

Validity, Practicality, and Effectiveness of Ludo Cartesius Learning Media to Improve Understanding of Mathematical Concepts

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ABSTRACT

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Mathematics learning requires media in outlining the material so that it can be well received by students. Media can help students understand and recall explanations from the teacher and test students' understanding more deeply. This research was conducted with the aim of knowing the validity of Ludo Cartesius' learning media to improve understanding of mathematical concepts in class VIII students at junior high school. This research will apply development research design with ADDIE approach developed by Robert Maribe Brach. The ADDIE stages include analysis, design, development, implementation, and evaluation. The Population in this study were all eighth grade students at junior high school. The research sample was 27 students who were taken randomly using cluster random sampling technique. The instruments used include media expert assessment sheets, material expert assessments, student and teacher response questionnaires, as well as pre-test and post-test understanding of mathematical concepts. The average value of media experts from the three validators of Dokar's media is 95.61. The average value of media experts from the three validators of Dokar's media is 92.36. The results showed that the Dokar media was categorized as "very valid" in terms of media experts and material experts and this media was suitable for use in class VIII students at junior high school. Dokar media is classified as practical media based on the average percentage of student and teacher responses, namely 86.23% and 85.83%. Dokar media is an effective medium based on the t-test (paired sample t-test) p value $(0.000) < \alpha (0.05)$ so that the post-test score is better than the pre-test.



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A. INTRODUCTION

Mathematics is a universal science. Mathematics plays an important role in developing scientific and technological progress because it is used as a tool to solve scientific problems (Maulidya et al., 2022). Mathematics underlies the development of other sciences. Almost every science involves simple concepts from mathematics including counting, calculating, measuring, and so on. For example in physics, basic mathematical concepts are used in determining quantities such as length (cm), mass (kg), area (cm²) and volume (cm³). "it is an eye opener to all sciences" (Dwijayani, 2019). The meaning of this sentence is that mathematics has a role as paving the way for other sciences to be able to develop. This shows that the basic concepts of mathematics are very important to be mastered in order to be able to solve problems in mathematics itself and other sciences.

Understanding is an individual's ability to understand something that is already known and remembered (Pujiastuti, Suvati, et al., 2020). Memorizing and remembering are not part of understanding. This is a wrong view of the meaning of understanding (Misu et al., 2019). Understanding is interpreted as a goal in learning mathematics. Concept understanding focuses not only on definitions and rules, but also on generalizations from specific examples (Kusumaningsih et al., 2019). The most important component of understanding is developing students' conceptual thinking to understand mathematical material (Lai et al., 2019). The ability to understand concepts is very important to master (Pujiastuti, Haryadi, et al., 2020). This is due to continuous learning of mathematics between concepts from one concept to another from elementary school to college. Conceptual understanding is the core standard and key in developing mathematical skills (Andamon & Tan, 2018).

Many students have difficulty in understanding simple concepts of mathematical material. This is due to the abstract nature of mathematics so that it gives students a view that mathematics is difficult and difficult. This also has an impact on learning the Cartesius coordinate material. This material requires mastery of understanding basic concepts about units, integers, and drawing number lines horizontally and vertically (Khaeroni & Nopriyani, 2018). In addition, many other difficulties faced by students in learning the material. For example, from the results of the initial test given to 23 grade VIII students at junior high school regarding the understanding of the concept of Cartesius coordinates. Many students are found who cannot explain the position of the point on the X-axis and Y-axis, students cannot classify the quadrants that exist in the Cartesius coordinate plane, students cannot give examples and are not examples of parallel lines or lines perpendicular to the X-axis and the Y-axis, and many students are unable to draw dots or lines on the Cartesius plane. According to Mariana (Khaeroni & Nopriyani, 2018), there are several factors that cause students to have difficulty understanding the concept of coordinates. These factors are low learning motivation, students' understanding and accuracy regarding coordinates is still low, and students find it difficult to spell practice questions.

Meanwhile, there are many factors that hinder the achievement of learning mathematics. For example, the implementation of the 2013 curriculum has not been maximized due to the limitations of textbooks and learning only comes from one textbook (Pratiwi & Handayani, 2019). "The results of interviews with students indicate that the language of textbooks is difficult to understand. Meanwhile, the characters, needs, and abilities of students vary in learning" (Ningrum et al., 2019). In addition, based on the results of interviews with mathematics teachers at junior high school in March 2021. The information obtained is that teachers do not have learning media in teaching. The teacher only uses the blackboard as a teaching medium. This causes students to tend to be passive in learning. Learning objectives that should be student-centred turn into teacher-centered learning. Teachers have limited time and money in making learning media that are in accordance with the Cartesius coordinate material. Most likely this is one of the factors causing the low understanding of the mathematical concept of Cartesius coordinates. Therefore, additional learning resources are needed to accommodate the learning needs of students in schools.

