

APPLICATION OF TRANSFORMATION MATERIAL IN THE ULTIMA GAME (SNAKES AND LADDERS OF MATHEMATICS) ON PROBLEM-SOLVING ABILITIES

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Received 05 July 2025; Received in revised form 05 August 2025; Accepted 30 September 2025

ABSTRAK

Penelitian ini dilatarbelakangi oleh rendahnya kemampuan pemecahan masalah matematis siswa yang disebabkan karena kurangnya menggunakan media permainan di dalam kegiatan belajar dan mengajar yang mengakibatkan siswa menjadi jenuh dan bosan dalam proses pembelajaran. Oleh karena itu, diperlukan pengembangan media permainan utama (ular tangga matematika) untuk meningkatkan kemampuan pemecahan masalah matematis siswa pada materi transformasi. Penelitian ini menggunakan model pengembangan 4D (Define, Design, Development, Disseminate). Penelitian ini dilaksanakan di MTs Satu Atap Hidayatul Athfal dengan subjek penelitian kelas IX-1 berjumlah 14 siswa. Instrumen penelitian yang digunakan yaitu instrumen uji kelayakan yang meliputi instrumen kevalidan, kepraktisan, dan keefektifan. Teknik analisis data yang digunakan dianalisis dengan rumus deskriptif presentase yaitu $V = (TSEV/S-max) \times 100\%$. Hasil uji kelayakan meliputi uji kevalidan ahli materi diperoleh nilai sebesar 75% dan hasil uji ahli media diperoleh nilai 81,73%, sehingga didapat kriteria sangat valid. Hasil uji kepraktisan dari respon guru diperoleh nilai sebesar 97% dan hasil dari respon siswa diperoleh nilai 81,87%, sehingga didapat kriteria sangat praktis. Hasil uji keefektifan dengan melakukan post-test untuk mengukur peningkatan kemampuan pemecahan masalah matematis siswa setelah menggunakan media permainan utama (ular tangga matematika) pada materi transformasi diperoleh nilai sebesar 92,9% dengan kriteria sangat efektif. Berdasarkan hasil uji-uji tersebut, produk yang dikembangkan memenuhi kriteria valid, sangat praktis, dan sangat efektif sehingga media permainan utama untuk meningkatkan kemampuan pemecahan masalah matematis siswa pada materi transformasi layak untuk digunakan dalam proses pembelajaran matematika.

Kata kunci: Kemampuan pemecahan masalah matematis, media permainan, ular tangga matematika

ABSTRACT

This research is motivated by the low mathematical problem-solving ability of students caused by the lack of use of game media in teaching and learning activities which causes students to become bored and tired in the learning process. Therefore, it is necessary to develop the ultimate game media (snakes and ladders of mathematics) to improve students' mathematical problem-solving abilities in transformation material. This study uses the 4D development model (Define, Design, Development, Disseminate). This research was conducted at MTs Satu Atap Hidayatul Athfal with 14 students in class IX-1. The research instrument used was a feasibility test instrument that included validity, practicality, and effectiveness instruments. The data analysis technique used was analyzed using a descriptive percentage formula, namely $V = (TSEV/S-max) \times 100\%$. The results of the feasibility test including the material expert validity test obtained a value of 75% and the results of the media expert test obtained a value of 80.56%, so that very valid criteria were obtained. The results of the practicality test from the teacher's response obtained a value of 97% and the results of the student's

response obtained a value of 81.87%, so that very practical criteria were obtained. The results of the effectiveness test by conducting a post-test to measure the increase in students' mathematical problem-solving abilities after using the *Ultama* game media (mathematical snakes and ladders) on the transformation material obtained a value of 92.9% with very effective criteria. Based on the results of these tests, the developed product meets the criteria of valid, very practical, and very effective so that the *Ultama* game media to improve students' mathematical problem-solving abilities on the transformation material is worthy of use in the mathematics learning process.

Keywords: Game media; mathematical snakes and ladders; mathematical problem solving skills.



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Introduction

Students often find mathematics difficult to learn, primarily because the concepts associated with the material can be abstract and difficult to grasp. Therefore, new methods are needed to improve students' understanding of the material and enhance their mathematical problem-solving skills. One way to make learning enjoyable is by using interactive and engaging learning media, especially for challenging mathematical topics such as transformations. Media are tools used by teachers to convey learning information to students. The use of learning media can assist students in learning.

