



## DEVELOPMENT OF ARITHMETIC CONGKLAK MEDIA (CONGKARIT) TO IMPROVE LEARNING OUTCOMES OF GRADE VIII STUDENTS

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### ABSTRACT

Mathematics is often considered an abstract and difficult discipline to understand by many students. One of the media that can be used to help students understand arithmetic material is the Congklak Arithmetic (CONGKARIT) media. The purpose of this study is to develop and test how effective the media is in improving the learning outcomes of grade VIII arithmetic. The method used is RnD (*Research and Development*) which uses the ADDIE (*Analyze, Design, Development, Implementation, and Evaluation*) model. The data collection techniques used include observation, test interviews, and questionnaires given to teachers and students. The data analyzed came from the results of observations and interviews of the products that were developed and then tested for the suitability of the arithmetic congklak media. This media obtained a score of 94% from media experts and 85% from material experts, indicating that the product is very valid or very suitable for use. Students showed an increase in learning outcomes with a pretest score of 34.65% and a post-test score of 81.05%, so this arithmetic media is considered relevant and suitable for use in this study. Furthermore, teachers and students gave positive responses, with a score of 94.2% and an average score of 81.8%, indicating that this multiplication medium is practical and effective in improving students' arithmetic learning outcomes. The arithmetic spoon not only serves as a teaching aid, but also serves as a learning aid.

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### INTRODUCTION

Mathematics is a universal science that drives technological advancement. Mathematical concepts such as problem solving, analytical thinking, and logical reasoning have greatly contributed to advances in the fields of technology and science. Learning mathematics from an early age is essential to building students' critical and systematic thinking skills. Learning mathematics early also trains students to develop the mindset and skills necessary to become superior human resources who are ready to contribute to future technological advancements. Mathematics should be taught to students because it is essential for daily life (Aritonang & Lubis, 2024).



Historically, congklak is believed to have originated in the Middle East and spread to Southeast Asia through trade routes. In Indonesia, this game has become an integral part of the local culture and is often played by children and adults as a form of entertainment and learning (Febriyanti et al., 2019). In the context of learning, congklak offers a variety of mathematical concepts that can be explored. For example, players must divide seeds into holes on a cone board, which involves basic arithmetic operations such as addition and division. In addition, players are also required to plan strategic steps, which are related to problem-solving and decision-making (Widenisah et al., 2023).

Previous studies have shown that incorporating traditional games such as congklak into math lessons can improve students' understanding of concepts and increase their motivation to learn. This is because the games they are familiar with can show how mathematical concepts can be applied in everyday life (Lestari et al., 2023).

In addition to the academic aspect, the game of congklak also teaches social and cultural values. During the game, players learn about honesty, sportsmanship, and cooperation. These values are important in the formation of student character and can be integrated into classroom learning (Fitriatunnisa et al., 2024). However, as technology develops and lifestyle changes, the popularity of traditional games such as congklak begins to decline. Children are more interested in digital games, so cultural heritage such as congklak is endangered. Therefore, it is important to revive this game through integration in the educational curriculum (Taus et al., 2022).

Students often find mathematics education at the junior high school (SMP) level difficult, especially arithmetic material, which requires a strong understanding of concepts and strong numeracy skills. The absence of interest and desire to learn can hinder the achievement of expected competencies. In addition, character education, especially the value of honesty, is an important aspect of the learning process that needs to be instilled from an early age (Okpatrioka, 2024).

Traditional games such as congklak have proven to be effective in improving mathematics learning outcomes at the elementary school level. Research (Zainudin et al., 2022) shows that the use of congklak in mathematics learning can increase students' motivation to learn. In addition, the game of congklak can also instill character values such as honesty, responsibility, and cooperation.

Although there have not been many studies exploring the use of congklak games in junior high school (SMP), most of the previous research has concentrated on the elementary school level. In fact, students face more complex challenges in terms of academics and character development in adolescence. As a result, this study aims to study how effective the congklak game is in improving their analytical abilities in arithmetic material. The congklak game can be used by teachers as a tool in classroom learning to explain abstract mathematical concepts, helping students understand the material better (Fajriyah et al., 2023).