Based on various explanations regarding students' difficulties in understanding the concept of Cartesius coordinate material, it is necessary to develop character-oriented

learning, learning needs, and problems faced by students. It aims to help students describe and describe abstract material in mathematics, especially Cartesius coordinates. A learning process requires learning resources (Fahmi et al., 2019). Another learning resource that is expected to help students is learning media. According to the Association for Education and Communication Technology (AECT), media are various forms that can be used to convey information. In line with (AECT), the National Education Association (NEA) also provides a definitional view of the media. According to the NEA, media are all forms of objects that can be designed, manipulated, seen, heard, read or instruments that are included in the use of these activities (Ardiyah et al., 2022). Media is used as an intermediary to convey messages from the sender of the message to the recipient of the message (Sutikno, 2021). Media has a function as a carrier of information from a source, namely the teacher and gives it to the recipient of information, namely students. Learning media is a tool used by teachers to convey lesson information to make it easier for students to understand the subject matter. Learning media is defined as a tool that is used in the learning process between the information giver and the recipient of information in order to achieve learning objectives (Prasetio & Musril, 2021). Learning media is a means used in the learning process both inside and outside the classroom (Junias, 2022). Learning media can be in the form of components that create a learning atmosphere as expected, minimize misunderstandings in the delivery of lesson information, and create interaction between teachers and students (Widodo, 2018). The function of learning media is to help students understand interactive and interesting material, arouse students' curiosity, motivate students in learning, and focus students' attention to pay attention during the learning process (Muslim et al., 2022). Another function of learning media is to increase student motivation (Fadillah, 2018). "Mathematics learning media is a tool for the student to deliver mathematical materials to a real form with the basic form to understand the use of mathematics, which it is not merely to memorize" (Rohaeti et al., 2019). The meaning of this sentence is that the mathematics learning process can be designed using learning media as a means of delivering subject matter. Mathematics learning media is designed to change the abstract form of mathematics into a real form to understand the subject matter without the concept of memorizing. This means that mathematics learning media plays an important role in helping teachers provide subject matter to students. Through learning media, the material can be described in real terms so that students are able to master the concept well.

Meanwhile, many types of learning media can be developed. For example, game-based learning media can motivate students and increase their knowledge and skills (Azhar, 2014). Game-based learning media encourages students to be active in learning. In addition, it makes it easier for students to learn the content which is the subject matter in the game and communication occurs between students (Tseng et al., 2019). Media games are also specially designed to teach students certain materials, develop students' understanding of a concept and train students' abilities (Kristanto et al., 2019). Game learning media in mathematics learning is designed to describe, introduce numbers, symbols, and symbols to a concept so as to be able to solve mathematical problems. Ludo Board games learning media which shows that the media has an effect on students' ability to understand concepts (Simbolon et al., 2022).

Many types of games can be used as learning media. For example, the game Ludo King. This game originated in India in the 6th century AD and was popularized by the British in the 19th century AD. Ludo is a game played by two or four people by racing. Players compete to move four pieces of pawns to reach the finish (Ramadani, 2021). Ludo game learning media is very fun and easy to use (Angguntari & Nugraha, 2019). In addition, this media can help students understand and recall explanations from the teacher and test students' understanding more deeply. The difference between the Ludo game developed by researchers and other Ludo lies in the aspect of student abilities that will be improved and the content of the learning materials. Ludo, which the researchers developed, focuses on improving the ability to understand mathematical concepts in Cartesius coordinates. Therefore, based on the background that has been described previously. Researchers can formulate a problem in this study, namely how is the validity, practicality, and effectiveness of the Dokar learning media to improve understanding of mathematical concepts for class VIII students at junior high school? This research was conducted with the aim of knowing the validity, practicality, and effectiveness of Ludo Cartesius learning media to improve understanding of mathematical concepts in class VIII students at junior high school.

B. METHODS

1. Research Design

The type of research that researchers use in this research is development research. The method used is the method of research and development (RND). This research will apply the research development design developed by Robert Maribe Brach. The design proposed by Robert Maribe Brach (Sugiyono, 2016) is to develop a learning design using the ADDIE approach. The ADDIE stages include analysis, design, development, implementation, and evaluation. Research and development steps using the ADDIE approach as shown in Figure 1.

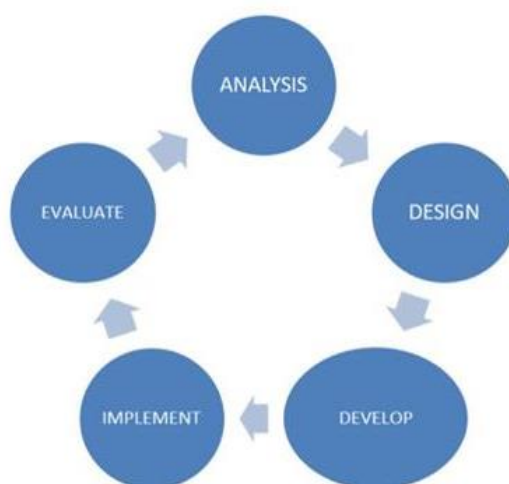


Figure 1. Development of learning design with ADDIE approach
(Rayanto & Sugianti, 2020)

The population in this study were all eighth grade students at junior high school 1 Jereweh. The research sample was taken based on the cluster random sampling technique so

that the randomly selected class was class VIII E as the experimental class. Class VIII E consists of 27 students.