There are two types of manipulative learning media: in-class and out-of-class learning media. Out-of-class learning media, such as Math Around Us, allows students to utilize their surroundings as a learning resource, encouraging them to explore mathematical concepts in a realistic and engaging context. Meanwhile, in-class learning media, such as the *Ultama* game, *Ultama* (mathematical snakes and ladders), is an example of manipulative media that can be used to improve students' understanding of transformation material. This game can improve students' understanding of transformation concepts in a more interactive and enjoyable way. By using this game, students can learn while playing, thereby increasing their motivation to learn and their mathematical problem-solving skills. Learning media that are appropriate to student characteristics and the material being discussed will increase the effectiveness of the learning approach. According to Ulfah et al. (2021), learning media is anything that can be used to convey messages or information in the teaching and learning process so that it can stimulate students' attention and interest in learning. In a study by Sekarwangi et al. (2021), it was stated that learning media is very influential in improving student learning outcomes in schools. This is because learning media plays a role in accommodating teachers, namely as a message delivery from an abstract nature to a more concrete one so that the material will be easily understood by students. By implementing *Ultama* game media, the learning environment becomes more enjoyable, thus making students more interested in exploring the transformation material. According to student learning outcome data on the transformation material before using *Ultama* game media in learning activities, students tend to get bored easily in class because the monotonous learning only listens and then takes notes, so their problem-solving ability in solving questions is very low. However, when tested using *Ultama* game media, students become enthusiastic when faced with questions that require problem solving.

In pursuing mathematics learning, students are required to understand the material being taught. Furthermore, students must possess mathematical problem-solving skills, which are useful for addressing the challenges emerging in today's era of globalization and information. Mathematics learning cannot be separated from problem-solving activities. According to Asmara & Puspaningtyas (2023), problem-solving is a key activity in learning mathematics. Problem-solving skills are a crucial component of mathematics learning. This can help students become more confident in addressing mathematical problems and making better decisions in their daily lives. As Cooney (Laia, 2019) states, "possessing problem-solving skills helps students think analytically in making decisions in everyday life and helps improve critical thinking skills in dealing with new situations. One alternative that can be applied in learning to overcome students' weak creativity (Oviana, Jazim & Vahlia, 2017). Students are invited to be able to solve mathematical problems that are difficult to find solutions to using analytical methods (Vahlia & Agustina, 2016).

Game media development is the process of creating or refining existing media through needs analysis. This media conveys messages from the message source to the message recipient and serves as learning material to improve learning outcomes and achieve goals. The importance of using media in learning, taking into account the situation on the ground, is quoted from (Anwar & Anis, 2020). One challenge is the duration constraints in completing mathematics learning. The transformation learning material includes mathematics consisting of many sub-chapters, namely reflection, translation, rotation, and dilation. Meanwhile, teachers do not have much time to teach due to limited resources. Teachers deliver the material both verbally and in writing on the board, which takes a long time. Research conducted by Ardiyanti et al. (2014) found that errors in transformation, or converting contextual problems into mathematical form, were very common, reaching 56.03% of the study subjects. During the problem-solving strategy planning stage, Utami & Wutsqa (2017) found that students had difficulty finding appropriate formulas or concepts.

Many factors contribute to successful learning. The teacher is not the only factor, but other factors also play a role. According to Ma'ruf & Syaifin (2021), factors that also determine learning success are student engagement in learning, available learning facilities, comfortable classrooms, and safe classrooms. For example, if classroom conditions are conducive, learning will proceed according to objectives. If classroom conditions are not conducive, learning activities will not go according to plan, because only a portion of the material is presented. Furthermore, teachers who rely solely on textbooks will create boring learning. The importance of using learning media is to attract students' attention and interest in teaching and learning activities. The novelty of this *Ultama* game media is the use of question cards as an introduction to the questions to be solved. Furthermore, this media also displays a tutorial on how to play next to the game board so all students can directly see how to play.

