



# ADPIKS

Asosiasi Dosen Peneliti  
Ilmu Keislaman dan Sosial

## DEVELOPMENT OF RAINBOW MATRIX MANIPULATIVE LEARNING MEDIA ON MATERIAL OF DETERMINANTS AND MATRIX MULTIPLICATION

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### **Abstract**

This study aims to develop learning media with a visual manipulative approach from rainbow materials in matrix learning so that it can increase the effectiveness of mathematics learning with the use of learning media as one approach that has been proven effective in supporting student understanding. This study is included in research and development using the ADDIE development model. The stages in the ADDIE development model include Analysis, Design, Development, Implementation, and Evaluation. The subjects for observation and testing in this study were all female students of grade XI-9 of SMA Al Hikmah Surabaya. The instruments used were expert validation sheets, interviews, questionnaires, and observations. Data from these instruments were analyzed using a one-shot case study pattern. The results of the study indicate that the rainbow matrix learning media is valid, practical, and effective for use in mathematics learning in SMA Al Hikmah Surabaya class XI on the material of determinants and matrix multiplication.

**Keywords:** *Learning Media; Rainbow Matrix; Determinant; Matrix Multiplication.*

### **Abstrak**

Penelitian ini bertujuan untuk mengembangkan media pembelajaran dengan pendekatan visual manipulatif dari bahan rainbow pada pembelajaran matriks sehingga dapat meningkatkan efektivitas pembelajaran matematika dengan penggunaan media pembelajaran menjadi salah satu pendekatan yang terbukti efektif dalam mendukung pemahaman siswa. Penelitian ini termasuk dalam research and development dengan menggunakan model pengembangan ADDIE. Adapun tahapan-tahapan dalam model pengembangan ADDIE meliputi Analysis, Design, Development, Implementation, and Evaluation. Subjek untuk observasi dan pengujian dalam penelitian ini adalah siswa kelas XI-9 SMA Al Hikmah Surabaya yang bergender perempuan semua. Instrumen yang dilakukan dengan menggunakan lembar validasi ahli, wawancara, kuesioner, dan observasi. Data dari instrumen tersebut dianalisis menggunakan pola studi kasus one-shot. Hasil penelitian menunjukkan bahwa media pembelajaran rainbow matriks tersebut valid, praktis, dan efektif untuk digunakan dalam pembelajaran matematika di SMA Al Hikmah Surabaya kelas XI pada materi determinan dan perkalian matriks.

**Kata kunci:** *Media Pembelajaran; Rainbow Matriks; Determinan; Perkalian Matriks.*

## INTRODUCTION

Mathematics is a universal science in the development of modern technology because mathematics is useful and provides a lot of assistance in studying various other fields of science including natural sciences, engineering, medicine/medical sciences, and social sciences such as economics and psychology.(Simanjuntak et al., 2021). This rapid development has finally inspired educators to be able to design and implement education that is more directed at mastering the concept of Mathematics, which can support daily activities in society.(Solihah et al., 2022). To increase the effectiveness of mathematics learning, the use of learning media is one approach that has proven effective in supporting student understanding.(Nurrahman et al., 2022). In line with this statement, research has been conducted byThe Great War (2018)stated that the use of mathematics learning media in the form of PAKADES: Decimal Multiplication Flannel Board for elementary school students has been effective in increasing students' scores on decimal multiplication material, as evidenced by an increase in the average student score, which was originally an average pretest of 25, while the average student score during the posttest was 62.(Purwandaru, 2018).

Learning media can help students understand mathematical concepts that are often considered abstract, including through visual and manipulative approaches.(Winanda et al., 2024). Manipulative media are all objects that can be seen, touched, heard, felt, and manipulated. This shows that everything that children can and usually find in their daily lives can be used as more contextual learning media.(Susilowati, 2014).

Visual-based manipulative learning media can use rainbow, rainbow itself is a type of styrofoam that is colorful and has various sizes. Rainbow Matrix is a learning tool that uses visual representation with the use of colorful or interesting visual variations. which is expected to help students understand the concept of the matrix better and more enjoyable.(Edo et al., 2021). The use of rainbow in Matrix material in specific topics such as determinants and multiplication of two matrices is expected to support a more interactive, engaging mathematics learning process and facilitate understanding of complex concepts, especially the concept of determinants and multiplication of two matrices themselves.