2. Product Validity

This stage implements the instruments of material experts and media experts. Media expert guidelines using Walker and Hess theory (Arsyad, 2015) include 3 aspects, namely the quality of content and objectives, instructional quality and technical quality. Material expert guidelines cover 3 aspects, namely content, format, and linguistic aspects (Hestari et al., 2016). Media validation is carried out with the aim of evaluating products based on aspects of material, language, presentation and usability of the resulting product. Validation is carried out by three validators or experts who have expertise in their respective fields. This sheet is compiled using a Likert scale with four alternative answers, namely Not Good score 1, Less Good score 2, Good score 3 and Very Good score 4.

This research was conducted by giving the media expert and material expert guide sheets to the three lecturers to validate the Ludo Cartesius (Dokar) learning media. Previously, the media and material expert guidelines had been validated by three lecturers at the University of Muhammadiyah Mataram and were declared valid and suitable for use. The score obtained will be calculated using the following formula (Arikunto, 2012).

$$N = \frac{\sum x}{\sum maks} \times 100 \tag{1}$$

Information: N is the score, $\sum x$ is the number of scores obtained, and $\sum maks$ is the maximum number of scores.

After obtaining the validity value, the results will be interpreted into the following validity categories (Domara, 2021), as shown in Table 1.

Table 1. Category Validity

Level	Category
81 - 100	Very Valid
61 - 80	Valid
41 - 60	Quite Valid
21 - 40	Not Valid
0 - 20	Invalid

The value obtained from the experts will be calculated on average using the formula (Arikunto, 2012):

$$X = \frac{\sum x}{N} \times 100 \tag{2}$$

Information: X is the average value, $\sum x$ is the number of scores, N is the number of raters.

3. Practicality Product

The next step is to test the product based on its practicality and effectiveness. The practicality test of the product was carried out by distributing questionnaires for teacher and student responses. The practicality score is calculated by the formula according to Darmawan dan Deni (Arif & Mukhaiyar, 2020).

$$Practical\ Value = \frac{Score\ obtained}{Maximum\ Score} \times 100\% \tag{3}$$

The practicality values are then interpreted with the categories as shown in Table 2.

Table 2. Practical Category

Percentage (%)	Category
90 - 100	Very Practical
80 - 89	Practical
65 - 79	Practical enough
55 - 64	Less Practical
0 - 54	Not Practical

After getting data from student response questionnaires, the next step is to get data from teacher response questionnaires (Saputra, 2019), as shown in Table 3.

Table 3. Assessment Criteria

Percentage (%)	Criteria
0 - 39	Not much
40 - 55	Not enough
56 - 65	Enough
66 - 79	Well
80 - 100	Very well

4. Effectiveness Product

The effectiveness test was carried out by experimental research with a one group pre-test-post-test design. The design as Shown in Table 4.

Table 4. Design Pre-test and Post-test in one Group (Budiyono, 2019).

Pre-test	Treatment	Post-test
T ₁	X	T ₂

The researcher calculated this t-test data using the SPSS version 26 application. The steps taken were to enter pre-test and post-test data then select **Analyze** → **Compare Means** → **Paired-Samples T test**. If value $p < \alpha$ then H_0 is rejected, whereas if $p \geq \alpha$ then H_1 is accepted.

C. RESULT AND DISCUSSION

1. Result

The design and research was carried out in class VIII of junior high school. The resulting product is a Ludo Cartesius learning media design (Dokar) on the material of Cartesius coordinates for class VIII. The product is in the form of a foldable two-dimensional game board. The product is designed to be played by two to 4 people. The process of product design and research uses the Research and Development method with the ADDIE approach. This research is limited to the implementation stage of the media and materials expert assessment sheet. The following are the steps for the validity of the Dokar learning media product:

a. Analysis

This stage aims to analyze the problems that occur in the object under study. The stage is carried out by means of field observations. This observation activity includes

initial data collection by direct observation and giving a test for understanding the mathematical concept of Cartesius coordinate material.

1) Analysis of Problems and Needs in the Field

This stage was carried out to obtain initial data and analyze the understanding of mathematical concepts in junior high school. The test is structured based on indicators of understanding mathematical concepts according to the National Education Standards Agency in 2006. The results of the concept understanding test show that there are still students who have low understanding of mathematical concepts, as shown in Table 5.

Table 5. Preliminary Test Results for Understanding Mathematical Concepts

Highest Score	13
Lowest Score	5
Highest Value	72.22
Lowest Value	27.78
Score Total	1050
Average	45.65
Standard Deviation	20.24

In addition, based on the results of interviews with eighth grade mathematics teachers at junior high school, no learning media was used. The teacher only uses the whiteboard to convey the subject matter. Teachers have cost and time constraints in making learning media that are in accordance with the Cartesius coordinate material.

