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Development of Snake and Ladder Board Game Media to Improve Fifth-Grade Students Learning Outcomes on Fraction

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Abstract: Development of Snake and Ladder Board Game Media to Improve Fifth-Grade Students Learning Outcomes on Fraction. **Objective:** This study aims to develop a game-based snake and ladder learning media to improve the learning outcomes of fractional mathematics in grade 5 elementary school students. **Methods:** Research and Development (R&D) is the type of research used. The research design applied is ADDIE design, which consists of five stages: analysis, design, development, implementation, and evaluation. The data collection techniques used in this study consisted of test and non-test techniques. Test techniques include pre-test and post-test, while non-test techniques include observation, interviews, questionnaires, and documentation. **Findings:** Based on the validation results by media experts and material experts, the following results were obtained: the assessment from media experts was 91.25% (very feasible), and the evaluation of material experts was 89.70% (very feasible). The assessment of the two experts shows that the snake and ladder game media is worth using. The data analysis techniques used in this study consisted of normality tests, T-tests, and N-Gain tests. The normality test results showed that the significance value (Sig.) > 0.05 means the data was normally distributed. Based on the T-test on a small scale and a large scale, a Sig. (2-tailed) value of 0.000 was obtained, showing a significant difference between the use of snake and ladder game media and the learning outcomes of grade 5 students. Furthermore, the N-Gain result for the small scale is 0.71, and for the large scale, it is 0.76; both results are included in the high category. **Conclusion:** Thus, based on the results of data analysis, snake and ladder game media has been proven to be effective in mathematics learning to improve learning outcomes in fractional materials as well as as a fun educational tool, especially in the context of 21st-century learning that emphasizes collaboration skills, creativity, critical thinking, and communication (4C). This media increases students' motivation and facilitates active learning through a game-based learning approach. Snake and ladder can be adapted for various subjects by modifying the content of the questions or challenges according to the needs of the curriculum.

Keywords: snake and ladder, learning outcomes, fraction.

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■ INTRODUCTION

The education system meets all students' educational needs and allows them to achieve a higher level of understanding. This system consists of various components that ensure the implementation of quality education. Keeping all elements in harmony is essential to maintain quality standards. Alignment is critical to achieving educational goals (Majeed et al., 2024). Quality education also plays a vital role in shaping

students' character and intellectual abilities and positively impacting the community. In Indonesia, the purpose of basic education is contained in Government Regulation of the Republic of Indonesia Number 4 of 2022 Article 6, which emphasizes the formation of students as members of society who are faithful, pious, noble, and moral by the values of Pancasila, and have literacy and numeracy competencies as a provision for continuous education.

Mathematics is taught at all levels of education, from elementary school to higher education (Laurens et al., 2018). This obligation is based on the role of mathematics as part of basic human skills, namely arithmetic, that will equip students with mathematical skills that can be applied in daily life (Sukardjo et al., 2020). As one of the subjects in primary education, mathematics plays a strategic role in developing logic, problem-solving, and critical thinking skills. Therefore, the mathematics learning process in elementary school is designed as a planned learning experience to achieve mathematical competence (Shidqi et al., 2023). This learning involves providing learning experiences that allow students to acquire mathematical skills and knowledge relevant to daily life. Interestingly, mathematics attracts students' attention in elementary school because of its unique characteristics compared to other subjects (Tabuena et al., 2021). Mathematics education must go beyond acquiring procedural skills to develop students' abilities to think critically, analyze data, and engage in mathematical inquiry. The goal is to empower students to become active participants in building mathematical knowledge and solving complex problems (Boaler, 2016).

Based on observations and interviews with 5th-grade teachers of SDN Wonoplembon 02, several problems were found in mathematics learning. Although teachers have implemented innovative learning models such as ad project-based learning and utilize digital media such as YouTube ads. Students still have difficulty understanding the material, lack focus during studying, and do not complete the assignments given. This situation leads to poor learning outcomes for students. This aligns with the findings that engaged teaching strategies are essential for effective learning, which innovative and creative teachers primarily drive (Ohlsson et al., 2024). Teachers actively create engaging learning environments and increase student motivation, which inspires enthusiasm for learning and achieving learning goals (Cilalÿ et al., 2024). Appropriate teaching materials and the right learning environment are essential components of a practical and engaging learning experience in addition to teaching methods (Cilalÿ et al., 2024). These factors significantly affect the continuity and success of the learning process between teachers and students. Therefore, efforts are needed to develop innovative and engaging learning media to improve student learning outcomes and motivation.

Previous research has explored using snake and ladder media in mathematics learning (Sari, 2022; Harwini et al., 2020; Amin et al., 2019). However, the literature has significant limitations regarding the specific application of this medium for fractional learning in primary schools. Existing research focuses on integer concepts, basic arithmetic operations, or other mathematical topics. Therefore, an in-depth understanding of effectively designing the snake and ladder to teaching fractions, including a visual representation of fractions, fraction operations, and troubleshooting involving fractions, is still limited. Another limitation is that most of the research has not involved technology in the learning media that has been developed, so fractional material has not been explored in depth. In addition, monotonous game learning cannot increase students' motivation to study fractional material in depth. This study aims to fill this gap by developing and testing the effectiveness of a

game-based snake and ladder learning media explicitly designed for fractional learning, considering the unique characteristics of fractional materials and the cognitive needs of elementary school students.