### ***Instructional Media***

The change movement in education refers to efforts to change the traditional learning paradigm to be more inclusive, interactive, and relevant to the needs of today's students.(Hatija, 2024). This involves the use of learning approaches that enable students to be actively involved in learning, promoting critical, creative thinking and problem solving.(Hasanah & Himami, 2021). To create education that emphasizes change, one of the things needed is manipulative learning media, which are learning tools or materials designed to allow students to interact directly with the concepts being studied.(Clements, 2000).These media include physical objects or simulations that allow students to manipulate objects directly, facilitating concrete understanding of concepts.(Ummah, 2021).

In learning mathematics on matrix material, there is a sub-chapter that is not well understood by many students, namely the concept of determinants and matrix multiplication, especially 3x3 matrices, especially in the class studied by the researcher consisting of all female students in one class. Therefore, a manipulative learning media called the rainbow matrix is needed. The rainbow matrix is a matrix-based learning tool that uses colors and physical manipulation to clarify the concept of determinants and matrix multiplication. The rainbow matrix consists of a physical matrix that can be moved, rearranged, and has a color according to the mathematical operation being studied.

### ***Constructivism Theory***

Constructivism theory is a view in education that emphasizes that learning is an active process in which students actively construct their own understanding through interaction with the environment and learning experiences.(Piaget, 1979). Constructivism states that students do not simply receive knowledge from teachers or other sources, but they actively construct their own knowledge and understanding through reflection and direct experience. This theory places emphasis on active learning, where students act as creators of their own knowledge. Constructivism describes learning as a process of concept building that focuses on understanding and constructing knowledge that is meaningful to students. According to constructivism, learning is an internal process that is influenced by external experiences. Students are actively involved in restructuring new

information into their existing cognitive frameworks, and this process helps them build deeper understanding. One of the main figures in constructivism theory is Jean Piaget, who emphasized the importance of stages of cognitive development in children's understanding of the world. According to Piaget, students actively construct their own knowledge through the processes of assimilation and accommodation, in which they integrate new information into their existing cognitive schemas or change their cognitive schemas to fit the new information.

By basing learning on constructivism theory, the learning approach becomes more student-centered, allowing them to actively engage in the learning process and build a deep understanding of the concepts being learned. Techniques such as problem-based learning, group discussions, and experiments become important in creating a learning environment that supports the construction of knowledge by students. Constructivism theory has become an important foundation in the development of student-centered learning practices at various levels of education.

### ***Determinants and Matrix Multiplication***

Matrix theory is one of the branches of Linear Algebra which is an important topic in Mathematics. A matrix is a rectangular arrangement of numbers (real or complex) arranged according to the rules of rows and columns. The determinant of a matrix is defined as the difference between the multiplication of the elements on the main diagonal and the multiplication of the elements on the secondary diagonal. The determinant of a matrix can only be determined in square matrices. (Purwantini & Dewi, 2020). To find the result of multiplying matrix A by matrix B is to multiply the elements in the rows of matrix A by the elements in the columns of matrix B, then add up the results of the multiplication between the rows and columns. (Kuntarti et al., 2006).

Previous research on rainbow matrices was conducted by Maria Angelina Weo Edo et al., stating that the use of rainbow matrix media in learning matrix arithmetic operations has proven to be effective. (Edo et al., 2021), but the study was limited to only 15 students (not one class) with male and female gender. The research conducted by the author is using a one-shot case study pattern in one face-to-face meeting in class with the research subjects being all students in one class with all female gender.

This study aims to develop innovative learning media in the learning process and also as an alternative interactive learning through visual-based manipulative learning that may be more inspiring and increase students' interest in learning materials that are considered complex so that they are easier to understand and interesting for students, especially for homogeneous classes of all female students. Thus, the development of rainbow matrix manipulative learning media on determinant and matrix multiplication materials is an important step in improving the quality of mathematics learning in the current educational environment, especially at SMA Al Hikmah Surabaya.

## RESEARCH METHODS

The development of this media uses the Research and Development (R&D) method. This method will focus on the stages of developing learning media from planning, design, implementation, evaluation, and revision. The research model uses the ADDIE model. This approach provides a clear framework for producing better learning media products systematically and measurably so that it can facilitate students in understanding the concept of determinants and matrix multiplication. The development procedure in this study consists of the following steps: (1) Analysis, consisting of a) student needs analysis, b) user analysis, c) curriculum analysis, d) media needs analysis, e) analysis of facilities and infrastructure; (2) Media design consisting of a) Display design, b) rules; (3) Development; (4) Implementation (implementation then revision); and (5) Evaluation (Cahyadi, 2019; Martatiana et al., 2023). These steps become row models in every activity of this research from the beginning to the end of the research. The validators in this study consisted of material experts from Masters students of the Mathematics study program and learning media experts from the State University of Malang. After being validated, the product was then tested with the research subjects being students of Al Hikmah High School Surabaya by taking one class (XI-9) from nine classes at the XI grade level totaling 29 students and all female.