2) Curriculum Analysis

The activity carried out is to find out the curriculum used at junior high school. The curriculum used is the 2013 curriculum. The 2013 curriculum emphasizes student-centered learning or student center. Therefore, the learning media designed must focus on student-centered learning media.

3) Analysis of Student Characteristics

Students aged 11 years and over are in the obedient playing phase and want to get the best results even though they are limited by strict rules. Therefore, the characteristics of students in class VIII junior high school are included in the age that still likes games. Games that are adapted to the right subject matter can help students understand the material.

b. Design

The product is designed by taking into account the suitability of the product based on problems and needs in the field, the curriculum used at junior high school, and the character of the students who are in class VIII. Therefore, the product made is in the form of learning media that contains Cartesius coordinate material. The researcher also designed the Learning Implementation Plan (RPP) using the Dokar media. This is done with the aim of being a reference for researchers and teachers in applying the Dokar learning media. In addition, the selection of the Ludo game in the design of this media was chosen because the characteristics of class VIII junior high school students tend to still

like to play. Ludo is a game that is widely played by children to adults. In addition to the product, the researcher also made instruments from media experts and material experts to be validated based on content validation. This instrument has been validated by three lecturers at the University of Muhammadiyah Mataram and is declared valid and feasible to use. The product design was first made in the form of a sketch and then continued in the design process using the X8 version of the CorelDraw application. The results of the design using the application can be seen in Figure 2, Figure 3, and Figure 4.



Figure 2. Logo Dokar



Figure 3. Cover

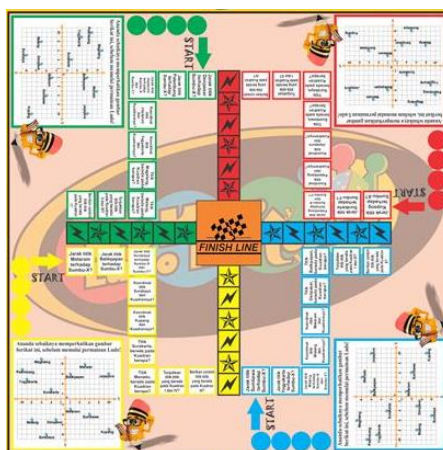


Figure 4. Media Content

c. Development

1) Develop Dokar Media Indicators

The product is designed to match the indicators of understanding mathematical concepts in the Cartesius coordinate material. The Cartesius coordinates material is divided into three sub-chapters, namely the position of the point on the X-axis and Y-axis, the position of the point with respect to the origin (0, 0) and to a certain point (a, b), as well as the position of the line on the X-axis and the X-axis. Y. Therefore, three Dokar game boards will be designed according to each sub-

section of the material. Each Dokar is designed using indicators that have been adjusted to the indicators of understanding the concept of Cartesian coordinates.

a) Dokar 1

Students are able to restate the position of the point on the X-axis and Y-axis; Students are able to classify point positions in quadrants I, II, III and IV; Students are able to give examples and not examples of points located in quadrant I, quadrant II, quadrant III or quadrant IV; Students are able to make certain pictures that are connected from several points.

b) Dokar 2

Students are able to restate the position of the points with respect to a point $(0, 0)$ and a certain point (a, b) ; Students are able to classify the position of a point with respect to a point $(0, 0)$ or a certain point (a, b) ; Students are able to give examples and not examples of the position of a point with respect to a point $(0, 0)$ or a certain point (a, b) ; Students are able to make pictures related to a point $(0, 0)$ or a certain point (a, b) .

c) Dokar 3

Students are able to restate the position of the line with respect to the X-axis and Y-axis; Students are able to classify parallel lines and perpendicular lines to the X-axis and Y-axis; Students are able to give examples and non-examples of parallel lines and lines perpendicular to the X-axis and Y-axis; Students are able to draw parallel and perpendicular lines to the X-axis and Y-axis. After making indicators on the Dokar media, the researchers developed the content of the media. The content of the media is in the form of questions that students must answer regarding the material being discussed. In addition, there are also statements in the form of true/false which are all loaded on the media and Dokar cards.

2) Creating Game Rules

The next step is to make the rules of the game. Like the Ludo game in general, the Dokar game is almost the same but additional rules are needed so that the process of playing while learning can be realized. The following rules have been created:

a) The teacher divides groups of students heterogeneously.

b) Dokar game is played by 2 – 4 people.

c) Step according to the roll of the dice that appears.

d) Students are asked to answer questions in the stop box (answer correctly; students occupy the box, answer incorrectly; students take 2 steps back and answer unanswered questions again at the next opportunity.

e) When they have finished, students answer the finish card questions and immediately take turns with their group friends.

f) The answers to the finish cards are collected at the end of the lesson.

3) Making a Foldable Board

The Dokar board game is made with the following materials and tools.

a) Material

Cardboard, black duct tape, stickers (cover, KI, KD, indicators, learning objectives, and a basic picture of a product measuring 25 × 25 cm).

b) Tool

Ruler, Cutter and Printer.

c) Making steps as follows.