Learning media has a crucial role in supporting the success of the learning process (Fadillah et al., 2023). By definition, learning media is a tool, both hardware and software, that teachers use to deliver material to students to increase the effectiveness and efficiency of learning (Puspitarini et al., 2019). Learning media facilitates the learning process, making it easier for teachers to deliver material (Sulthon et al., 2021). Not only that, but learning media also has an important role in conveying basic mathematical concepts to students (Mashuri, 2019). The benefits of using learning media are very diverse, including (1) it can broaden students' horizons, (2) students gain diverse experiences during the learning process, (3) provide concrete and direct learning experiences to students, (4) overcome limitations, (5) provide accurate and up-to-date information, (6) adding attractiveness to the appearance of the material, (7) stimulating students to think critically, use their imagination, behave and develop further, (8) increase the efficiency of the learning process, (9) solve educational problems (Ghufron et al., 2024).

The characteristics of students in elementary school who tend to be active and like games require creative and innovative learning approaches, such as the use of game-based media (Wandini et al., 2019; Wayan et al., 2020). Educational games are a learning media option that allows students to learn while playing to increase interest and motivation to learn (Treceñe et al., 2023). This strategy is very effective in mathematics learning, where games can increase student engagement (Phuntsho, 2020). Board games such as Advertising Snakes and Ladders are practical tools for turning learning into games, as they provide cognitive and social benefits and encourage collaboration, critical thinking, and communication (Mansor et al., 2024). One of the media that is considered adequate is game-based media because it can create a fun and interactive learning atmosphere. One study states that game-based learning can improve student activity and learning outcomes (Hikmawan et al., 2020).

Games attract interest as it is becoming increasingly clear that the main element of fun in gaming is social interaction with other players during play (Kamal et al., 2019). The advantageous influence of this game lies not only in the number of movements but also in the fact that the game is played outdoors with the participants. They have a refreshing effect and emotionally charged students (Kostadinova, 2023). The Giant Snake and Ladder board game, in particular, combines physical movement with learning, making it an engaging activity for elementary school students. The game stimulates excitement through its competitive nature and integrates tasks (Mokhtar et al., 2019).

The gamification learning in this study is based on constructivist principles, where students actively build their knowledge through experience. Bruner's (1966) theory of cognitive representation provides a relevant framework for understanding how the game of snake and ladder facilitates learning. Bruner proposes three stages of representation: behavioral learning (learning through physical actions), imagination learning (learning through visual representation), and symbolic learning (learning through abstract symbols). The game of snake and ladder takes students through these three stages of learning: they physically manipulate the dice and their fruit (enactive), see a visual representation of the fractions on the game board (iconic), and use mathematical symbols to solve problems (symbolic).

In addition, this study also considers Csikszentmihalyi's (1990) theory of flow, which

is when a person is completely immersed in an activity and feels happy. Flow occurs when the challenges you face are balanced with the skills you have. Snake and ladder games can create a flowing state because they have clear goals, structured rules, and direct feedback, so students feel challenged while learning the fractions but still achieve the game's goals. When students experience flow, they tend to be more motivated to learn and achieve better learning outcomes.

One of the games that has the potential to be adapted as a learning medium is snake and ladder. These games are popular with children and can be modified to teach math concepts in a fun way. Elements in the game, such as dice, game boards, and game rules, can be designed to actively engage learners in the learning process. The advantages of using snake and ladder games in learning are: (1) increasing students' concentration in learning, (2) effective content increases, (3) the psychomotor aspect can be shown from the students' activity in asking questions, playing, and discussing, (4) the creation of a fun learning environment (Amin et al., 2019). However, this media also has weaknesses, such as requiring careful preparation and a long enough time to explain the rules of the game (Sari, 2022; Harwini et al., 2020). Thus, the development of snake and ladder learning media is expected to be a solution to improve the mathematics learning outcomes of students in elementary school.

Learning outcomes should be understood as a statement of what learners know understand, and can do after completing the learning process, defined in terms of knowledge, skills, and competencies (Cedefop, 2024). The indicators of these learning outcomes are reflected in changes in students' cognitive, affective, and psychomotor behavior (Nabillah, 2019). As a benchmark of learning success, factors influence learning outcomes, such as motivation and interests, and external, such as the school and family environment (Leni et al., 2021). One of

the significant internal factors is interest in learning, where increased interest in learning has been shown to lead to better learning outcomes (Alyusfitri et al., 2024). In addition, external factors such as numeracy problems, namely the ability to understand and use mathematics in daily life, also play an important role in academic achievement (Khumalo & Utete, 2023). To improve learning outcomes, the development of innovative learning media is crucial; research by Syaikhu et al. (2022) in developing mathematics learning media based on electronic snake and ladder proves that this media is valid, practical, and effective in increasing students' learning motivation. In addition, research by Defa (2022) on the development of snake and ladder media for integer learning in elementary schools also shows that this media is feasible and effective. These findings indicate that snakes and ladders have great potential as innovative mathematics learning mediums.

In recent years, research on mathematics learning media has grown rapidly. Different media types have been explored, from traditional media, such as physical props, to modern media, such as computer software and mobile applications. In general, effective learning media captures students' attention, enhances conceptual understanding, and provides opportunities for practice and application. Furthermore, an effective learning medium must adhere to multimedia principles: People learn better through text and images than text alone. This view is supported by cognitive theory, which suggests that the dual coding of verbal and visual information can improve learning (Mayer, 2020). Visual media is often considered important in mathematics learning. Visualization transforms mathematical concepts into interactive experiences that deepen conceptual understanding through manipulation and exploration (Baccaglini-Frank et al., 2023). Visual representations of mathematical concepts

can help students understand abstract concepts and connect symbolic representations to the real world. Games as a learning medium have great potential to motivate students and make learning fun. Game-based learning has shown its potential to improve mathematics education by increasing student motivation, engagement, and understanding of mathematical concepts while encouraging the development of problem-solving and critical-thinking skills. Students who participated in gamified learning showed statistically significant improvements in math problem-solving skills compared to traditional instruction (Tokac et al., 2019).