The method of collecting data for this research uses a one-time case study pattern which is intended to show the strength of measurement and scientific value of a research design. This research design uses a one-shot case study where the researcher only conducts one treatment which is estimated to have an effect and then a port-test is

conducted.(Bosse et al., 2014). Subjects were treated with rainbow matrix manipulative learning media to understand the concept of determinants and matrix multiplication.

Furthermore, the type of data used in this study is a mixed-method with the instruments used are non-test instruments in the form of validation sheet media, validation sheet materials, student response questionnaire media, and student response questionnaire sheets. Data analysis techniques in this study, data analysis techniques are divided into two categories, namely through validity tests consisting of media expert lecturers and postgraduate students of Malang State University. The results of the scale validity measurement obtained from the validation sheet by the validator will be processed using the average(Hobri, 2010), while to measure the validity of this manipulative learning media, researchers use assessment criteria(Arikunto, 2006).Criticism and suggestions from the validation process are needed as material for media revision so that the quality of this rainbow matrix manipulative learning media increases so that it can become a better learning media. Testing the presentation of material, language and appearance in the use of this learning media, a test tool in the form of a questionnaire is needed. This measurement scale is obtained from a questionnaire filled out by students and processed by determining the average value.(Hobri, 2010). Comments or suggestions are needed as material for media revision. Revisions are made to improve the media into better learning media and can support students' independent learning activities.

## **RESULTS AND DISCUSSION**

The development of manipulative learning media began with analyzing the needs of students in November 2023 at SMA Al Hikmah Surabaya, grade XI level, namely grade XI-9 which are all female. The needs analysis was obtained from the results of class observations, teachers and students during interviews. Several aspects were analyzed at this stage, namely student needs analysis, user analysis, curriculum analysis, media needs analysis, and analysis of facilities and infrastructure, the following data were obtained:

### ***Student Needs Analysis***

In the analysis of student needs, based on the researcher's observations after conducting field studies and interviews with mathematics subject teachers, it was found

that many students still do not understand the concept of determinants and matrix multiplication, especially 3x3 matrices and the concept of conditions so that the two matrices can be multiplied. In addition, so far teachers have delivered determinant and matrix multiplication materials abstractly so that many students have not understood the material presented. Students find it easier to understand the material if it is presented physically or visually. Therefore, learning media are needed that can provide visualization of the process of determining determinants and matrix multiplication to improve students' understanding in solving problems related to matrices.

### ***User Analysis***

Based on the observation results, it was found that students of SMA Al Hikmah Surabaya, grade XI, especially grade XI-9, who are female, still need visualization media in learning to make it easier for them to understand the mathematical concepts taught by teachers, including the material on determinants and matrix multiplication.

### ***Curriculum Analysis***

This learning media can be used on the topic of matrices in grade XI of the Merdeka curriculum, sub-topics of determinants and matrix multiplication. In addition, this media is also used to ensure that students understand the concept of the conditions for the two matrices to be multiplied.

### ***Media Needs Analysis***

At the media analysis stage, the researcher found that media for delivering determinant and matrix multiplication materials were still rarely found. In SMA Al Hikmah Surabaya itself, the use of media in the form of visualizations has not been found, either made by the teacher themselves or by third parties. Most of the media used by teachers are interactive media in the form of power points. This media also provides a solution so that students do not feel bored in learning mathematics which is considered too abstract.

### ***Facilities and Infrastructure Analysis***

In this rainbow matrix manipulative learning media, the main raw materials needed are rainbow, cutter, pencil or ballpoint pen, double tape, and plywood or PVC



ceiling measuring 80x60 cm. These needs are easily obtained in the school canteen, while the need for plywood or PVC ceiling can be obtained at a building materials store or can utilize the withboard in the classroom at SMA Al Hikmah Surabaya.

### ***Media Design***

The design creation is based on the results of initial observations in the needs analysis activity. The appearance of the rainbow matrix manipulative learning media can be seen in Figure 1 and Figure 2.



Figure 1. Rainbow matrix (Determinant of 3x3 order matrix)

In figure 1, it explains the concept of determinants, where students can determine the determinant of a matrix of order 2x2 or 3x3 with the help of LKPD that has been prepared by the teacher. In this activity, students are expected to be able to draw the conclusion that determinants can only be found if the matrix is a square matrix.