- (1) Cut 12 pieces of cardboard with a size of 26 × 26 cm (one Dokar board requires 4 pieces of board).
- (2) Glue 4 boards with black duct tape so that they can be folded.
- (3) Paste cover stickers, KI, KD, indicators, learning objectives, and basic product pictures on the board.

4) Making Dokar Cards

The Dokar card is designed with a star and lightning background image. In addition, there are also finish cards that students answer when they arrive at the finish box. Star, lightning, and finish cards are made with a size of 9.5 × 5 cm. The star card is blue, the lightning card is yellow and the finish card is orange. The following is a picture of a Dokar card in Figure 5a and Figure 5b.



Figure 5a. Dokar Card (Front)

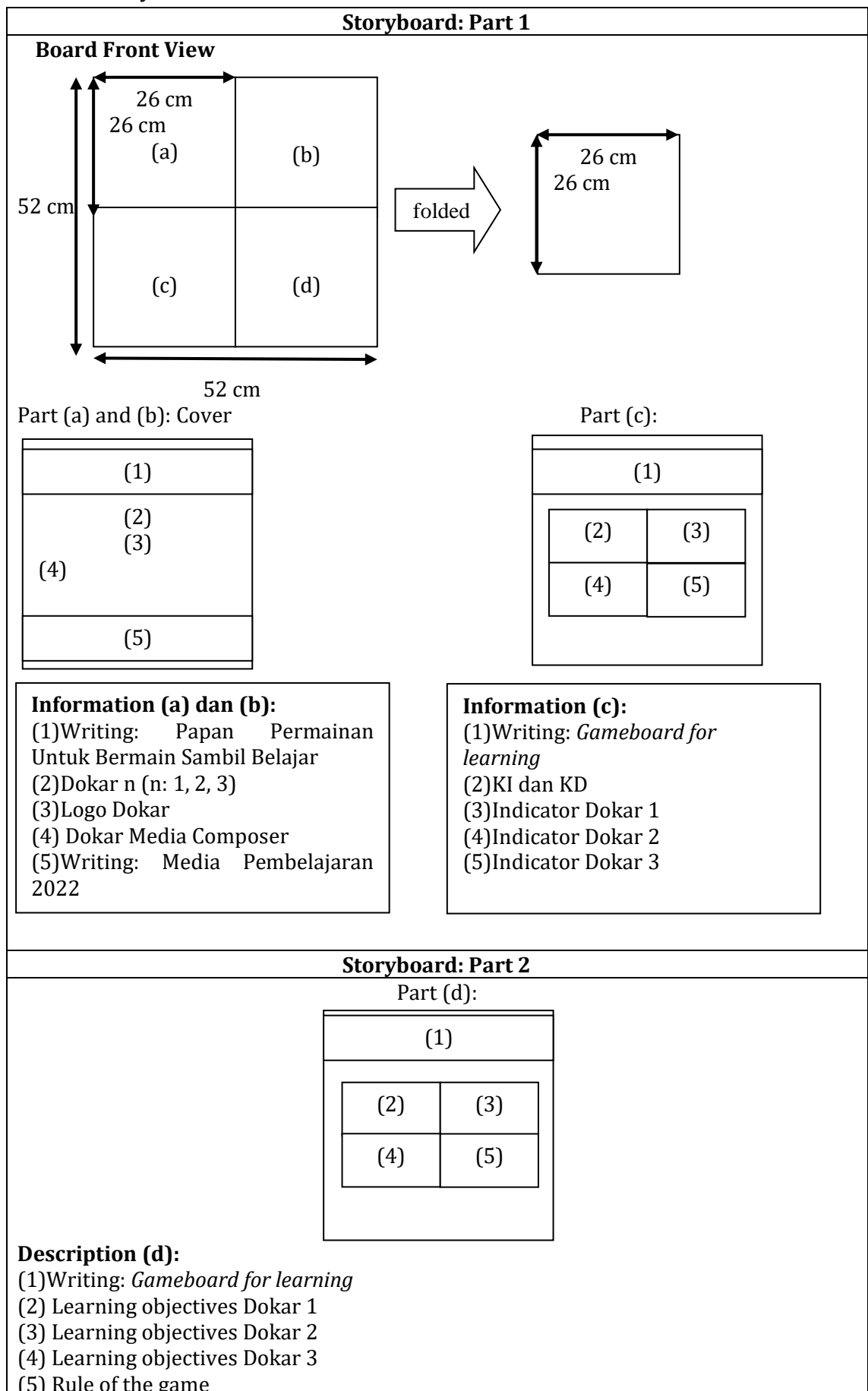


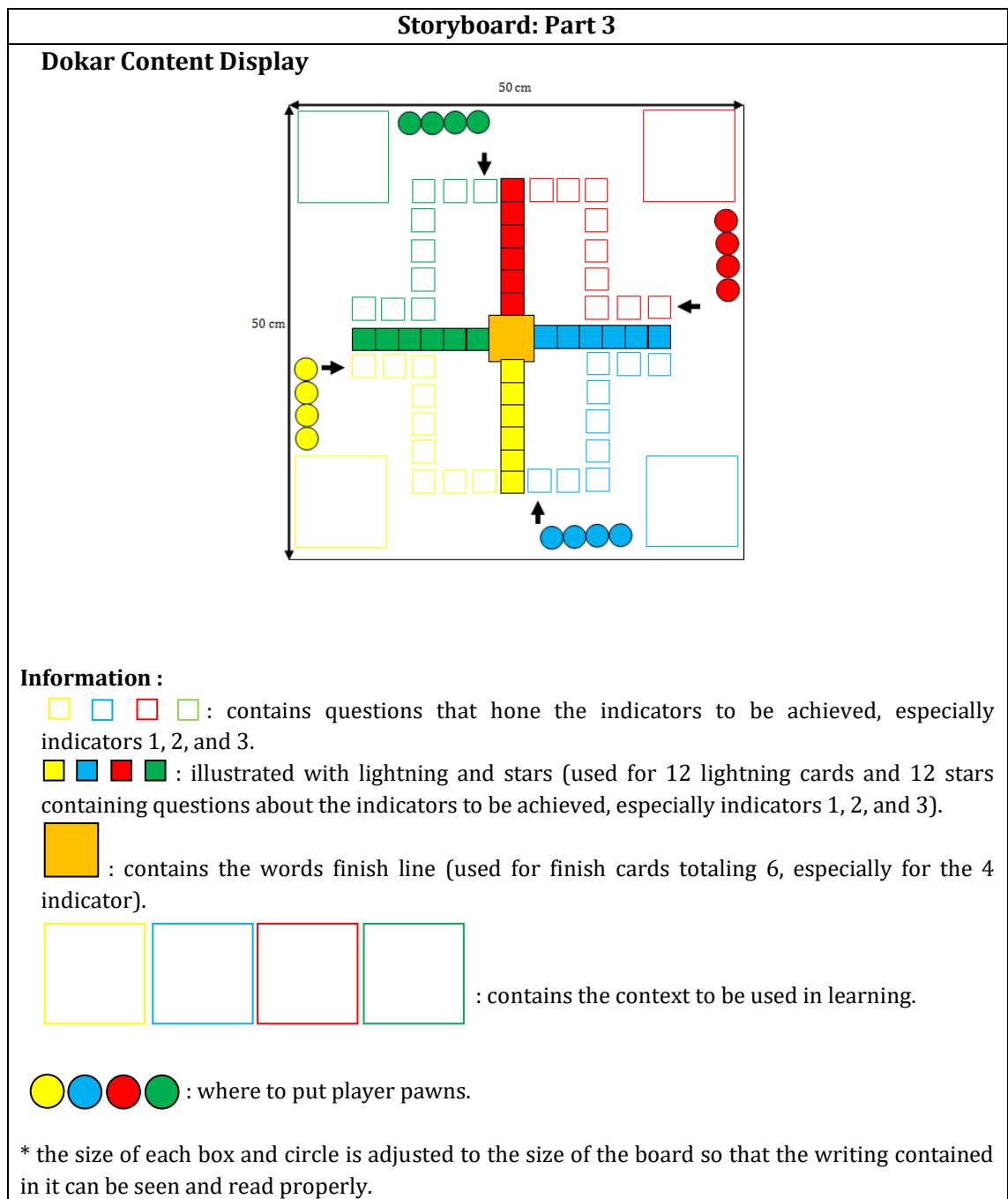
Figure 5b. Dokar Card (Back)

5) Making or Finding Dice and Pawns

Dice and pawns that will be used in playing Dokar can be obtained at the sale of game tools.

6) Create a Storyboard





d. Implementation

1) Media Expert Validation Results on Media Dokar

The results of the validation of the Dokar learning media that were assessed by three lecturers or validators as shown in Table 6.

Table 6. Media Expert Validation Results

Validator	Total Score	Value	Criteria
Validator 1	72	90.79	Very Valid
Validator 2	72	94.74	Very Valid
Validator 3	74	97.37	Very Valid

In addition, the media expert average score of the three Dokar media validators was also obtained, namely 95.61.

2) Material Expert Validation Results on Dokar Media

The results of the validation of the Dokar learning media assessed by three lecturers or validators as shown in Table 7.

Table 7. Material Expert Validation Results

Validator	Total Score	Value	Criteria
Validator 1	43	85.42	Very Valid
Validator 2	44	93.75	Very Valid
Validator 3	46	95.83	Very Valid

In addition, the average value of media experts from the three Dokar media validators is 92.36.

e. Evaluate

The percentage of practicality value or practicality value of student response questionnaires in this research and development is 86.23%. This means that the student's response to the Dokar media is in the practical category. In addition, data regarding student responses will be presented based on indicators of student response questionnaires, as shown in Table 8.