The use of snakes and ladders as a tool for teaching mathematics has been studied in several studies. A study by (Defa, 2022) is oriented towards innovating integer ladder snake media in mathematics learning in grade 6 of elementary school. The main objective of this study is to evaluate the feasibility and effectiveness of integer snake and ladder media. This research uses a development research design with a 4-D model from Thiagarajan: define, design, develop, and disseminate. The results indicate that the percentage of media experts reaches 90% and material experts at 88%. Meanwhile, the average score of student learning before the use of media was 54.33% and increased to 82.66% after the application of the media that had been developed. The findings of this study show that learning media that is valid and suitable for use in mathematics learning for students, as well as integer snake and ladder learning media, are effective in improving learning outcomes and understanding of mathematical concepts in integer calculation at the elementary school level.

The study (Syafa, 2022) focuses on snake and ladder media innovations to teach students language skills regarding using standard and non-standard words among 3rd-grade elementary school students. This study aims to create a learning medium integrated with games for grade 3 students using snake and ladder media. The research method applied is Design and Development (D&D) with a procedure following the steps from Paffers et al.: identifying problems, describing objectives, designing and developing artifacts, testing artifacts, evaluating test results, and communicating test results. Based on the research findings, snake and ladder media development begins with identifying problems, describing objectives, designing products, developing products, testing products, evaluating product test results, and communicating product test results. The results of the feasibility evaluation showed a percentage of 78.67% of media experts, 100% of material experts, and 90% of language experts. The result of the student response percentage score reached 87.92%, while the teacher's response was 80%. Thus, it can be concluded that snake and ladder media is appropriate for 3rd-grade elementary school students as a learning tool for mastering students' language skills in standard and non-standard vocabulary materials.

From the analysis of the previous two studies, the research on the development of snake and ladder learning media has several major innovations compared to previous research. Mathematics content is designed explicitly for integer material, including addition, subtraction, comparison operations, media equipped with problem-based problems, and examples in various contexts to strengthen understanding. Both studies show that snake and ladder media can be adapted to various fields of science with specific design innovations, where research by (Defa, 2022) excels in visualizing abstract mathematical concepts and integrating contextual problems, while research by (Syafa, 2022) innovates in strengthening linguistic memory through game mechanisms.

Based on the background of the problems that have been described, the problems of this research can be formulated as follows: (1) how

is the validity of snake and ladder media for fractional material? (2) is a snake and ladder media effective in improving mathematics learning outcomes?

■ METHOD

Participants

This study's target population is all 5th-grade students of SDN Wonoplembon 02. The technique used to select the research subject is the non-probability sampling technique. This sampling method does not provide the same opportunity for each element selected to be a sample (Sugiyono, 2020). There are two subjects in this study, namely small-scale test subjects and large-scale test subjects. The research subjects used to test the questions were all 5th-grade students of SDN Wonoplembon 02, which amounted to 28 students. Subjects in small-scale tests were selected using the purposive sampling technique, which is a sample selection technique by considering specific criteria. In this study, six students from grade 5 of SDN Wonoplembon 02 were selected for the small-scale trial, which was selected based on three categories, namely two high-achievement students, two medium-achievement students, and two low-achievement students. This sampling aims to determine whether the developed media is effective when used by all students with different cognitive levels. Meanwhile, the research subjects on the large scale used the rest of the small-scale test, totaling 22 students.

Research Design and Procedures

This research uses research and development (R&D) methods. R&D methodology in educational research is required to produce effective and efficient products or services related to pedagogical or educational practices. This method develops or designs a proposed model for educational practice in several steps (Gustiani, 2019). The research design applied is the ADDIE design, which consists of five stages: analysis, design, development, implementation, and evaluation (Sugiyono, 2020).

At the analysis stage, potential and problem analysis is carried out; the process begins with observation of learning activities in the classroom, followed by interviews with class teachers. Furthermore, an analysis of the needs for learning media by teachers and students is carried out to support the development of the products to be made. In the design stage, learning media is designed according to the needs that have been previously identified, namely the limitations of media in the classroom and the lack of motivation of students in following the learning process, especially in mathematics. This stage involves creating a media concept design with the help of the Postermywall website and the Canva app. This process begins with preparing learning materials that will be used on the game board in the form of barcodes, then continues by preparing questions to be included in math problem cards, as well as compiling game instructions and determining media components such as image elements on the media board, barcode design, and choosing attractive snake and ladder images and colors. In the development stage, the media is developed according to the design that has been prepared. Before students use the media, the media needs to be validated by media and material experts. Design validation aims to assess the feasibility and quality of the media. After the validation process, the product revision is changed according to the recommendations and input from experts. Material experts have made revisions in this development stage, adding more detailed information about fractions in teaching materials. In addition, there was also one revision from media experts related to adding media elements such as media boxes, math question card holders, and revisions to game rules. The next stage is implementation, which includes product testing. Once the media has been corrected based on recommendations and input from experts, it is

ready for the testing stage. The first step was a small-scale trial involving six students for grade 5 of SDN Wonoplembon 02. The results of this trial will be analyzed to identify if any aspects need improvement, after which it will be followed by a large-scale trial involving twenty-two students. The final stage is evaluation, which is carried out by involving teachers and students to provide feedback on the use of media that has been developed during the learning process. The goal is to assess the effectiveness and validity of media as a suitable learning tool in the classroom.

Instruments

The instruments used in this study include test and non-test kits. The test instrument used is a test of student learning outcomes in the form of multiple-choice questions given before (pre-test) and after (post-test) the use of learning media to assess the improvement of student learning outcomes. The test used in this study consisted of 40 multiple-choice questions. After conducting a validity test at a significance level of 5%, it was found that 20 questions were invalid, leaving 20 questions that had good validity. The reliability analysis results with KR-20 or Kuder Richardson-20 showed a value of 0.9034, indicating that the item in question had a high standard. The questions in this exam have varying levels of difficulty in assessing students' ability to solve fractions-related problems.