Therefore, research is needed to develop *Ultama* (Snakes and Ladders) media to determine whether it can be an appropriate effort to improve students' understanding of transformation material and enhance their mathematical problem-solving skills, thereby improving the quality of mathematics learning. By

using Utama (Snakes and Ladders), students can learn while playing. Furthermore, this game can also help teachers improve the quality of learning and reduce boredom. Unlike the typical snakes and ladders game, this game's innovation involves using cards containing questions related to transformation material. Teachers can use this game as an alternative learning tool to help students understand transformation material in a more enjoyable way.

Research Method

The type of research conducted was research and development (R&D). R&D is a research method used to produce a specific product and test its effectiveness (Haryati, 2013; Muqdamien, B., et al., 2021). Meanwhile, according to Sukmadinata (2008), research and development (R&D) is a research approach to produce new products or improve existing ones (Sukmadinata, 2008; Siregar, T., 2023). The development model used was the 4D model, which consists of four stages in developing the game media to be developed. These stages are Define, Design, Development, and Disseminate. The stages of the 4D model are illustrated in Figure 1.

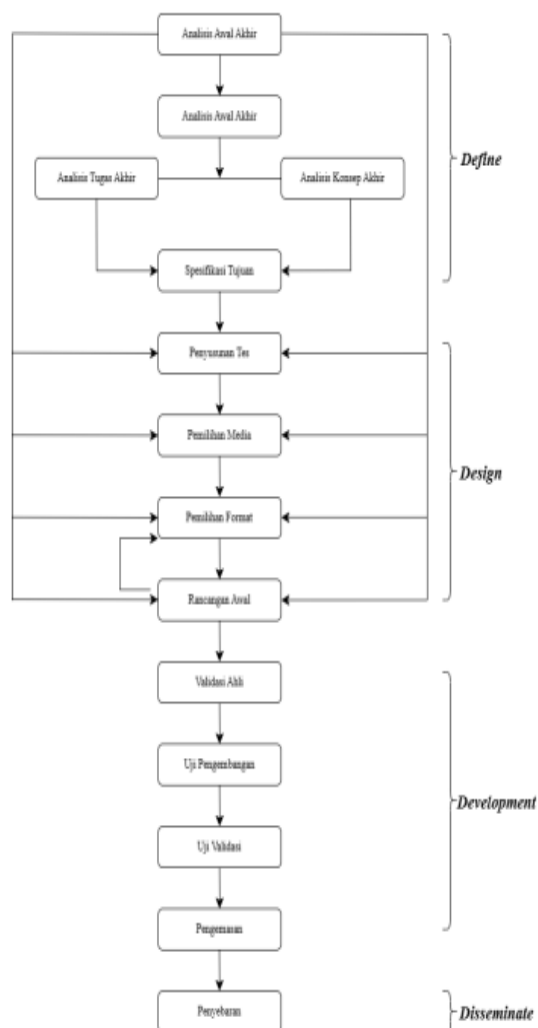


Figure 1 Stages of the 4D model adapted from Sivasailam Thiagarajan, et al.

The subjects of this study were 14 ninth-grade students at MTs Satu Atap Hidayatul Athfal, and the object of the study was the Utama game (mathematical snakes and ladders). Data collection methods used in this study included interviews, questionnaires, tests, and documentation. The research instruments used consisted of non-test and test instruments. The non-test instruments included a material expert validation questionnaire, a media expert validation questionnaire, a student response questionnaire, and a teacher response questionnaire. The test instrument consisted of five questions to assess students' mathematical problem-solving abilities.

The mathematical problem-solving ability test was conducted to evaluate the effectiveness of the Utama game (mathematical snakes and ladders). The questions designed in this test are adapted to the indicators of mathematical problem solving, namely: (1) Students can identify known elements, those being asked, and the adequacy of the required elements, (2) Students can formulate mathematical problems or construct mathematical models, (3) Students can apply strategies to solve various problems (similar and new problems) in mathematics, (4) Students can explain results according to the original problem, and (5) Students can use mathematics meaningfully.

