

## **The Development of Math Learning Media: 3-Dimensional Snake and Ladder**

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### **Abstrak:**

This article is motivated by the lack of mathematics learning media at Islamic primary education, which has an impact on the low motivation of students to learn the subject. To solve these problems, the development of three-dimensional snakes and ladders is an interesting thing to do. In order to develop the media and measure the feasibility of 3D snakes and ladders learning media in the mathematics subject matter of counting operations of whole numbers, this research is to be carried out. The research method used is research and development using the Borg & Gall model, which is composed of five stages that have been limited. The research subjects were homeroom teachers and fourth grade students at MI Miftaul Huda Kanigoro Blitar. By conducting validation tests with media experts, materials, math teachers, and students. So that the percentage of feasibility of material experts (79.3%) with the predicate "valid" is not revised, media experts (94.1%) with the predicate "very valid" is not revised, math teachers (92.8%) with the predicate "very valid" is not revised, and the increase in learning outcomes reaches 90%. So it is concluded that the learning media for the 3D snakes and ladders game of counting operations for small numbers reaches a value of more than 68%; therefore, it can be stated that the media is relevant or suitable for use.

### **Keywords:**

3-Dimensions; Snake and Ladder; Learning Media; Math

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## Introduction

Mathematics plays an important role in education at all stages of education, serving as a fundamental subject that is essential for developing competitive human resources ([Mahmudah & Inayati, 2019](#); [Negese Wayesa, 2020](#)). The National Curriculum Framework emphasizes the importance of mathematics education in developing children's mathematical abilities and useful skills such as numeracy ([Mazzocco, 2016](#)). However, there are challenges in teaching mathematics effectively, with questions raised about what and how to teach, as well as the training required for educators ([Charles-Ogan, 2014](#); [Jaworski, 2015](#)). To address these challenges, efforts such as seminars on the utilization of mathematics learning media have been made to increase teachers' capacity to use visual aids to enhance students' understanding of mathematical concepts ([Stylianides & Stylianides, 2014](#)). Overall, the interdisciplinary nature of mathematics underscores its significance in various fields of human activity, making it a cornerstone subject throughout the educational journey.

Mathematics learning has a specific concept or subject matter that can play a role in developing the way of thinking of elementary school-level students. So that in the implementation of mathematics learning in Madrasah Ibtidaiyah, it must be considered so that the learning signs and demands listed in the curriculum are not missed. The current education curriculum requires students to be active in learning ([Albar et al., 2020](#)). Learners must be positioned as subjects in learning and are no longer objects that only receive information from the teacher. Therefore, to stimulate the activeness and creativity of students, teachers are required to be more creative and innovative in order to create an effective and conducive learning atmosphere. With the efforts made by the teacher, it is hoped that the learning process created will be able to achieve maximum learning objectives.

In the context of mathematics learning in elementary schools, it is crucial to incorporate innovative models and media to enhance students' intellectual development ([Hasanah, 2023](#)). Elementary school serves as the foundation for future learning, with mathematics playing an important role in shaping students' cognitive abilities ([Lin, 2023](#)). Utilizing teaching aids and visual media can significantly improve students' understanding of mathematical concepts and promote active learning ([Zulfikar et al., 2022](#)). By encouraging teachers to be more creative and innovative in their approach, students can be positioned as active participants in the learning process, stimulating their creativity and engagement ([Mahmudah & Inayati, 2019](#); [Sarnoko et al., 2021](#); [Vale & Barbosa, 2023](#)). This learner-centred approach is in line with the modern education curriculum which emphasizes active student engagement in the learning process.

To achieve the required learning objectives, teachers need to present media in the classroom learning process ([Chusna, 2020](#)). Students of elementary school (MI or SD) age are basically in the concrete operational stage, where everything in learning is pursued using concrete examples or props for each subject matter ([Ulum, M. N., & Inayati, 2021](#)). According to the results of interviews with mathematics teachers, he stated that the majority of mathematics learning media are still in the form of a collection of formulas conveyed through posters or pocket books, this is certainly considered less interesting and makes students less motivated and easily bored with learning mathematics. In memorizing formulas, special media are needed that can provide one of the solutions to these problems. The effort made is to develop 3-dimensional snakes and ladders media with a fun game-based learning design. Snakes and ladders are basically one of the traditional games that have been very

attached to the world of students ([Seruni et al., 2019](#)). Usually, snakes and ladders are designed in the form of 2-dimensional media, but in this study, the researchers modified them into a 3-dimensional form. With this 3-dimensional snakes and ladders media, it is hoped that without realizing it, students will be able to memorize and practice it with pleasure and enthusiasm. Of course, the development of this media is tailored to the abilities and characteristics of students. The role of the teacher in using this 3-dimensional snakes and ladders media is, of course, as a learning facilitator in order to create an active and fun learning atmosphere.