In addition, incorporating traditional game media into learning can help parents and the community become more involved in the educational process. They have the opportunity to contribute and help preserve traditional games for the next generation (Fitriatunnisa et al., 2024). Learning media can also make students more interested in learning (Afri & Br Sembiring, 2022). In addition to the components of teachers and students, teaching materials using learning media are also very important in the success of learning objectives. Then traditional learning media can increase the enthusiasm and effectiveness of student learning (Siregar, M.A.P., et al., 2023).

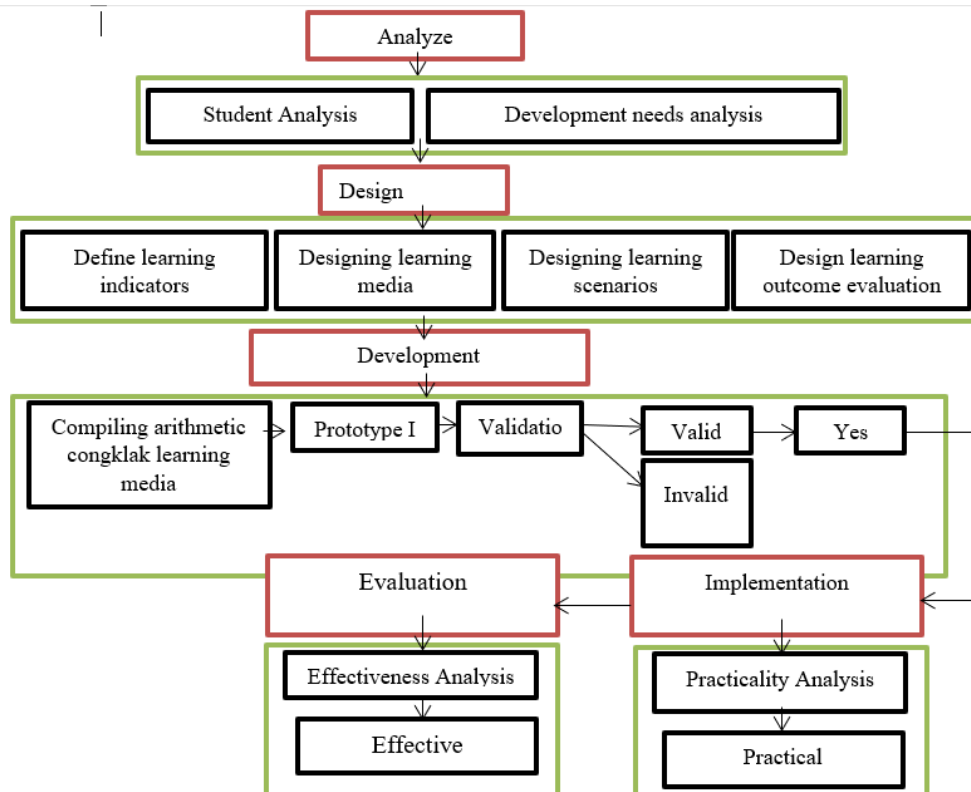
Based on the explanation above, the question asked by the researcher is: how is the development of the arithmetic congklak media carried out? And what are the achievements of students after using the Arithmetic Congklak media? Thus, the purpose of this study is to determine the development of arithmetic congklak media and student achievement after using it. Therefore, this study will develop a congklak board, game cards and arithmetic congklak game rules as well as the use of arithmetic congklak media in grade VIII junior high school (SMP). It is hoped that by understanding the explanation above, students will be motivated and enthusiastic to learn and improve the learning outcomes of arithmetic material.

## RESEARCH METHODS

Researchers conduct research called research and development (R&D). "Research" and "development" are the words that make up this methodology. To create a specific product design, the first step is to conduct research and analysis of the literature. The second step is development, which means testing the effectiveness and validity of the plan created so that it becomes a tested product that can be used by everyone. Certain products are created through needs analysis research to test how well they function in society (October, 2023). Based on the

above opinion, it can be said that research and development is an effort to create products that can be used in education and validated. In addition, the purpose of this research and development is to create new items and try new things. The ADDIE model, created by Dick and Carry (1996) for learning systems, is used in this research and development. Analysis, design, development, application, and evaluation are all part of the research and development process.