The non-test instruments applied in this study included needs, validity, and response questionnaires. A questionnaire of needs in this study was given to teachers and students regarding the use of learning media in the classroom, with 13 questions that discuss the implementation of mathematics learning, the need for learning media, and the criteria for the necessary learning media. The questionnaire for teachers consists of 13 questions and one suggestion box that focuses on developing this learning media so that students feel happier participating in learning in the classroom and can

play the role of peer tutors. The questionnaire for validating snake and ladder learning media products was submitted to validators competent in media and materials. In the media expert validator questionnaire, there are 20 questions divided into two aspects, namely the quality aspect, which includes media quality, media accuracy, design, materials used, and media proportions, as well as technical aspects, which include media appearance, font size selection, color selection, image composition, image size, and media usage instructions. The material expert validator questionnaire has 17 questions divided into content, material aspects, and linguistics. The content and material aspect includes the suitability of the material with the learning outcomes and goals to be achieved, the completeness of the material, illustrations of images in the material and questions, and the development of the questions. In contrast, the linguistic aspect includes grammar, symbol writing, spelling, and punctuation.

Furthermore, the response questionnaire, which comprised 25 questions for teachers and 12 for students, was distributed to both groups. The questions included their evaluation and satisfaction with applying the learning media that had been developed.

Data Analysis

Two types of data analysis are applied in this study: initial data analysis and final data analysis. Initial data analysis was carried out in a descriptive manner (delivery or illustration in detail) regarding the needs of teachers and students in the use of learning media. From the questionnaire carried out on the needs of teachers and students, the results were obtained in the form of a 2×2 meter media board, which is a banner made of flexi china material, with a display of media boards and question cards that have attractive colors, and the addition of relevant image elements. Furthermore, the analysis of teacher and student responses to snake and ladder learning media was used to assess the

feasibility of the product. The level of media eligibility is determined based on the percentage of achievement of the criteria, where the percentage range of 76% to 100% is categorized as very feasible, the rate of 51% to 75% is considered possible, the percentage of 26% to 50% is considered quite doable, and the percentage of 0% to 25% is declared unfeasible.

Furthermore, the final data analysis used SPSS to calculate the normality, t-tests, and N-Gain tests. Normality tests are carried out to determine whether the data is normal. This test is carried out by utilizing the Shapiro-Wilk Test to identify the data distribution; Shapiro-Wilk has strong statistical power in detecting deviations from the normal distribution, especially in data that tend to have kurtosis. This is very important because math learning outcomes are often not distributed normally due to differences in students' abilities. The rule is that if Sig > (more than) 0.05, then the data has a normal distribution, and if Sig < (less than) 0.05, then the data does not have a normal distribution. A non-parametric test such as Wilcoxon is used if the data is not normally distributed.

The T-test is carried out by testing the hypothesis to determine whether there is a difference in media use on student learning outcomes in fractional materials in grade 5 of SDN Wonoplembon 02. The T-test is carried out to control for variation between groups by comparing differences in individual scores. The hypothesis in this study is that Ho means that there is no significant difference between learning outcomes in pre-test and post-test using snake and ladder learning media. Ha means a significant difference exists between learning outcomes in the pre-test and post-test using snake and ladder learning media. The hypothesis test was carried out by comparing the significance value of the data to the significance value set (0.05). If the value of sig. If more than 0.05, then Ho is accepted, and Ha is rejected. On the other hand, if the value of sig. If it is less than 0.05, Ho is

rejected, and Ha is accepted. Furthermore, an N-Gain test was carried out to test the effectiveness of snake and ladder learning media. The effectiveness of using the media was evaluated by increasing the average pre-test and post-test scores obtained during product testing. The N-Gain score category is divided into three levels, namely high (N-Gain e" 0.70), medium (0.30 < N-Gain < 0.70), and low (N-Gain d" 0.30).

This study transforms the traditional snakes and ladders game into a math learning medium by adding educational elements such as math problems to each game box. In some game boxes, there is also a QR code that can be scanned with a cell phone; the rules in this game are also made as enjoyable as possible by placing the instructions for working on the question cards under the ladder and the head of the snake. This is done so that students try to answer the question correctly because if the student receives the question at the bottom of the stairs and manages to answer it correctly, they can go up the stairs. However, if the question is answered incorrectly, the student in the box must remain silent, and vice versa, for the question in the head of the snake. This change aims to create a fun and interactive learning atmosphere while improving the motto.

■ RESULT AND DISCUSSION
Analysis

In the first stage, namely analysis, the researcher evaluated the potential problems and collected data at SDN Wonoplembon 02. In order to identify potential problems, the researcher interviewed 5th-grade teachers of SDN Wonoplembon 02 and conducted observations in the classroom. The results of the interview and observation activities showed that several problems arose during the learning process. These problems include the selection of learning media that seems simple and less attractive to students, students' difficulties in understanding the material, students'

concentration who have not been able to focus during learning, learning outcomes of students who have not reached the KKTP, and learning that is still teacher-oriented.

After completing the analysis stage of potential problems, the researcher proceeds with data collection. Data collection activities aim to collect helpful information in the media development process. In this study, data was obtained through a research tool in the form of a needs questionnaire. Teachers and students fill out this needs questionnaire so that the media developed is right according to their needs. In this study, the questionnaire of teacher needs includes 14 and 13-question indicators with a choice of answer scores of 4, 3, 2, and 1. The indicator includes questions about the implementation of mathematics learning, the need for learning media, and the criteria for the required learning media. The analysis of the questionnaire showed that (1) the use of learning media is still minimal, (2) teachers and students agree that they need interesting learning media to increase interest and learning outcomes, (3) learning media must meet students' learning needs, (4) the display on media should use bright colors, (5) the need to add supporting elements such as pictures, (6) learning media must have an attractive and easy-to-understand design. The needs data collected from students and teachers will then be used as a reference in designing learning media.