3D snakes and ladders media is a game played by two or more people, equipped with components consisting of a snakes and ladders board, pawns as people, and dice. The snakes and ladders board is designed with small boxes enhanced with snake images as a sign of going down to the box below and stairs as a sign of going up to the box above. The dice are used as the course of the pawn when showing the number of steps found on each side of the dice. While three dimensions are the shapes of objects that have width, height, and length. In the fields of animation, art and computers, these terms are often used. And volume is the certainty of each three-dimensional building. Thus, this snakes and ladders media is expected to be able to increase the motivation and learning outcomes of students well.

The specification and development of mathematics learning media become the focus of this research. Learning media is a learning resource that can assist teachers in presenting learning materials to achieve learning objectives ([Inayati & Sufathan, 2022](#); [Susanti et al., 2022](#)). The results showed that problems in learning mathematics can be seen from several factors, one of which is student interest in learning, which can be seen from indicators of student interest in learning, including students' feelings of pleasure, attention to learning, subject matter and teacher attitudes, interest, benefits, and subject functions. (Mariyana et al., 2022) Using various types of learning media can increase students' interest in learning new things in the learning material delivered by the teacher so that it can be easily understood ([Nurrita, 2018](#)). Through the analysis of product validity, material, and learning experts, it is hoped that it will be able to distinguish the learning outcomes of classes that have not used snakes and ladders game media after using snakes and ladders as a medium for learning mathematics and arithmetic operation material.

Some research results conducted by previous researchers show that mathematics snakes and ladders media can be said to be feasible and practical for learning mathematics in elementary schools ([Atmoko et al., 2017](#)). Learning math with snakes and ladders game media can increase student motivation to continue learning ([Ferryka, 2018](#); [Afifah & Hartatik, 2019](#)) because learning becomes a pleasure ([Nawafilah & Masrurroh, 2020](#)). Several other studies state that the use of snakes and ladders media can increase knowledge ([Muqdamien et al., 2021](#)), activeness, and learning outcomes ([Suciati, 2021](#); [Baiquni, 2016](#)). From some of these research results, researchers are increasingly convinced that the development and use of 3-dimensional snakes and ladders learning media can increase students' learning motivation.

## **Research Methods**

Educational product-oriented development, specifically research and development (R&D), focuses on the creation of educational products through systematic research methods ([Chen, 2019](#)). R&D involves stages such as needs analysis, product development, and testing for effectiveness, aiming to improve the learning experience by providing innovative and effective learning materials ([Yuan et al., 2023](#)). Qualitative and quantitative data are the data sources in this study. The

data is obtained from two stages, namely field trials and expert validation. The validation of learning media was tested through assessments conducted by 3 validators, namely media expert validators, material expert validators, and validators by mathematics teachers at Madrasah Ibtidaiyah Miftahul Huda 01 Sawentar Kanigoro Blitar.

This learning media goes through several stages of development, namely: 1) analyzing potential problems; 2) preparing teaching materials in accordance with the product to be developed; 3) product validation conducted by three validators; 4) product improvement based on revision notes from validators; 5) conducting trials with students with the results of products that have been developed. Furthermore, the products that have been developed are tested to collect data that can be used as a basis for the effectiveness, validity, and attractiveness of the products produced. At the trial design stage, the researcher will determine the level of content, appearance, and applicability of the product. In this case, the product is accompanied by an implementation manual for the teacher. The teacher will provide criticism and suggestions after using the media in the learning process, and from the students' activities, the level of media attractiveness and applicability will be determined after the students take the test. A way to determine the validity of this product is by: 1) validation by mathematics learning experts; 2) validation by media experts; 3) small group trial; 4) large group trials.

The authors conducted this trial in small and large groups, because the results of the trial determine the success of the research and development. If the small group trial stage produces data that is in accordance with the development objectives, then in the large group trial stage, the data obtained must also be in accordance with the objectives of this product development. First The initial step of the small group trial is a trial test of students in one group of 15 with the criteria of active grade 4 students at MI Miftahul Huda 01 Sawentar. Second, the results of the evaluation of the small group trial of these students will represent the target of the large group trial. Third, the existence of students as a source of data in the development of this snakes and ladders learning media. Fourth, the next stage is the large group trial stage, which consists of twenty-six students selected from class IV MI Miftahul Huda 01 Sawentar.