Data analysis techniques are used to calculate the valid, practical, and effective scales of the developed product. The results of questionnaires from material experts and media experts are generated to obtain product validity, the results of student and teacher questionnaires to determine product practicality, and the results of post-tests to determine product effectiveness. The levels of validity, practicality, and effectiveness were analyzed using a specific formula, and the results in percentage form were interpreted according to the categories listed in Table 1, Table 2, and Table 3.

$$V = \frac{TSEV}{S - max} \times 100\%$$

Note:

V = Validation

Tsev = Total Empirical Score

S-max = Expected Maximum Score

Table 1. Validity criteria for utama game media

Percentage	Qualification
75,01% - 100%	Very valid (can be used without revision)
50,01% - 75%	Valid (can be used with minor revision)
25,01% - 50%	Invalid (cannot be used)
0% - 25%	Very invalid (prohibited from use)

(Adapted Sabrina., et al 2021)

$$V - pg = \frac{TSEV}{S - max} \times 100\%$$

Note:

V = Validation

Tsev = Total Empirical Score

S-max = Expected Maximum Score

Table 2. Practicality criteria for ultama game media

Percentage	Qualification
80% - 100%	Very interesting/very practical (can be used without revision)
60% - 79%	Quite interesting/quite practical (can be used with minor revision)
50% - 59%	Less interesting/less practical (cannot be used)
<49%	Not interesting/not practical (should not be used)

(Adapted Sabrina., et al 2021)

$$V - pg = \frac{TSEV}{S - max} \times 100\%$$

Note:

V = Validation

Tsev = Total Empirical Score

S-max = Expected Maximum Score

Table 3. Criteria for the effectiveness of ultama game media

Percentage	Qualification
80% - 100%	Very interesting/very effective (can be used without revision)
60% - 79%	Moderately interesting/moderately effective (can be used with minor revision)
50% - 59%	Less interesting/Less effective (cannot be used)
<49%	Not interesting/Ineffective (should not be used)

(Adapted Sabrina., et al 2021)

Results and Discussion

The following are the results and discussions, explained in more detail based on the 4D development stages:

1. Define

a. Front-end Analysis

A needs analysis was conducted by interviewing Mrs. Neneng Sunengsih, S.Pd.I., a mathematics teacher at MTS Satu Atap Hidayatul Athfal. Information was obtained that the use of learning media was a major problem in mathematics learning, especially for transformation material. Teachers only used textbooks as learning media, resulting in monotonous classroom learning. Furthermore, Mrs. Neneng stated that the

main problem in learning activities was the lack of use of learning media as a learning medium during practice exercises.

b. Student Analysis

Mrs. Neneng stated that the problem in learning was that students easily forgot the concepts of the material each time they studied. One factor contributing to inefficient teaching and learning activities was the teachers' continued use of lecture methods, the lack of use of learning media because learning was based solely on textbooks, and the focus on text without attractive images and colors.

c. Concept Analysis

This stage examined the main and important sections to be studied. The main sections have been created and arranged sequentially and align with the Basic Competencies (KD) in the transformation chapter, which includes four sub-chapters: reflection, translation, rotation, and dilation. Students mastered the material more fully in the reflection sub-chapter because, when they heard the word "reflection," they imagined its implementation in everyday life using a mirror.

d. Task Analysis

The analysis yielded an overview of the tasks required in mathematics learning that students must complete to achieve learning objectives and minimum competencies. Based on the analysis, students were given questions tailored to the indicators in the KD. Researchers used these questions as a reference for developing game media to achieve minimum competencies. These questions were in the form of descriptive texts that were read aloud from question cards, which the students themselves created.

e. Formulation of Learning Objectives

The learning objectives using the ultimate game (mathematical snakes and ladders) for transformation material are as follows: (1) Improving Understanding of Geometric Transformation Concepts: Through the snakes and ladders game associated with transformation material (such as translation, rotation, reflection, and dilation), students can better understand the basic concepts of geometric transformation in a fun and interactive way. (2) Improving Problem-Solving Skills: The mathematical snakes and ladders game challenges students to solve transformation problems step by step. This helps students hone their problem-solving and logical thinking skills when facing math problems.

2. Design

The design phase resulted in a temporary product. The temporary product at this stage is the *Ultama* (mathematical snakes and ladders) game media, which includes a gameplay guide, question cards, pawns, and dice.

The product display for the *Ultama* (mathematical snakes and ladders) game media development as in Figures 2, 3, 4, and 5 below.