Design

The core activity is to design learning media, which is developed by paying attention to the selection of safe and practical materials for students to carry, the use of bright colors, and the addition of media elements such as text, images, and color harmony between text, images, and backgrounds. The results of the initial design of the snake and ladder learning media are as follows.
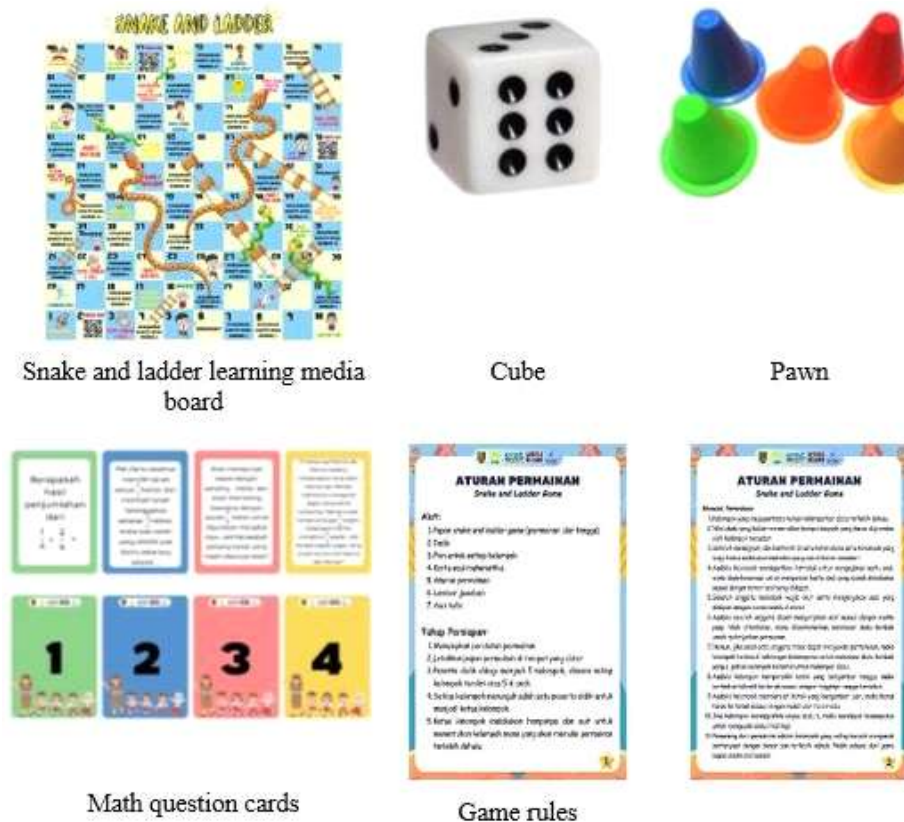

Snake and ladder learning media board

Cube

Pawn

Math question cards

Game rules

Figure 1. Initial design results of snake and ladder learning media

In creating snake and ladder learning media, the help of the Posterwall website and the Canva application were used. This learning medium consists of several elements such as a game board that has 100 boxes with various interesting instructions, barcodes that store teaching materials, pictures, cubes, and pawns in multiple colors, 30 question cards containing math problems about fractions for students to work on and printed on ivory 9 cm × 5 cm, and game rules designed with a bright background. Complete with page numbers and printed on A4 size HVS paper, which each group will accept.

Development

The next step is development, where learning media designed at the design stage needs to undergo evaluation by experts to determine its feasibility level. In this study, media design validation was carried out by media and material experts. Media and material experts validate learning media by referring to an instrument called a media feasibility assessment questionnaire. The validation results obtained are used as a reference in developing media. The results of developing learning media after receiving expert input and suggestions are as follows.

The results of the development of this media include materials that will be used for the snake and ladder learning media board, namely from a 2 × 2-meter china flexi material banner, the position of the question card instructions be placed under the ladder, and the snake's head, this is related to the rules of the game where the group that gets a box with a picture of a ladder, can go up to the box according to the height of the ladder, provided that students can answer questions appropriately. If the student answers the question incorrectly, they can remain in the starting position and not go up the stairs. If the students answer the questions correctly, the group that gets a box with a picture of a snake is allowed to stay in the box. If students answer the question incorrectly, they should move to the box corresponding to the snake's tail. The purpose of this is to increase students' motivation to learn so that it can impact learning outcomes.

The cube is transformed into a durable and attractively colored material; the cube is made from a pillow with a size reduced to 20 cm × 20 cm. There are containers for question cards designed using the Canva app, making it easy to store math question cards. The snake and ladder learning media box is also designed using the Canva application, which stores all the snake and ladder teaching media elements.

Implementation

After the learning media is revised following input from the validator and receiving a feasibility assessment, it is applied to classroom students. First, learning media was used on a small scale with six students. This aims to identify the extent of the learning media's feasibility and effectiveness. After that, learning media was also applied on a large scale with 22 students.