## **Results and Discussion**

### **Potential problem analysis**

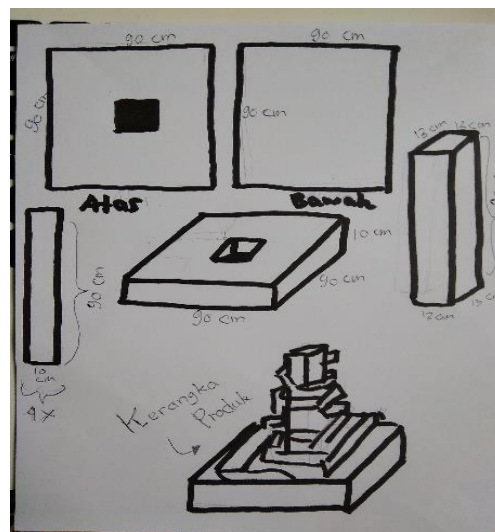
The problems at MI Miftahul Huda 01 Sawentar are: a) the utilization of existing school facilities in learning mathematics is still minimal, especially mathematics learning media. b) Learning in class IV still uses a classical learning style. During the learning process, the teacher was more active in explaining, while the students only recorded and listened to the material given by the teacher.

In recognition of the need for a more active and engaging math learning experience, researchers have developed 3-dimensional snakes and ladders media to enhance the learning process for students in grade 4 ([Hasanah, 2023](#)). This innovative approach aims to move away from traditional and passive learning styles towards more interactive and stimulating methods, aligned with the goal of encouraging creativity and skill acquisition in students ([Lutfia et al., 2023](#)). By incorporating game-based elements into mathematics learning media, students are not only encouraged to actively participate but also to enhance their emotional processing and cognitive abilities, ultimately leading to a more comprehensive understanding of mathematical concepts and achieving the desired learning outcomes ([Siregar, 2023](#); [Sakdah et al., 2022](#)). This movement towards interactive and game-based learning strategies reflects a broader trend in education towards the utilization of innovative technologies and media to optimize learning experiences and student engagement ([Syaikhu et al., 2022](#)).

Based on the explanation above, the researcher developed a 3-dimensional snakes and ladders media with the expectation that students can be more active in the mathematics learning process so as to gain knowledge in accordance with the learning objectives. The mathematics learning media developed through this game base is expected to not only make students play but also gain knowledge, process emotions, and improve skills and creativity that have never been obtained before.

**The preparation of teaching materials in accordance with the developed product**

In the next stage, the authors prepare teaching materials that are tailored to the product developed by designing a game-based mathematics learning media for learning materials for counting operations of small numbers in class IV Madrasah Ibtidaiyah. The design in this developed media is inspired by the stairs. From this inspiration, researchers develop their own media that is appropriate and refers to the material.



**Figure 1. Media Design**

At this stage of media making, researchers create real and three-dimensional media concepts. So that it looks more attractive for students to be motivated, enthusiastic and active in the learning process. This media is made from plywood base material which is cut in such a way and assembled into a snakes and ladders game-based math learning media.



**Figure 2: Product Development Process**

Snakes and Ladders game-based media development is a game that teaches counting and patience as well as characteristics in the affective and psychomotor

domains. From the game, researchers can take some materials that can be used to help develop game-based learning media. The components of the math teaching aid media consist of:

1. snakes and ladders packaging is a container to cover all components of math learning media;
2. snakes and ladders board is a board that serves to use media in teaching materials in the form of pictures and writings. The board is square, with an area of 50 cm<sup>2</sup> and a media height of 50 cm<sup>2</sup>. On the board, there is mathematics learning material for counting operations of small numbers with a variation of snakes and ladders in the form of three dimensions;
3. math dice are dice that contain numbers playing snakes and ladders media. The dice are the same as dice in general, which usually consist of dots;
4. pawns that are on the snakes and ladders board to show the player who will run in the teacher's direction. The pawns are 4 in number, but can be played by less than four children;
5. the teacher's guidebook, the book is useful for teachers in getting to know and learning how to use the 3-dimensional snakes and ladders math teaching aid learning media. The book contains instructions and directions for using the 3-dimensional snakes and ladders media and the function of each object in the 3-dimensional snakes and ladders.