1. **Stage 1: Analyze** , Before the research begins, field and literature studies are conducted to obtain information about the data potential and mathematics learning problems in schools.
2. **Stage 2: Design** , after obtaining data and information to support the design of the development of the arithmetic cone media (CongkArit), **compiling** the material, the design of the arithmetic cone product is made, choosing a background, a suitable theme, making 4 types of game cards and the rules of the arithmetic coneclak media game.
3. **Stage 3: Development** , conducted by researchers and validated by media experts. Validators assess each indicator by assigning a score from a range of 1-4. After the validity is completed, the researcher makes a design of the arithmetic cone media to produce an arithmetic cone media covering 3 developments, namely, cone board, game cards and rules in the game.
4. **Stage 4: Implementation**. Modified arithmetic combs are used to study arithmetic rows and sequences to determine how effective this medium is to use.
5. **Stage 5: Evaluation**: Evaluation is carried out after implementation. The goal is to find out if the developed media is worth using and whether the teaching materials developed aim to improve and improve the product.



**Figure 1.** Diagram Flow of Arithmetic Learning Media Development Activities in Arithmetic Materials at SMP SWT Utama Medan Using the ADDIE Development Model



This research was carried out at SMP SWT Utama Medan which is located at Jl. Suluh No.80A, Sidorejo Hilir, Kec. The sample of this study is grade VIII students with a total of 20 students. The author chose the location of this research because it is in accordance with the existing problem.

Several data collection techniques were used in this study, including interviews, validation sheets, pre- and post-test questions, and questionnaires answered by teachers and students. During the potential and problem learning stage, interviews are conducted to obtain information about the problem. The validation tool used is an assessment scale designed for validators of material and media experts with first-level mathematics expertise at the State Islamic University of North Sumatra to assess the feasibility of products made with a scale of 4. To evaluate students' ability to count arithmetic rows and sequences before and after, students are given questions before and after the exam. They use an arithmetic cone that they make themselves. In addition, information about the issue is also included in the validation tools used.

**Table 1 Media Validation Test Subjects**

Yes	Validator	Criterion	Skill
1	Media validator	<ol style="list-style-type: none"> <li>1. Have the ability in the field of learning media</li> <li>2. Minimum academic level of S2</li> <li>3. Have experience in learning</li> </ol>	Learner media members
2	Material validator	<ol style="list-style-type: none"> <li>1. Have the ability in the field of learning media</li> <li>2. Minimum academic level of S2</li> <li>3. Have experience in learning</li> </ol>	Material Expert
3	Teacher of Grade VIII SMP SWT Utama Medan	<ol style="list-style-type: none"> <li>1. Have the ability in the field of learning media</li> <li>2. Minimum academic level of S1</li> <li>3. Have at least 5 years of teaching experience</li> </ol>	Learning experts
4	Student	Junior High School Grade VIII Students	Respondents

Qualitative and quantitative data are used for data analysis. Using the media of arithmetic congklak, interviews and observations were carried out with teachers and students to obtain qualitative data. The goal is to find out how students interact with media, how they act towards learning activities, and how they can multiply after using media. This is done through pre- and post-test questions for quantitative data. To find out how well students' multiplication abilities improve, this data was statistically analyzed (Uswah et al., 2023). Validation presentation calculations can be performed using the following formula:

$$P(s) = \frac{f}{n} \times 100$$

Results are interpreted based on the following levels of validity:

**Table 2. Validation Categories**

Yes	Average Score	Criterion
1	76% - 100%	Valid
2	56% - 75%	Quite Valid
3	40% - 55%	Less Valid
4	0% - 39%	Invalid

The results of the pre-test and post-test of arithmetic material can be calculated using the following formula:

$$Nilai = \frac{Skor\ diperoleh}{Skor\ maksimal} \times 100$$

Using the N-gain formula, the results of increased effectiveness can be seen:

$$G = \frac{post - pre}{G\ max - pre}$$



The following gain formula is used to interpret the results found:

**Table 3 Effectiveness Categories**

G	Criterion
$g > 0.7$	Tall
$0.3 \leq g \leq 0,7$	Keep
$g < 0.3$	Low

The following formula is used to calculate media practitioners:

$$P(s) = \frac{f}{n} \times 100$$

Each score is categorized as follows:

**Table 4 Categories of Practicality**

Yes	Average Score	Criterion
1	76% - 100%	Practical
2	56% - 75%	Quite Practical
3	40% - 55%	Less Practical
4	0% - 39%	Impractical

## RESULTS OF THE DISCUSSION

In this study, ADDIE development model is used, which consists of five stages, *Analyze* (analysis), *Design* (design), *Development* (development), *implementation* (implementation), and *Evaluation* (evaluation).

### a. Analysis

The analysis was carried out on students, materials, and learning media. The results of the analysis showed that teachers still use little learning media when teaching mathematics, especially arithmetic material, which causes many students to feel unhappy learning. Therefore, learning media that is able to help students learn independently and interesting so that they feel happy and not bored learning mathematics. This media is expected to improve students' ability to solve arithmetic problems.

### b. Design

At this stage, learning media design is carried out using arithmetic cone. This arithmetic congklak game starts with a starting card in the form of a simple arithmetic problem as a start in the game, then there are 3 other types of cards, namely question cards (KS), knowledge cards (KP), and motivation cards (KM). At this stage, they also designed the appearance of the congklak with a sticker writing CONGKARIT on the congklak.

### c. Development

At this stage, the creation of arithmetic congklak media is carried out using papancongklak which is easy to find in toy stores, then 3 aspects of development are carried out, namely:

#### ➤ Congklak Board

The design of the arithmetic conical board is rectangular with the right and left ends in an oval shape. The artificial cone board has 14 holes and 2 head holes on the left and right sides of the player. Then the congklak board is also decorated to be attractive with colored stickers on each hole showing the game card code. There are 4 types of sticker colors on the congklak holes, including green for question card codes, green stickers are only found in 2 holes. Orange stickers for knowledge card codes, orange stickers are only available in 2 holes. Red sticker for motivation card code, red sticker is only available in 2 holes. Then the remaining 8 holes were decorated with blue stickers.



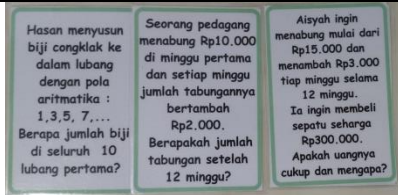

#### ➤ Playing Cards

The total card is 19 pieces, consisting of 4 types of cards, namely 4 start cards, 5 question cards, 5 knowledge cards and 5 motivation cards. The card has a color code and writing on the sticker of each cone hole. The development carried out on the game card is the use of *the starting card* as the beginning of the game, the content of the *starting card* is a simple arithmetic problem designed to determine the number of seeds in each hole in each time the arithmetic cone game starts. Then there are 3 other types of cards, namely question cards with content in the form of arithmetic and series questions, knowledge cards with content in the form of knowledge about arithmetic and arithmetic row and series of questions, and motivation cards with motivations to increase the

enthusiasm for mathematics learning for junior high school students in grade VIII. The cards in this game are also equipped with colored facial expression covers to make them more unique and attract students' interest in learning.

➤ In-game rules

For students into 2 groups, when the game will start, take one starting card then fill each hole with the number of seeds according to the question order on the *star* card, the students who successfully finish arranging the seeds first will start the game. The game begins to insert the cone seeds clockwise. If student A drops his final seed on the green sticker code, then student A takes one question card, if student A can answer correctly, then student B hands 4 of his seeds into student A's head, if student A answers the question incorrectly, then student A must hand over 3 seeds from the hole of student A's head to student B. Also applies to the knowledge card if student A drops his last seed in the hole with the orange color code then student A reads the contents of the knowledge card and student B hands his 2 seeds into the head of student A, if student A drops his last seed in the red color code, then student A gets a motivation card that must be read by student B then student B hands his 1 seed into the hole of student A's head. The winner in the game is the one who has the highest number of seeds inside each student's headhole.