Figure 2: Ultama game board



Figure 3: Utama question cards



Figure 4: Utama pawns

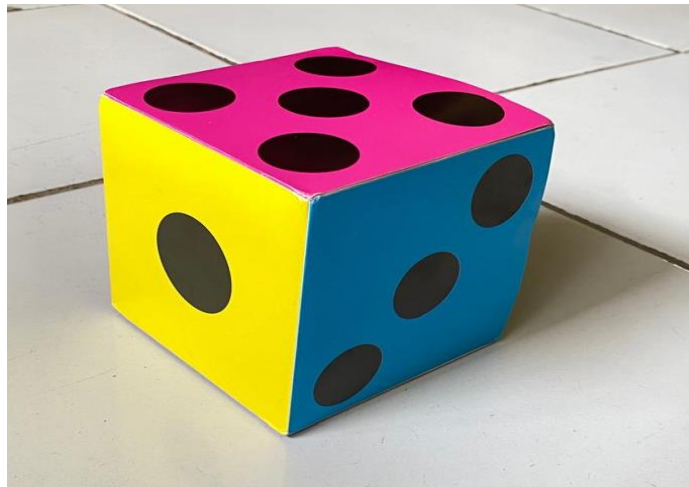


Figure 5: Utama dice

3. *Development*

The development phase began after the design of the Utama game media product (snakes and ladders mathematics) focused on transformation material was completed. It was then validated by material expert and media expert validators.

a. Material Expert Validity Test

The material expert tested the validity of the Utama Game Media supporting teaching materials to Improve Students' Mathematical Problem-Solving Skills, which were developed in terms of content aspects, including the following components: quality of the transformation content and material, accuracy of illustrations provided for material clarity, media appropriateness to the material, ease of understanding of the material, appropriateness of the material and questions to the indicators, depth of material presentation, quality of questions and assessments, and linguistic aspects, including language conformity with EYD (Indonesian Standard English), accuracy of spelling and punctuation, and accuracy of symbols.

The product validity questionnaire prepared by the material expert, Mr. Aan Subhan Pamungkas, M.Pd., was submitted to the material expert for validity testing. The questionnaire consisted of 16 assessment items, with 48 validation results, with a 75% percentage and a valid category. The following details of the material expert validity results are presented in Table 1.

Table 1. Material expert validity results

No.	Observed	Aspect Score Achieved	Percentage
1.	Content Aspect	36	75%
2.	Language Aspect	12	75%
	Total	48	75%

Based on the validation table calculations by the material expert, the average score was 75%, indicating that the developed Utama game media met the "valid" criteria. The results indicate that the Utama game media can be used for product trials with students. Although the product was deemed valid, there were still suggestions and input for improvements to the Utama Game Media to Improve Students' Mathematical Problem-Solving Skills, namely the need for more narrative in the story problems.

b. Media Expert Validity Test

The media expert tested the validity of the Utama Game Media to Improve Students' Mathematical Problem-Solving Skills developed in terms of the Utama game design, which included the following components: suitability of materials, fonts, use of spacing and placement, readability of text, images and colors, durability and practicality, suitability of dice and pawn size to the game board, and programming aspects, including the components: instructions for use, and student responses.

The product validity questionnaire prepared by the media expert, Ms. Yani Setiani, M.Si., was submitted to the media expert for validity testing. The questionnaire consisted of 26 assessment items, with a validation score of 85, or 81.73%, categorized as very valid. The following details the validity results from media experts are presented in Table 2.

Table 2. Validity results from media experts

No.	Observed	Aspect Score Achieved	Percentage
1.	Design Aspect	58	55,76%
2.	Programming Aspect	27	25,97%
Total		85	81,73%

Based on the validation table results from media experts, the average score was 80.56%, indicating that the Utama game media developed met the "very valid" criteria. The results indicate that the Utama game media can be used for product trials with students. Although the product was deemed highly valid, there were still suggestions and input for improvements to the Utama Game Media to Improve Students' Mathematical Problem-Solving Skills.

c. Practicality Test Results of the Teacher Response Questionnaire

Teachers were given a questionnaire related to the use of the Utama game media (snakes and ladders mathematics). This questionnaire aimed to assess and determine teacher responses to the use of the Utama game media (snakes and ladders mathematics) in the transformation material. This assessment examined aspects of appearance and content quality. The results of the data processing from the teacher response questionnaire to determine the practicality of the product through trials, which were then analyzed as percentages, are presented in the table below. The following

details the results of the practicality test of the teacher response questionnaire, presented in Table 3.