Table 8. Student Response Questionnaire Results

Student Response Questionnaire Indicator	%	Category
Evaluation	86.67	Very strong
Interest	87.78	Very strong
Motivation	87.41	Very strong
Interest	86.30	Very strong
Response	83.95	Very strong

Based on **Table 8**, information was obtained that all indicators in the student response questionnaire reached the very strong category. The average value also shows that the student's response to the Dokar learning media is very positive with an average percentage of 86.42%. After analyzing the student response questionnaire data, the next step is to analyze the teacher response questionnaire data in Table 9.

Table 9. Teacher Response Questionnaire Results

Teacher response questionnaire indicator	%	Criteria
Content quality and purpose	90	Very well
Instructional quality	77.5	Very well
Technical quality	90	Very well

Based on **Table 9**, information was obtained that the teacher's response to the Dokar media was in the Very Good category. This shows that the use of Dokar media from the

teacher's point of view with an average percentage of 85.83% is classified as very good media. In addition, the practicality value or practicality value of the teacher shows that the Dokar media is in the practical category with a score of 85.83%. After the data was collected, the researchers conducted a prerequisite test in the form of a normality test before testing the effectiveness of the Dokar media. Researchers used SPSS version 26 to ensure that the data calculations were more accurate. In the following, the results of SPSS version 26 are presented regarding the Kolmogorov Smirnov normality test, as shown in Table 10.

		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
Kelas_Eksperimen		Statistic	df	Sig.	Statistic	df	Sig.
Data_Pretes_Postes	1	,164	27	,060	,869	27	,003
	2	,122	27	,200*	,933	27	,083

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 10. SPSS Kolmogorov Smirnov Normality Test Experimental Class

Based on the explanation of Table 10, column Sig. Kolmogorov-Smirnov showed a score of 0.06 for the pre-test data and 0.200 for the post-test data. This means the value of Sig. > 0.05 then H0 is accepted. Therefore, it can be concluded that the conditions for conducting the paired t-test or effectiveness test are met. Researchers also used SPSS version 26 to ensure the accuracy of the calculation of the effectiveness test. The following is a picture of the test results, as shown in Table 11.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sebelum menggunakan media pembelajaran Dokar	58,8889	27	15,27525	2,93972
	Setelah menggunakan media pembelajaran Dokar	69,3115	27	14,53095	2,79648

Table 11. The Results Of The Experimental Class Descriptive Data

Based on Table 11, information was obtained that the average value of the pre-test in the experimental class or before using the Dokar media was 58.8889 with a standard deviation of 15.27525. Meanwhile, the average post-test score for the experimental class or after students learn using the Dokar media is 69.3115 with a standard deviation of 14.53095. This shows that there is a fairly large difference between the average value of the pre-test and post-test, which is 10.4226, as shown in Table 12.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Sebelum menggunakan media pembelajaran Dokar - Setelah menggunakan media pembelajaran Dokar	-10,42259	12,57690	2,42043	-15,39785	-5,44734	-4,306	26	,000

Table 12. SPSS Effectiveness Test Results (Paired Sample T-Test)

Based on Table 12, it can be seen that the p value in the Sig.(2-tailed) column with 26 degrees of freedom (df) is 0.000. This means that the p value (0.000) < 0.05, then H0 is rejected. Therefore, the calculation using SPSS version 26 also shows the same conclusion as the Microsoft Excel calculation, namely the average final test score (post-test) is better than the average pre-test score.

2. Discussion

Based on the results of research conducted, the resulting product refers to the purpose of research and design. In addition, validation results were obtained in the form of validation of media experts and material experts. The process of designing Dokar learning media, produces two-dimensional learning media in the form of a board that can be folded to make it easier for teachers to carry, store, and use the media. Researchers specially designed this media to help the learning process carried out by teachers and students on the Cartesius coordinate material. This research procedure uses the Research and Development method with the ADDIE approach.

The results of expert validation are obtained from the results of the validator's assessment by filling out the guide sheet for media experts and material experts. This sheet contains statements that are filled in by putting a checklist if the validator chooses four alternative answers, namely Not Good score 1, Poor score 2, Good score 3 and Very Good score 4.

The results of media expert validation have the aim of assessing Dokar's learning media products based on three aspects, namely the quality of content and objectives, instructional quality and technical quality. Meanwhile, the results of material expert validation have the aim of assessing Dokar's learning media products based on three aspects, namely content, format, and language. The validation assessment of media experts and material experts was assessed by three validators. The value of media experts obtained from validator 1 is 94.74 and material experts is 89.58. This shows that the gig media is categorized as "very valid" and feasible to use. The value of media experts obtained from validator 2 is 94.74 and material experts is 91.76. This shows that the gig media is categorized as "very valid" and feasible to use. The value of media experts obtained from validator 3 is 97.47 and material experts is 95.83. This also shows that the gig media is categorized as "very valid" and feasible to use.

This study supports the results of other studies regarding the feasibility or validity of a learning media. Research on Adobe Flash CS 6 learning media (Nasution & Hasanah, 2022), research on Android-based Physics learning media (Ikhbal & Musril, 2020), research on

interactive learning media for biology material for the digestive system based on Macromedia Flash (Tasril & Putri, 2019) , as well as research on instructional media based on video tutorials on designing local networks/LANs (Mapicayanti et al., 2018), with an average in the category of minimally strong and valid and appropriate media for use.