Prorotype I (Before Validation)	Prorotype II (After Validation)
<b>Media Display and Arithmetic Puzzle Cards</b>	
 <p data-bbox="399 1500 820 1621">The design of the congklak board is still plain and only has the card code written in a few holes</p>	 <p data-bbox="861 1500 1311 1621">The arithmetic cone hole is added stickers according to the color code of the card and the addition of the CONGKARIT reading design.</p>
 <p data-bbox="399 1825 820 1908">The question card before it is designed has a picture.</p>	 <p data-bbox="861 1825 1311 1908">The question card after being designed with additional images to make it more attractive.</p>

**Table 5. Differences in Prototype I and Prototype II Results in Arithmetic Combination Media**

After the media is finished, it is then validated by a mathematics education lecturer (media expert).

*d. Implementation*

At this stage, the media that has been created is then revised based on the input and suggestions of the validator and this media is implemented in grade VIII students of SMP SWT Utama Medan with a total of 20 people.

*e. Evaluation*

The researcher distributed a questionnaire to teachers and students about the use of this learning medium to get suggestions and results on how practical the medium is. Next, the researcher conducted a learning outcome test to find out how effective this media was.

The validity data created by this study is to evaluate how effective the use of media has been. The results showed that the arithmetic congklak media was included in the category of valid or very feasible use with a score of 95 percent in the validity analysis of media experts. Thus, the arithmetic consonant media received a score of 94.3% in the material validity analysis, which placed it in the category of feasible or valid for use.

For the effectiveness of the media, the arithmetic congklak media received an average pre-test score of 35%, placing it in the impractical category, then an average post-test score of 81.05%, placing it in the effective category. N-gain is used to interpret the result with an average of 0.71% which places it in the high category. The results show that students at SMP SWT Utama Medan can improve their ability to work on their arithmetic row and series problems, especially in grade VIII, by using arithmetic cone.

The arithmetic congklak media helps students learn arithmetic rows and series in grade VIII of SMP SWT Utama Medan. The results showed that the arithmetic congklak media had a score of 94.2% from teachers and 81.8% of student responses that were considered practical.

**Figure 2: Arithmetic Circle Media**



Media experts verify the arithmetic congklak product using a validation sheet. The evaluation was carried out based on the statement item on a scale of four. Lecturers of Mathematics Education, Faculty of Tarbiyah and Teacher Training, State Islamic University of North Sumatra validated the material and media, as shown below:

**Subject matter expert validation**

Validation of material experts by Mrs. Eka Khairani Hasibuan, M.Pd, the researcher validated material experts in two stages. The first stage includes the submission of the lesson plan, and the second stage includes the necessary pre-test and post-test questions. Currently, several improvements are needed such as improving lesson plans, learning activities, assessment rubrics, adding instructions for working on pretest and posttest questions.

**Media expert validation**



Media expert validation by Mrs. Lisa Dwi Afri, M.Pd, validated media experts in two stages: initial submission and valid media after minor revisions. In the first stage, several improvements are needed, such as adding stickers in each hole and pictures on several question cards as well as reading "CONGKLARIT" on the congklak board. After minor revisions, the media is declared valid. As shown in the following figure, media is considered valid and can be used at the learning stage:

Arithmetic puzzles are one of the effective media to improve students' ability to solve arithmetic problems during mathematics learning. This media makes learning more interesting and fun, making students more engaged and focused during the learning process. Teachers have an important role in optimizing the use of this media in a creative way, so that the concept of arithmetic that is often considered difficult can be conveyed more easily and easily understood by students.

In addition, it is proven that the arithmetic congklak media is able to attract students' attention well. Students become more interested in learning, which ultimately helps them understand the concept of multiplication better and solve math problems better. Not only do students understand the material faster, but they are also more confident in using multiplication skills in a variety of situations thanks to interactive and fun learning. This media can be a useful learning tool for students.

In this study, the arithmetic congklak media created by the study has been validated by media experts and subject matter experts with excellent results, the media validation reaches 95%, which is categorized as "valid", and the validity of the material reaches 85%, which shows that this media is suitable for use without improvement. significant. The results show that the arithmetic congklak media is not only pedagogically relevant, but can also meet the quality standards of arithmetic learning materials.