The components of the 3-dimensional snakes and ladders media described above can be seen in the following figure:



Figure 3. 3-Dimensional snakes and ladders media display

In the development of three-dimensional educational media such as snakes and ladders game-based math learning media, various components play an important role in increasing student engagement and motivation. These components include snakes and ladders packaging to cover all materials, square boards for visual and written content, math dice for interactive number activities, player markers for game progression, and teacher manuals for instructional support (Nurbaiti et al., 2022;

[Panjaitan et al., 2023](#)). By combining these elements, researchers aim to create an engaging and interactive learning tool that promotes counting skills, patience, and affective development among learners. The 3D nature of the snakes and ladders game adds a tactile dimension to math learning, making it more engaging and effective in facilitating student understanding and participation in the learning process ([Syaikhu et al., 2022](#); [Anggraeni et al., 2023](#); [Isnawati et al., 2022](#)).

### **Validating the developed product**

The next step after the product is completed is data analysis and material validation. To increase the level of validity of the product developed, analysis techniques are needed to process data from the results of product trials. The assessment of the product test was carried out by mathematics subject matter experts through descriptive analysis and content analysis.

The data presentation of the results of expert validation of the content of mathematics learning on the material of counting operations of whole numbers is as follows: 1) The relevance of learning media to the applicable curriculum and syllabus is very appropriate; 2) The writing of the title in the learning media is appropriate, relevant and clear; 3) The learning media used is in accordance with the existing SK-KD; 4) The language used in the learning media is very relevant, and very clear; 5) The learning media used is interesting; 6) The coverage of the material is in accordance with the learning media. The material coverage is in accordance with the learning media; 7) The relevance of the learning media to the indicators that students will achieve is relevant; 8) the questions given with the learning material are very suitable; 9) the questions given in the learning media really provide motivation for students to study more diligently.

The first validation of the 3-dimensional snakes and ladders game as a mathematics learning media showed an achievement level of 57.64%, indicating the need for revision or improvement ([Anggraeni et al., 2023](#)). However, after the second validation, the achievement level increased to 79.3%, indicating that the game qualifies as a suitable learning medium for counting operations without requiring further revision ([Aela et al., 2023](#)). This increase shows that the Snake Ladder game can effectively improve students' math skills. To refine the development product, researchers can consider feedback from math subject content experts, incorporating their criticisms and suggestions for further improvement ([Ongko Halim et al., 2023](#)).

### **Product Improvement**

The next stage is data analysis and media validation. The snakes and ladders game design developed as a media in learning mathematics must go through assessment and validation. In validating the product, there are several aspects that must be assessed.

The following are the components of the learning media design validation results, including: 1) The accuracy of the media is very relevant to the learning objectives; 2) The accuracy of the media with the characteristics of elementary school level children is quite appropriate; 3) The ease of obtaining media making devices is sufficient; 4) The ability of the media to develop students' interests is very relevant; 5) The ability of the media to activate students in thinking is quite relevant; 6) The ease of using the media is very easy; 7) The clarity of the images presented is clear and very easy to use. The clarity of the images presented is clear and very interesting; 8) The safety of the media when used is very relevant; 9) The clarity of the colors presented is very interesting.

Based on the assessment results of the snake ladder game as a learning media, the feasibility level increased from the initial validation of 70.5% to the final validation of 94.1% after revision based on feedback from media experts [1]. This significant

increase indicates that the snake ladder game can effectively serve as a math learning tool for counting numbered operations (Panjaitan et al., 2023). The high feasibility percentage of 94.1% indicates that the game requires no further revisions and can be used as an engaging and effective educational resource for students, demonstrating its potential as a valuable medium for improving learning outcomes in a variety of subjects, including mathematics and biology (Ongko Halim et al., 2023).

In the development of mathematics learning media, validation by mathematics subject teachers at MI Miftahul Huda 01 Sawentar played an important role in assessing the quality and effectiveness of the Snake Ladder game as a learning media, resulting in a high quality level of 92.8%. This validation process, in addition to assessment by material and design experts, ensures a thorough evaluation of the validity and usability of the product in an educational setting (Mawarsari et al., 2023). Feedback from math teachers, including comments on question difficulty and efficiency considerations, provided valuable insights to further refine the snake ladder game as a math learning tool, increasing its overall effectiveness and relevance in teaching math (Putri et al., 2023). Incorporating these teacher feedback and suggestions can lead to continuous improvement and optimization of the learning medium, making it more engaging and beneficial to students' learning experiences (Ongko Halim et al., 2023).

