student's responses use a Guttman Scale ranging from 1 to 2: Disagree (1), and Agree (2).

After all the necessary data has been collected, data analysis is conducted to determine the level of validity, practicality, and effectiveness of the Magic Board. The following are the formulas used to analyze data from all questionnaires:

$$P = \frac{\Sigma f}{N}\ x\ 100\%$$

Explanation:

P : Final Score

∑f : Score Obtained

N : Maximum Score

Here is a table to see the criteria for validity, practicality, and effectiveness of the Magic Board:

Table 1 Criteria for Media Validity

Number	Scores	Criteria
1.	81-100 %	Highly valid
2.	61-80 %	valid
3.	41-60 %	Moderately valid
4.	21-40 %	Invalid
5.	0-20 %	Highly Invalid

Table 2 Criteria for Media Practicality

Number	Scores	Criteria
1.	81-100 %	Highly practical
2.	61-80 %	practical
3.	41-60 %	Moderately practical
4.	21-40 %	Impractical.
5.	0-20 %	Highly Impractical

Table 3 Criteria for Media Effectiveness

Number	Scores	Criteria
1.	81-100 %	Highly effective
2.	61-80 %	effective
3.	41-60 %	Moderately effective
4.	21-40 %	Ineffective
5.	0-20 %	Highly Ineffective

C. Result and Discussion

The findings of this research are delineated within the six stages of Borg and Gall, which are combined with the ADDIE:

First step is research and information collecting and analysis. At this stage, data collection is done by observing the first-grade students and interviewing first-grade mathematics teachers at SD Negeri Tanjung 01. After observing the first-grade students and conducting online interviews with the first-grade mathematics teachers at SD Negeri Tanjung 01, it was found that the average age of first-grade students in the school is six to seven years old and they still face difficulties in solving problems presented in addition story problem. This is because students are not interested in lengthy questions, and also because they are not yet able to understand the concept of addition in story problems. On the other hand, students are very interested in real objects but learning media is still limited in usage. The teacher said she has never implemented math manipulative in the learning process. Based on the observation and interview results, students' need learning media to increase their problem-solving skills.

Second step is planning and design. This stage is conducted by creating a prototype to outline the Magic Board that will be developed. The prototype sequentially explains the Magic Board's, card design, and instructions for Magic Board. After the design is completed, the second step is the implementation of the prototype into a product using the Canva application. Design and color selection are adjusted to the characteristics of first-grade students. The instructions are made simple for first-grade students. Additionally, the Magic Board is designed to enable students to solve problems according to the four problem-solving steps outlined by Polya. The design stage also applies the manipulative criteria proposed by Smaldino (2014), namely: 1) Manipulatives provide realism and illustrate concepts, 2) Manipulatives provide hands-on experience, 3) Manipulatives arouse interest because they are multisensory, 4) Manipulatives can be ideal mechanisms for stimulating small-group project work, 5) Manipulative can revolve problem solving.

Here is the initial design of the Magic Board accompanied by instructions inside it, the dice and card designs:

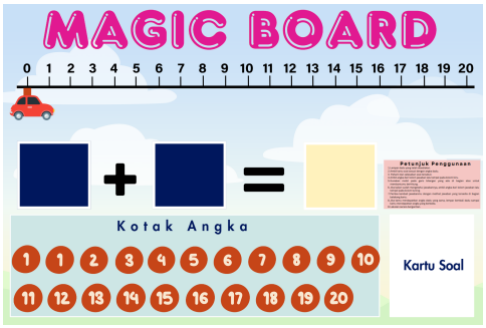


Figure 1 Magic Board and Instruction

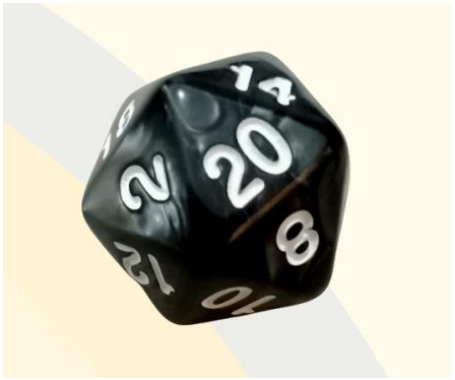


Figure 2 Dice

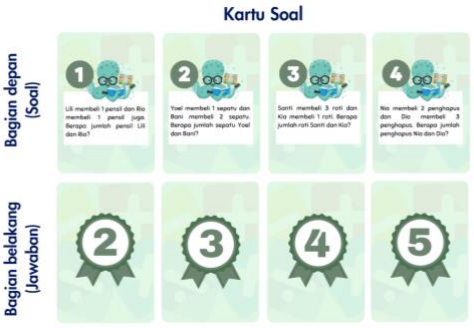


Figure 3 Card Design

The Magic Board consists of twenty cards containing questions on the front side and answers on the back side of the cards. The Magic Board uses a twenty-sided dice to determine which question card the students will choose. The total score obtained from the media experts is 80 out of 85. The percentage is 94.1%, indicating highly valid criteria, suggesting that the Magic Board is suitable for field testing with revision. Meanwhile, the total score obtained from the material experts is 53 out of 65. The percentage is 81.5%, indicating highly valid criteria, suggesting that the Magic Board is suitable for field testing with revision.

Third step is develop preliminary form of product and development. At this stage, revisions are made to the product based on critiques, suggestions, and comments from media experts and material experts. Based on the criticism, suggestions, and comments provided by the material expert and media, changes have been made to the Magic Board. Instructions are presented separately and made larger. Here are the results of the validation from content and media experts:

Table 4 Validation Results

No	Experts	Percentage	Criteria
1.	Media	94.1 %	Highly Valid
2.	Material	81.5 %	Highly Valid

Here is the Magic Board after

receiving feedback from the media and material experts:

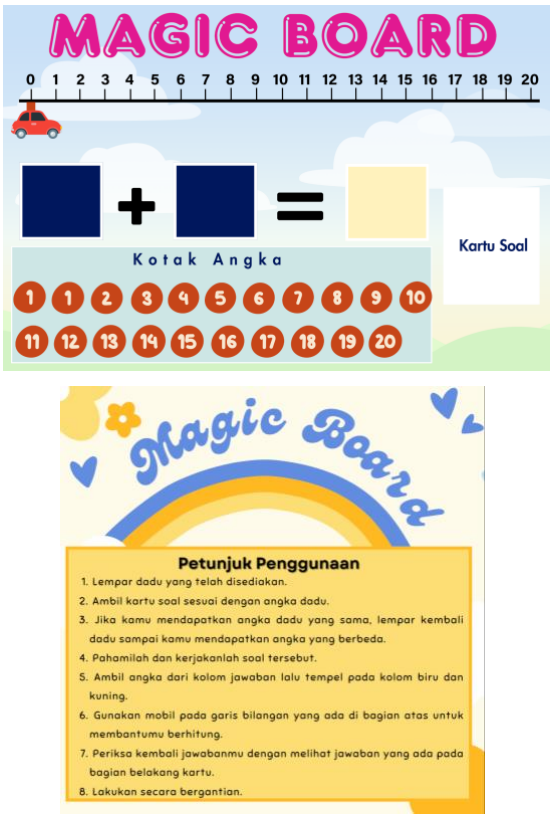
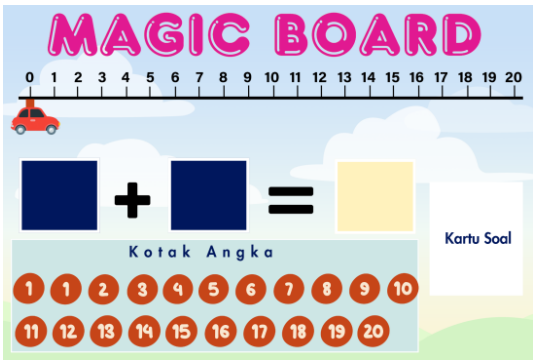


Figure 4 Magic Board After First Revising

Fourth step is preliminary field testing and implementation. A small-scale trial was conducted after the product was improved according to the recommendations and approval of the experts. The small-scale trial of the Magic Board was conducted to twelve first-grade students. After the Magic Board was implemented, eight students filled out student response sheets in the form of a Guttman scale questionnaire, and four students were interviewed. Based on the student response sheet results, a score of 123 out of 128 was obtained with a 96% percentage, indicating highly practical criteria. However, based on the interview results, it was found that students did not read the instructions thoroughly, and some even skipped them altogether. The reason given was that the instructions were too lengthy. Therefore, based on the student response and questionnaire results, the Magic Board received highly practical criteria with revisions.