Table 3. Practicality test results of the teacher response questionnaire

No.	Observed	Aspect Score Achieved	Percentage
1.	Appearance Aspect	19	47,5%
2.	Content Quality Aspect	20	50%
Total		39	97%

Based on the table above, the results of the trial to determine the responses of mathematics teachers at MTS Satu Atap Hidayatul Athfal who were familiar with the process of playing the Utama (Snakes and Ladders) game on transformation material showed an average total of 97%, meaning the Utama (Snakes and Ladders) game met the criteria of "very practical."

d. Practicality Test Results of the Student Response Questionnaire

The questionnaire was also tested on students to determine their responses to the quality of the Utama (Snakes and Ladders) game, based on aspects of appearance and content quality. The results of the student response questionnaire are presented in Table 4.

Table 4. Practicality test results of the student response questionnaire

No.	Observed	Aspects Average Total	Criteria
1.	Appearance & Content Quality	81,87%	Very Practical

Based on the table above, the results of the trial to determine the responses of mathematics teachers at MTS Satu Atap Hidayatul Athfal who had learned how to play the Utama (Snakes and Ladders) game on transformation showed an average total of 97%, meaning the Utama (Snakes and Ladders) game met the criteria of "very practical."

e. Effectiveness Test Results

After the learning activities and Utama (Snakes and Ladders) game were completed, students were given a post-test consisting of 5 descriptive questions aligned with the core competencies and indicators of the transformation material, which comprises 4 sub-chapters: reflection (reflection), translation (movement), rotation (rotation), and dilation (enlargement/reduction in size). Students were considered successful if their score was greater than or equal to 70 (Minimum Completion Minimum).

The results of the post-test score analysis of 14 students conducted after learning activities using the Utama game (mathematical snakes and ladders) on the transformation topic are shown in table 5 below:

Table 5. Effectiveness Test Results

Highest Score	100
Lowest Score	60
Average	88
Percentage of Completion	92,9%

Based on the table above, the results of the post-test data analysis of the limited trial showed that 14 ninth-grade students at MTS Satu Atap Hidayatul Athfal achieved learning completion with a percentage of 92.9%, with a score \geq the Minimum Competency Minimum (KKM), and one student fell into the lowest score category (not yet completed) with a percentage of 7.1%. Therefore, it can be concluded that the Utama game (mathematical snakes and ladders) is very effective in mathematics learning because the percentage of students' learning completion falls into the "very effective" category. Therefore, it can be concluded that the Utama game (mathematical snakes and ladders) on the transformation topic is very effective in learning activities in mathematics.

4. Disseminate

Disseminate is the final stage of the development process for the Utama (Snakes and Ladders) game to improve students' mathematical problem-solving skills. The goal of this stage was to disseminate the Utama (Snakes and Ladders) game, which was conducted on January 9 and 23, 2025, to 14 ninth-grade students at MTS Satu Atap Hidayatul Athfal.

Conclusion and Suggestion

The development of Utama game media to improve mathematical problem-solving skills has proven valid, practical, and effective. This product development process followed a 4D process (define, design, develop, and disseminate). Utama game media was printed on flexi china material with a standard size of 120 cm x 80 cm. Product validity was demonstrated through expert material and media testing, while practicality and effectiveness were demonstrated through classroom dissemination. Therefore, this game media can be an alternative for improving students' mathematical problem-solving skills through fun gameplay and fostering the practice of traditional games in today's technology-driven era.

Based on the research and development that has been carried out, accompanied by suggestions from material experts and media experts, student and teacher responses, the researcher suggests the following things to future researchers, namely: (1) Researchers must have the ability to control the class so that research can be carried out conductively, (2) when implementing learning and research, attention must be paid to the time limits that have been set and arranged according to the RPP so that it can be carried out well and smoothly, (3) Extend the time when using this game media during learning.

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