### Products Trial

The next stage is the analysis of the trial comparison. The results of students' responses to the 3-dimensional snakes and ladders learning media on counting operations of whole numbers. Based on the average response received by researchers from respondents, the VI grade students obtained a percentage of the feasibility level of the snakes and ladders game as a mathematics learning media of 90%. Based on the results of small-scale tests in class IV that researchers conducted at MI Miftahul Huda 01 Sawentar, Kanigoro sub-district, Blitar district, they got a score of 270, which should be the highest score of 300, with an average percentage of 90%.

The description above shows that the mathematics learning media that was developed through the snakes and ladders game is very interesting, very feasible, and can motivate students to be active in learning, especially in the material of counting operations of whole numbers. The percentage obtained at the feasibility level of the learning media concludes that this snakes and ladders game is feasible, so it does not need to be revised.

The large-scale product trial was obtained from the results of the pre-test and post-test scores. As stated in the research subject, namely in class IV with a total of 26 students. The values obtained from the pre-test and post-test results of class IV students of MI Miftahul Huda 01 Sawentar are as follows:

**Table 1. Student Test Results**

Item	Pre tes	Post tes
Number of students	27	27
Total score	1435	2155
Average	55,1	82,8

The use of game-based media in the snakes and ladders game has significant results; the post-test score in class IV MI Miftahul Huda 01 Sawentar in learning math is a difference of 26.3 from the pretest score. For this reason, it can be concluded that this 3-dimensional snakes and ladders learning media is suitable to be used as a medium for learning mathematics in grade IV.



The next stage is the revision of the development results. The development and manufacture of mathematics learning media on counting operations of small numbers with a 3-dimensional snakes and ladders game can be completed to the final stage through several revisions, criticisms, and suggestions given by mathematics material experts, media development design experts, and subject teachers. Equipped with a guidebook for teachers and students who have been assessed with predetermined criteria and components.

The development and creation of mathematics learning media materials, particularly counting operations with a 3-dimensional snakes and ladders game, can advance to the final stage through iterative revisions based on feedback from experts and teachers ([Haluti et al., 2022](#); [Baok et al., 2022](#)). By incorporating criticisms and suggestions from mathematics material experts, media development design experts, and subject teachers, learning materials can be refined to ensure effectiveness and practicality ([Fardah et al., 2022](#); [Fatimatuzzahro et al., 2022](#)).

. In addition, the inclusion of handbooks for teachers and learners, evaluated based on predetermined criteria and components, can further enhance the usability and educational value of the developed media ([Hanifah et al., 2022](#); [Rohmah et al., 2023](#)). This comprehensive approach, integrating feedback from various stakeholders and utilising assessment tools, ensures that the final product meets the standards required for quality and educational impact.

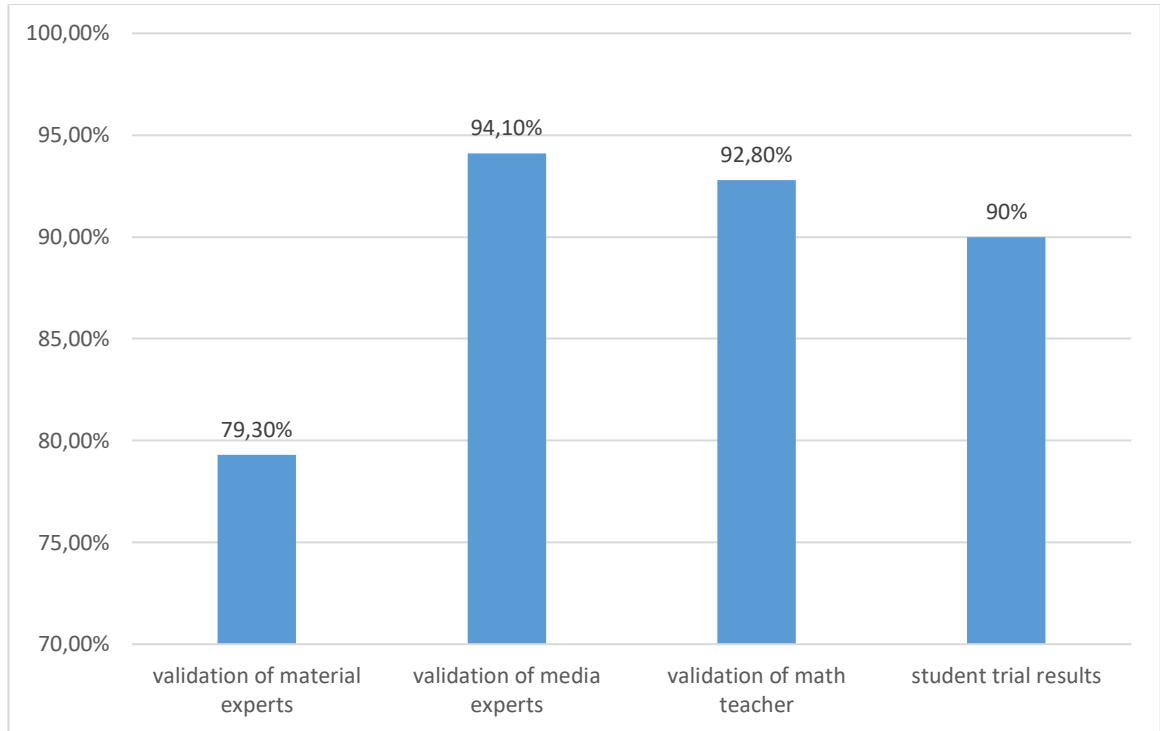
The development and refinement of learning media, such as 3D snakes and ladders games, relies heavily on feedback from validators and experts to ensure effectiveness and efficiency in achieving learning objectives ([Rohman, 2022](#); [Syaikhu et al., 2022](#)). Through the ADDIE model and research methodology, studies have consistently shown that incorporating feedback from subject matter experts, media experts, and educators leads to the creation of valid, practical, and effective learning tools, increasing students' motivation and interest in the subject matter. An iterative revision process based on feedback ensures that learning media meet the necessary criteria for feasibility and appeal, ultimately creating a conducive learning environment that supports educational objectives and improves learning outcomes.