Fifth step is main product revision and evaluation. Based on the feedback from the small-scale trial conducted, there are student feedbacks that need to be considered. The part of the Magic Board that still needs improvement is the usage instructions. The usage instructions are rarely read by students to completion, and some students do not read them at all, resulting in reluctance to take turns, failure to check their answers, and didn't use the number line cards on the Magic Board. Therefore, changes to the instructions are necessary to make students interested in reading them to completion and paying attention to the game patterns described in the instructions. The changes made to the usage instructions include simplifying some words to be more concise,

adding images at each stage, and using star symbols on certain stages to draw students' attention to those stages. The stages marked with star symbols are stages four, five, and six. Below are the revised usage instructions:



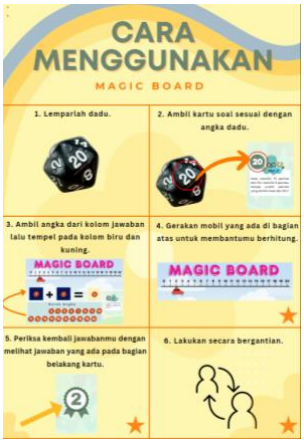


Figure 5 Magic Board After Second revising

Sixth step is main field-testing. The effectiveness of the product was tested by conducting a pre-experiment at SD Negeri Tanjung 01, following the sequence of pre-test, treatment, and post-test. The pre-test and post-test questions provided were story problems related to addition for first-grade primary school students. Based on the calculation and hypothesis testing, the obtained significance value (2-tailed) is 0.008, which is less than the desired 0.05. Therefore, it can be concluded that there is a significant difference in the average problem-solving ability between the pre-test and post-test results, as shown in Table below:

Table 5 Result of Paired Sample Test by Wilcoxon

Test Statistics[a]	
	Post-Test - Pre-Test
Z	-2.673[b]
Asymp. Sig. (2-tailed)	.008

In addition, students provided their responses regarding the effectiveness of the Magic Board through student. Based on the student response sheets, a score of 497 out of 504 was obtained with a 98.6% percentage. Thus, the Magic Board received the criteria of being very effective in improving first-grade primary school students' problem-solving abilities. Additionally, at this stage, teachers also provided responses through a Likert scale questionnaire given to assess the practicality of the Magic Board in mathematics teaching. The result obtained from the teachers' responses is that the Magic Board meets the criteria of being highly practical for use

in mathematics teaching, with a score of 90.1%.

In this research, it was found that first-grade students greatly benefit from concrete objects to aid in understanding learning concepts. This is also support by Bungao-Abarquez (2020) statement, that using manipulatives in mathematics instruction is more effective than conventional methods. They seem enthusiastic and interested in solving the problems presented in the story questions. As explained by Rahayu (2019), students learn progressively from concrete to abstract, from whole to parts, and from simple to complex. This is also support by Fahma and Purwaningrum (2021) statement, that manipulatives can make students more active and engaged in learning. Furthermore, after the implementation of the Magic Board, students find it easier to understanding the problems, make a plan, carryout the plan, and check their answers. This indicates that the Magic Board was effectively utilized in the mathematics lesson. This is similar to the research conducted by Filahanasari et al. (2023) where the instructional media they created was found to be valid, practical, and effective for addressing problem-solving issues in second-grade primary school.

D. Conclusion

This research has been successfully conducted using the R&D method, which incorporates the six stages of Borg and Gall combined with ADDIE. The validity level obtained from media experts shows a percentage of 94.1%, and from content experts, it shows a percentage of 81.5% with a highly valid category, concluding that the Magic Board is suitable for testing with revisions from content and media experts. The practicality level provided by the students obtained a percentage of 96%, and from first-grade mathematics teachers, it obtained a percentage of 90.1% with a highly practical category. Based on the analysis of pre-test and post-test data using the Wilcoxon T-test through SPSS a significance value of 0.008 was obtained, indicating that the Magic Board has an effect on students. According to the effectiveness questionnaire filled out by students, a percentage of 98.6% was obtained with a highly practical category. Based on the research results, it is concluded that the Magic

Board is valid, practical, and effective in improving the problem-solving skills of first-grade primary school students.

As for some suggestions for future research: The next study should aim to utilize the complete Borg and Gall Steps (not stopping at the sixth stage). Furthermore, given the rapid advancement of technology, future research should focus on developing the Magic Board product packaged in an online format while measuring its validity, practicality, and effectiveness.

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