This implementation stage is carried out by students undergoing a pre-test, after which the teacher explains the fractions-related material. Furthermore, students are divided into five groups with members who have diverse abilities. After that, the teacher introduced the snake and ladder learning tool. The teacher outlined the game's rules and stated there would be two winners: the group that reached the finish line the fastest and answered the most questions correctly. After the game ends, the teacher will collect the scores obtained by each group, and the two group winners will receive a prize from the teacher. At the end of the lesson, students complete post-test questions to evaluate their ability in fractional material after participating in learning using the medium of snake and ladder games. The analysis is carried out on students' learning outcomes in the pre-test and compared with their learning results in the post-test so that the impact and effectiveness of learning media in improving student learning outcomes can be known.
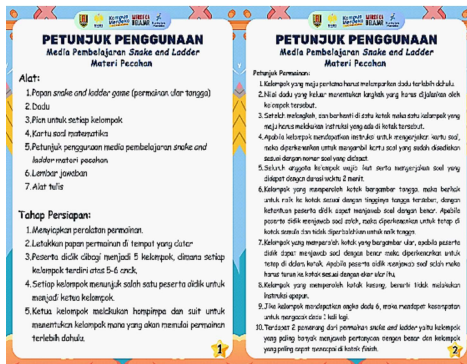
Snake and ladder learning media board made clearer

The cubes are made of pillows and have an interesting color

There is a description on the math question card

Media usage instructions were made more specific

Math question card box

Snake and ladder learning media box

More complete teaching materials

Figure 2. Results of the development of snake and ladder learning media

Evaluation

The final stage is evaluation, where teachers and students fill out a response questionnaire to assess the effectiveness and validity of snake and ladder learning media so that it can be used as a learning tool in 5th grade of SDN Wonoplembon 02, especially in fractional materials. Response questionnaires were given to teachers and small-

scale and large-scale trial students. The responses from the 5th-grade teacher resulted in a total score of 92 out of 100, which means it reached a percentage of 92% and is classified as very feasible. In the small-scale trial, a total score of 234 out of a maximum of 288 was obtained with a percentage of 81.25%, which is also included in the very feasible category. In the large-scale trial, a total score of 855 out of 1,056 was obtained, with a percentage of 80.96% still meeting the criteria of being very feasible. It can be concluded that the results of this questionnaire show that the snake and ladder learning media is very possible to use.

Results of Snake and Ladder Media Validity for Fractional Materials

In this study, the effectiveness of snake and ladder learning media can be measured through feasibility validation conducted by media and material experts. Media experts fill out questionnaires to evaluate media based on quality and technical aspects. In contrast, material experts fill out questionnaires to assess media in terms of content, materials, and language contained in learning media. According to the media feasibility evaluation results, the snake and ladder learning media scored 44 for quality and 29 for technical aspects. Thus, the evaluation of snake and ladder learning media by media experts obtained a score of 73 with a percentage of 91.25%. This percentage, if interpreted into the category, is very feasible because it is in the range of 76%-100%.

Based on the feasibility assessment by material experts, the snake, and ladder learning media obtained a score of 46 in the content and material aspects and a score of 15 in the linguistic aspect. If the results of the score are summed, then the total score obtained is 61, with a percentage of 89.70%. The 89.70% obtained from the feasibility evaluation by material experts shows that the learning medium of snakes and ladders is very feasible to use. Based on the feasibility evaluation by media and material

experts, in addition to obtaining excellent assessment results, snake and ladder learning media also received several suggestions for revision. The revision includes an explanation of the media title that should be added, the position of the instruction for making question cards, which should be under the stairs and snakeheads, and the selection of fonts by the standards. Explanations should accompany these cube materials that are more durable and attractive; question cards and instructions for use need to be explained in more detail, boxes for question cards, offer containers to learning media, the questions must be more realistic, the explanations in the illustrated questions must be completed, and the material in the teaching materials needs to be multiplied.

The validation results of these two experts are in line with the principles of efficient learning design and media development. According to the perspective of multimedia learning theory put forward by Mayer (2020), this media effectively combines visual elements (colored game boards, illustrations of snakes, and ladders) with verbal components (question cards and written instructions), supporting dual information processing that strengthens conceptual understanding. The principle of coherence is also evident in the revision recommendations that suggest simplifying typefaces and adding image captions to reduce cognitive burden. From the perspective of contextual learning theory, creating realistic questions according to the recommendations of subject matter experts allows students to relate fractional material to daily living conditions, as expressed in the concept of authentic learning. The placement of artistry instructions under strain and snakes is a liaison that supports the student in solving problems gradually, according to the theory of proximal developmental zones (Vygotsky, 1978). The game mechanics that include question cards, cube, and pawn movement provide immediate interaction and feedback that enhances the spirit

of learning. Proposed improvements, such as the use of more durable cube materials and the preparation of storage boxes, reflect attention to the usability and durability of the media, as well as the importance of practicality factors in learning design.

In addition to going through a validation process by competent validators, the level of media feasibility can also be measured through response questionnaires from teachers and students. In the teacher's response questionnaire, the snake and ladder learning media received positive results with a total score of 92 and a percentage of 92%. Furthermore, in a small-scale test, the response questionnaire was filled out by six students, who got a score of 234, which was converted into a percentage of 81.25% so that the media could be categorized as very suitable for use. On a larger scale, the results of completing the questionnaire by 22 students showed a total score of 855, which, if converted into percent, would be 80.96%. Therefore, based on feedback from teachers and students regarding the media, it can be concluded that the snake and ladder learning media is very feasible to use.

In addition to validation activities by competent validators, the level of media suitability can also be measured through feedback questionnaires from teachers and students. In the teacher evaluation questionnaire, the snake and ladder learning media received positive results with a total score of 92 and a percentage of 92%, according to the statement of the 5th-grade teacher. "The snake and ladder learning media is straightforward for children and can help explain the concept of fractions. Students seem more enthusiastic in following the learning." ("*Media pembelajaran ular dan tangga sangat mudah untuk anak-anak dan dapat membantu menjelaskan konsep pecahan. Siswa tampak lebih bersemangat dalam mengikuti pembelajaran*"). This statement shows that the media is technically qualified and successfully building a pleasant learning atmosphere.