Student response questionnaires were measured through five indicators, namely assessment, interest, motivation, interest, and response. There were 27 students who filled out this questionnaire in the experimental class. Student responses to the assessment indicators are included in the "Very Strong" category with a percentage of 86.67%. Student responses to the indicators of interest are included in the "Very Strong" category with a percentage of 87.78%. Student responses on motivation indicators are included in the "Very Strong" category with a percentage of 87.41%. Student responses to indicators of interest are included in the "Very Strong" category with a percentage of 86.30%. Student responses to the response indicators are included in the "Very Strong" category with a percentage of 83.95%. Student responses to the Dokar media are also classified as "Very Positive" with a percentage of 86.42%. The value of practicality or practicality of student respondents is 86.23% with the "Practical" category. In addition, the teacher's response questionnaire was measured through three aspects, namely the quality of content and objectives, instructional quality, and technical quality. There were two teachers who filled out this questionnaire, namely Mrs. Yulia Safitri, S.Pd. and Mrs. Etri Jayanti, S.Pd. as a mathematics teacher at Junior high school. The teacher's response to the aspect of content quality and objectives is classified as "very good" with a percentage of 90%. The teacher's response to the aspect of instructional quality is classified as "very good" with a percentage of 80%. The teacher's response to the technical quality aspect is classified as "very good" with a percentage of 83.33%. The practicality value of the teacher respondents obtained a percentage of 85% with the "Practical" category. Therefore, it can be concluded that both teachers and students are easy to use Dokar media. This facility is expected to help students of class VIII at Junior high school in improving their understanding of mathematical concepts.

The results of the effectiveness test were carried out by testing the hypotheses, namely H_0 (the mean post-test score was not better than the average pre-test score) and H_1 (the average post-test score was better than the average pre-test score). Previously, it had been tested for normality of the pre-test and post-test data and it was stated that the data were normally distributed. Based on the results of the effectiveness test through the calculation of SPSS version 26, it shows that H_0 is rejected. This means that the average post-test score is better than the average pre-test score. The average value of the pre-test was 58.8889 < compared to the average post-test value of 69.3115. This proves that the use of Dokar media in the experimental class has a role in increasing students' understanding of mathematical concepts. Therefore, it can be concluded that the Dokar learning media developed was effective in increasing the understanding of the concept of Cartesius coordinates for class VIII students at Junior high school.

This study supports other research on testing the effectiveness of learning media. These studies include research on the effectiveness of the use of educational game educational media Quizizz on learning outcomes (Citra & Rosy, 2020), research on the effectiveness of magic box media on mathematics learning outcomes in the material of simple spatial nets

(Fitrianti et al., 2020), research on the effectiveness of letter card media on students' legena literacy reading skills (Hidayati et al., 2019), research on the effectiveness of congklak traditional game media to improve student learning outcomes (Nurdiana & Widodo, 2018), and research on the effectiveness of wheel media fractions assisted by realistic mathematics education models in mathematics subjects (Arintasari et al., 2019).

D. CONCLUSION AND SUGGESTIONS

Ludo Cartesius or Dokar learning media are very valid media. This result is shown from the validation of media experts from three experts with an average score of 94.30 in the "very valid" media category. The results of material expert validation from three experts with an average score of 91.67 with the material category "very valid". Ludo Cartesius or Dokar learning media is a practical medium. This result is shown from the students' responses with a practicality score of 86.23% including in the "practical" category. In addition, student responses to the Dokar media were very positive with an average percentage of 86.42%. The results of the teacher's response with a practicality score of 85.83% are included in the "practical" category. The teacher also responded to Dokar's media with the category of "very good" media with an average percentage of 85.83%. Ludo Cartesius' or Dokar's learning media is an effective medium in increasing the understanding of mathematical concepts in the material of Cartesius coordinates for class VIII students at Junior high school. These results are shown from product trials by applying Dokar media to the experimental class. The results of SPSS version 26 (paired sample T-Test) show that the p value in the Sig.(2-tailed) column with 26 degrees of freedom (df) is 0.000. This means the p value (0.000) < 0.05. Based on these two calculations, H_0 is rejected, which means the average post-test value is better than the average pre-test value.

Based on the results of the research on the design of the Dokar learning media on the Cartesius coordinate material, the researcher can put forward some suggestions. The first suggestion is for students to pay attention to the teacher in explaining how to play Dokar so that they can use the Dokar learning media to the maximum. Students are also expected to improve their understanding of mathematical concepts, especially on Cartesius coordinates. Suggestions for teachers are to apply the Dokar learning media optimally to be able to improve understanding of mathematical concepts in the Cartesius coordinates material for Class VIII students at Junior high school. Meanwhile, suggestions for schools are to carry out trainings on the development of learning media so that teachers can create learning in order to improve the quality or quality of learning.

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