Mathematics subject matter experts emphasised the importance of integrating snakes and ladders media content that aligns with the Core Competencies and Basic Competencies in grade VI mathematics textbooks to increase direct uptake by learners. By providing clear instructions in 3D snakes and ladders learning media, game-based media can be used independently, offering educational value as a learning tool for calculating operations in mathematics ([Firmansyah, 2023](#)). The development of interactive and engaging media such as snakes and ladders games not only increases student motivation and enthusiasm but also significantly improves learning outcomes, as evidenced by the positive impact on student performance and engagement in various studies ([Aela et al., 2023](#)). This approach ensures that learners can access and benefit from educational content outside of the traditional classroom setting, making math learning more accessible and enjoyable for everyone.

The mathematics subject matter expert suggested that there should be brief rules that can be shaped like a small book or placed behind the game board. The rules are clearly stated as a user guide or instructions for game users. Meanwhile, according to media development design experts, teaching resources and materials provide revisions, namely, some images that are less clear and less neat, so that they can provide opportunities for deviations in perception. For that, the researcher fixes them as a design improvement. In contrast to the math teacher, the revision of the questions given in the 3-dimensional snakes and ladders game was made easier so that the duration of playing students could be faster. This is necessary as a consideration of the time allocation available in math lessons each week ([Annam et al., 2021](#)). Revisions were made for clearer images and faster gameplay duration.

These revisions, suggestions, and input were then used as a reference for researchers to refine and improve the game developed, namely the snakes and ladders game.

From the final results of the validation/field trial above, it can be depicted in the form of a graph as follows:



**Figure 4. Final validation results**

The 3-dimensional snakes and ladders media for learning mathematics on the material of whole numbers has 79.3% results from the validation of material experts, 94.1% of learning media experts, 92.8% of validation results from mathematics learning teachers, and 90% of the results of student trials, so it is feasible to be used as one of the solutions in solving problems in the mathematics learning process to make it more interesting, active, effective, and fun for students.

### **Conclusion**

The problem-solving approach is the focus in math problems so that each problem can be solved. Therefore, researchers apply concepts effectively, efficiently, and appropriately to solve problems in learning so that student learning outcomes can improve. The learning media for the snakes and ladders game for the operation of integers consists of a game board, dice, pawns, question cards, and a guidebook for teachers. All of these parts are packaged on a board resembling steps that are used as a place for media and as a game board. The media is developed in the form of a game that is much loved by students, in which there is educational learning that supports students to understand and solidify learning material. In its development, the game is developed in content and design by adjusting the needs or abilities of students. The rules of play and game equipment are almost the same as the snakes and ladders game in general. This is intended so that students are not confused or so that students do not have to learn the rules of the game again when going to play. Through the mathematics learning media products developed through the 3-dimensional snakes and ladders game of integer operations, by going through several stages in its preparation, it gets a good qualification assessment and is feasible. So that the game will feel familiar and easily understood by students.

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