The validity of the media shows that the design has been modified according to the needs of grade VIII students visually, functionally, and in terms of material content. By adding elements such as cards Start, question cards, knowledge cards, motivation cards, students more easily understand abstract concepts of arithmetic. This is an excellent tool for learning in the first intermediate stage.

Both pre-test and post-test are carried out to find out how effective the arithmetic congklak media is. The results show significant progress. Before using the media, the average score of students on the pre-test test was only 34.65%, which was in the "less" category. However, after using the media, the average post-test score increased to 81.05% which was in the "excellent" category. This increase is also supported by the calculation of an N-Gain value of 0.71% which indicates the ability of students in the "high" category.

These results suggest that the arithmetic cone can significantly improve students' understanding of arithmetic concepts. Students become more motivated and more focused during an interactive process that involves play and visualization. This helps them understand the relationships between the patterns of numbers in rows and arithmetic sequences.

The practicality of the Arithmetic Congklak Media was assessed through a questionnaire of responses from teachers and students. The teacher's response received a score of 94.2% and the student's response received a score of 81.8%, both in the category of "very practical." The teacher stated that this medium is easy to use in daily learning, especially because the materials are simple and easy to prepare. Students also feel that this medium grabs their attention and makes learning multiplication more enjoyable.

This practicality shows that the media was created to facilitate its use in schools. With a simple yet useful design, teachers can deliver material easily without much preparation. Because the learning outcomes that are expected to be achieved by students, learning objectives can be described from learning objectives with one of the important components in it being practical learning media (Asrul et al., 2022).

The results of this study confirm that the use of interactive learning media is very important to overcome the difficulties faced by students in understanding abstract concepts such as arithmetic. Arithmetic conecling media can eliminate the difficult impression of arithmetic material by creating a pleasant learning environment. This is in line with previous research that emphasized that activity-based learning media can improve student motivation and learning outcomes (Rahmawati et al., 2022).

However, because these mediums are limited to arithmetic material, further development is needed to help students cover material such as geometric rows and series and opportunities. Thus, this media can provide wider benefits to students.

The results of this study have a direct impact on learning methods in the classroom. It is possible for teachers to use the medium of arithmetic congklak as an innovative alternative to learning that focuses on





increasing student engagement. It is also hoped that similar media will be included in the school curriculum, so that mathematics learning at the junior secondary level becomes more interactive and fun.

Students followed the lessons enthusiastically during the study. The medium of arithmetic congklak has advantages and limitations. The advantage is that this media can encourage students to participate more actively in learning and more easily understand arithmetic concepts. The limitation of the development of the arithmetic congklak media is that this media only discusses one material, so it is necessary to develop additional products on a wider range of materials.

## CONCLUSION

Referring to the ADDIE development model, the arithmetic congklak learning media about arithmetic row and series material. This model includes the analysis stage (Analyze), design (Design), development (Development), implementation (implementation), and evaluation (Evaluation). So the arithmetic congklak media developed includes 3 parts, namely, (1) modification of the congklak board, (2) using 4 types of cards (cards Start, question cards, knowledge cards and motivation cards), (3) and the development of game rules. This study shows that the improvement of arithmetic learning outcomes by using the arithmetic congklak media is actively involved in the learning process with arithmetic congklak. Media experts gave a score of 94.3% and material experts 85% percent for the suitability of arithmetic congklak media, which categorized it as valid or very suitable for use. The arithmetic congklak learning media has very practical criteria, with an average score of 88 from the questionnaire of teacher and student responses. There was an increase in students' multiplication ability from a pretest score of 35% and a post-test score of 81.5%. Therefore, this arithmetic congklak media is considered appropriate and relevant for use in this study. The results of this study have a direct impact on the way learning is carried out in the classroom. Teachers can use Congklak arithmetic as an alternative to new learning methods that prioritize increasing student participation. The limitation of the arithmetic congklak media is that they only discuss one material. Therefore, the next researcher must design a new product for the arithmetic congklak media.

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