Furthermore, six students filled out the response questionnaire in the small-scale test. It resulted in a score of 234, which was converted into percent to 81.25% so that the media could be categorized as very feasible to use. A competent student with a pre-test score of 85 stated, "I enjoy learning by playing. The problems in the math cards are exciting, and I want to reach the finish box soon." ("*Aku menikmati belajar sambil bermain. Masalah dalam kartu matematika sangat mengasyikkan, dan aku ingin segera mencapai kotak finis*"). This response shows that learning media can generate high learning motivation among students with exemplary academic achievements.

On a large scale, the results of collecting response questionnaires from 22 students showed that the total score obtained was 855 or, if converted into percent, 80.96%. A more detailed analysis reveals response differences depending on the student's initial ability level. Students who obtain a high pre-test score (>70) usually respond more positively to the element of challenge in the media. On the other hand, students with low pre-test scores (<50), as expressed by one of the students who said, "I still don't fully understand how to play this snake and ladder because the time available is too short, so I also have a hard time understanding the problem." ("*Aku masih belum sepenuhnya mengerti cara memainkan ular tangga ini karena waktu yang tersedia terlalu singkat, jadi aku kesulitas memahami soalnya*"). Although the media is helpful, they need additional explanations specific to the questions. The pedagogical implications of these results suggest that although the media is generally very feasible, there is a need to make adaptations to improve accessibility for students with low initial abilities.

Results of the Effectiveness of Snake and Ladder Media for Fractional Materials

The effectiveness of snake and ladder learning media can be measured through student

learning outcomes in pre-test and post-test activities. These activities are carried out during small-scale testing and large-scale testing. In small-scale tests, students' average pre-test score of 50.83 experienced a significant increase to 87.5 in the post-test. Meanwhile, in large-scale tests, the average student pre-test was higher, at 63.63, and also reached 87.5 in the post-test. The findings indicate that the development of applied learning media improves student understanding, with equivalent post-test results on both scales. In addition, data analysis can be performed with SPSS through normality tests, T-tests, and N-Gain tests to evaluate the effectiveness of snake and ladder media.

In this section, normality testing is carried out using the Shapiro-Wilk test formula, where the test criteria used as a reference for the normally distributed data in the Shapiro-Wilk test are if the significance value obtained is > 0.05 (greater than 0.05). Based on the Shapiro-Wilk normality test results, the data on students' learning outcomes in small-scale and large-scale tests showed a normal distribution. In small-scale testing, the p-value for the pre-test is 0.452, and the post-test is 0.700, both exceeding the significance level of 0.05, thus indicating a normal distribution. Likewise, in large-scale tests, the pre-test yields a p-value of 0.505 and a post-test of 0.013, both greater than the significance level of 0.05, indicating that the distribution is normal. Normally distributed data is a prerequisite for applying parametric analysis techniques in analyzing data in the next stage.

Furthermore, a t-test was held to evaluate the effectiveness of the media by looking at the difference in average values before and after using the media. The paired t-test criteria state that if the significance value (Sig.) is below 0.05, there is a significant difference between pre-test and post-test learning outcomes. The test results showed an essential difference between both evaluation scales' pre-test and post-test scores. In small-scale tests, the significance value (2-tailed) obtained is 0.000, and the same is true in large-scale tests that show a significance value of 0.000. These results show that both data have significance values below 0.05. Significance values below 0.05 result in a verdict that Ho is rejected and Ha is accepted. In other words, there is a significant influence between the use of snake and ladder learning media on students' outcomes in the 5th-grade fractional material of SDN Wonoplembon 02.

The last test was the N-Gain test, which was carried out to measure the effectiveness of snake and ladder learning media. It was estimated by increasing the average pre-test and post-test scores obtained during product tests. The higher the increase in the average score obtained, the higher the effectiveness of the learning media. The results of the N-Gain test on a small scale showed that the average pre-test score from 50.83 initially increased significantly to 87.5 in the post-test, with an increase in the difference of 36.67. Based on the calculation of N-Gain, it was obtained that the score reached 0.76 or 76%, which was included in the high category. This shows that the applied learning interventions successfully improve participants' understanding, with the rate of improvement being in the high category.

Meanwhile, the large-scale N-Gain test results showed that the average pre-test score of 63.63 significantly increased to 87.5 in the post-test, with an average difference of 23.87. Based on the calculation of N-Gain, a Class N-Gain value of 0.71 was obtained, which was included in the high category. In percentage, the N-Gain Score results reached 71%, showing the effectiveness of the intervention or teaching method to improve participants' understanding. For N-Gain score data, it is shown in the following bar chart.

Based on Figure 3, it can be seen that the analysis of the N-Gain test is carried out on each indicator, namely concept understanding, counting operations, and context application. In the control class, where learning took place without media,
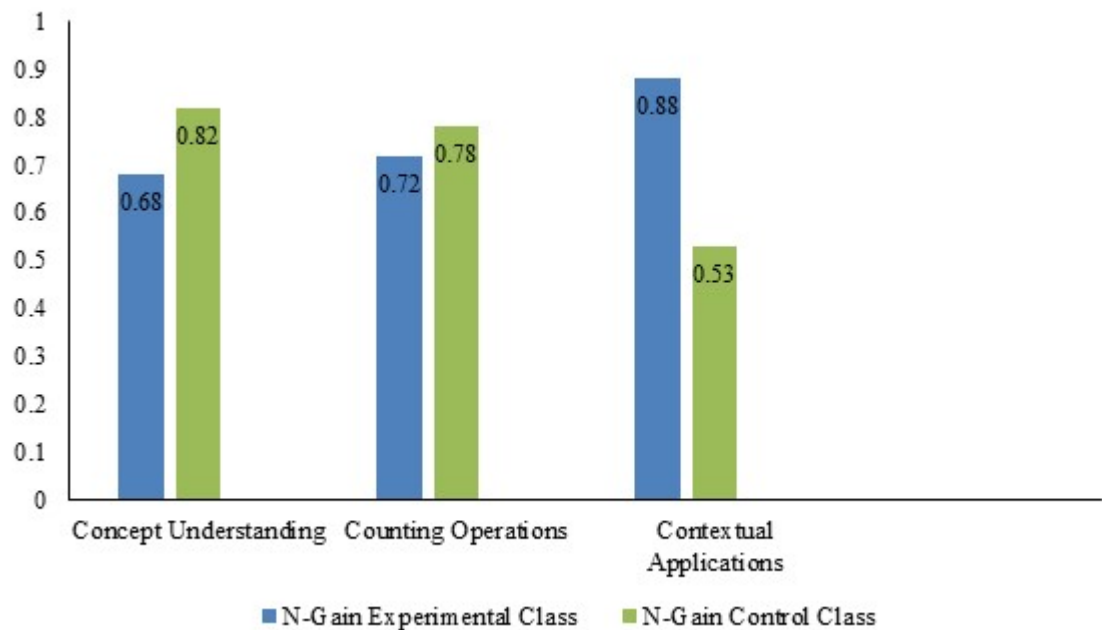
Figure 3. N-Gain score diagram based on indicators

the N-Gain value for each indicator was as follows: concept understanding 0.68, counting operations 0.72, and contextual application 0.88. Meanwhile, for the experimental class that applied media in learning, the N-Gain value obtained was as follows: concept understanding 0.72, counting operations 0.78, and contextual application 0.53. The increase in the highest score of N-Gain lies in the indicators of concepts understanding and counting. Overall, the average N-Gain value in the experimental class was 0.76, while in the control class it was 0.71. Both showed a Gain Index exceeding 0.70, so it can be concluded that the media effectively improves student learning outcomes in 5th-grade fractional material of SDN Wonoplembon 02.

Using snake and ladder learning media has been proven to improve students' ability in fractional material, especially in addition and subtraction of fractions. This increase in learning outcomes can be explained through several factors related to the characteristics of game-based learning media. First, game-based learning media offers a high level of interactivity, allowing students to interact directly with the learning material through game mechanisms such as

challenges or direct feedback (Plass et al., 2015). Second, an interesting aspect of snake and ladder learning media is that it encourages students to participate more and enjoy the learning process. Third, the game rules presented can increase students' motivation to learn until the end of the game so that they are more focused and try to answer questions appropriately. This increase is in line with the results of previous research explaining that the use of snake and ladder media for fractional learning has been proven to increase student participation; students become more enthusiastic in answering questions and compete positively to achieve the highest score, so that through educational games can reduce students' anxiety about subjects that are considered difficult, such as mathematics (Sailer & Homler, 2020).

According to research conducted by (Widyaningrum, 2022), the ULTAKABI (*Ular Tangga Perkalian dan Pembagian*) learning media shows a more significant improvement in understanding the concept of multiplication and division, while the snake and ladder learning media is more effective in fractional material, especially in addition and subtraction of fractions.

The findings of this study indicate that the use of ULTAKABI has proven to be effective in increasing student learning achievement. This can be seen from students' exam scores, which show progress between pre-test and post-test scores. The increase in learning outcomes achieved by students from 48 to 78, where the students' achievement increased by 30%. Although this study focuses on multiplication and division, this learning tool can be further improved in various other mathematical concepts, such as basic operations, measurements, geometric shapes, and integers, by modifying the design and content of the questions. That way, snake and ladder learning media can be a creative solution to improve learning outcomes and student participation in the mathematics learning process. The limitations of this study are (1) the limited sample size, involving only 28 students from one elementary school, so the results cannot be generalized to a more varied population; (2) the duration of the experiment was short, so the results obtained only reflect the initial response of the students, and did not include the consistency over a more extended period. The suggestion for research in future issues is to test the effectiveness of snake and ladder learning media on other mathematical topics, such as basic number operations, measurement, flat builds, and integers, integrating digital technology to improve interaction, and conducting research by expanding the sample and longer duration.

■ **CONCLUSION**

The snake and ladder game media is designed to learn while having fun. The results of the feasibility evaluation showed that the snake and ladder game media received an assessment from media experts of 91.25% with a very feasible category and an evaluation by material experts of 89.70% with a very feasible category. The difference in learning outcomes on a small and large scale shows that the use of snake and ladder game media can improve student learning outcomes in fractional materials. The evaluation applied in this study was in the form of a multiple-choice exam consisting of 20 questions. The striking difference between the pre-test and post-test scores is shown by the average difference on a small scale of 36.67, while on a large scale, it is 23.87.

The t-test showed that the results of the significance test value were 0.000, which means that the use of snake and ladder game media significantly influenced student learning outcomes in fractional material in grade 5 of SDN Wonoplembon 02. The N-Gain test indicates that learning with the medium of snake and ladder games is very effective and can improve learning outcomes on fractional topics. Small-scale N-Gain analysis shows a value of 0.71, while large-scale shows a value of 0.76, both of which fall into the high category. Therefore, snake and ladder games are very effective in grade 5 to improve understanding of fractional concepts and reduce students' anxiety about math lessons. The snake and ladder game media can be a learning option that improves learning outcomes, motivates students, and strengthens their skills in performing fractional basic operations. Information from questionnaires filled out by teachers and students indicated that snake and ladder media have visual appeal and can create a pleasant learning atmosphere, thereby increasing students' active participation in working on fractional problems, especially in the context of 21st-century learning that emphasizes collaboration, creativity, critical thinking, and communication skills (4C). This media increases students' enthusiasm for learning and supports active learning through a game-based learning approach. Snake and ladder can be customized for various lessons by changing the content of questions or challenges according to the needs of the curriculum. Suggestions related to snake and ladder game media include testing the effectiveness of snake and ladder game media on other mathematical topics such as basic operations, measurements, geometry, and integers, as well as integrating digital technology to improve interactivity.

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