Figure 2. Rainbow matrix (Multiplication of two matrices)

In Figure 2, it explains the concept of multiplying two matrices, where students can determine the multiplication of two matrices and the conditions for two matrices to be multiplied with the help of LKPD prepared by the teacher. In this activity, students are expected to find it easier to visualize the process of matrix multiplication and the



conditions for two matrices to be multiplied.

Students work on this manipulative learning media with the help of LKPD both in understanding the concept of determining determinants and matrix multiplication by using the color symbols that have been provided and symbols for terms in the matrix. In working on this media, students only attach the results of determinants and matrix multiplication according to the color on the questions that have been determined in the LKPD.

Instructions for using this media are as follows: (1) The teacher divides students into 5 groups; (2) Two groups conduct demonstrations, two other groups as observers and assessors, while one other group regulates the course of the activity so that it runs according to the LKPD; (3) Alternately, the second step is repeated so that each group has been a demonstrator, observer and assessor as well as a regulator of the course of the learning activity according to the LKPD; (4) The main tasks of the demonstration group: a) Compiling a matrix according to the instructions of the group regulating the course of the activity on the rainbow matrix that has been provided by discussing and exchanging opinions with their group members; b) Writing the matrix determinant and the multiplication of two matrices, ensuring that the demonstration group knows the location of  $\det(A)$  and the multiplication of two matrices on the rainbow matrix learning media; c) Completing the results of the matrix determinant and the multiplication of two matrices on the rainbow matrix learning media by attaching the appropriate colors (according to the types of rainbow matrix pieces explained in section A.2; d) Solving other matrix problems (in the third task); (5) The teacher provides assistance to groups that need it; (6) The main tasks of the observer and assessor group: a) Select one group to demonstrate in front of the class; b) Assess the work of the demonstration group; c) Give appreciation to the group that correctly demonstrates determinants and multiplication of two matrices; (7) Other group members respond to the demonstration group; (8) The main tasks of the group that regulates the course of the activity: a) Ensure that the rainbow matrix materials and media are ready to be used by the demonstration group; b) Manage the course of the discussion and presentation in class well; c) Reprimand friends who do activities outside of learning; (9) The teacher evaluates and invites students to conclude together.

## Data analysis

The designed rainbow matrix manipulative learning media has been validated by a media expert lecturer and a Masters student of Malang State University. The validation score can be seen in Table 1. From the validation results in Table 1, it can be seen that the validation of the content of the learning media obtained an average of 3.70; the usefulness of the learning media obtained an average of 3.83; the form and appearance of the media obtained an average of 3.83; and the language and symbols used obtained an average of 3.25. From these results, all are included in the valid category with an overall average of 3.69. These valid criteria indicate that the rainbow matrix manipulative learning media is feasible and ready to be used for class XI level of SMA Al Hikmah Surabaya with research subjects of class XI-9 who are all female on the topic of matrices, sub-topics of determinants and matrix multiplication.

Table 1 Rainbow Matrix Learning Media Validation Score

NO.	Validation Type	Average Score	Validation Level
I	<b>Learning Media Content</b>		
	Learning media can help students learn mathematics	4.00	Valid
	Learning media can help students build an understanding of mathematical concepts.	3.50	Valid
	The activities provided allow for positive interactions between students and learning media.	4.00	Valid
	The activities contained in the use of learning media are in accordance with the learning objectives	3.50	Valid
II	<b>Uses of Learning Media</b>		
	Learning media does not cause ambiguity	3.50	Valid
	Can be used to help students achieve learning goals	3.50	Valid
III	<b>Media form and appearance</b>		
	Can be used as a support for mathematics learning in schools	4.00	Valid
	Can encourage students to be more active	4.00	Valid
IV	<b>Language and symbols used</b>		
	Attractive learning media display	4.00	Valid
	Proportional media form	3.50	Valid
	Practical media to carry	4.00	Valid
	The language used is communicative	3.00	Valid

The color display, font type, font size used is attractive to students.	3.50	Valid
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The rainbow matrix manipulative learning media that has been validated and revised by the validator will then be tested on class XI-9 which are all female at SMA Al Hikmah Surabaya with a total of 29 students. The results of the student response questionnaire on the rainbow matrix related to the presentation of material, language and appearance can be seen in Table 2.

Table 2 Results of Student Questionnaire on Rainbow Matrix Learning Media

NO.	Aspect	Average Score	Category
I	<b>Presentation of Material</b>		
	I find mathematics learning media easy to use	3.45	Valid
	Presentation of problems in mathematics learning media helps me understand mathematical concepts.	3.25	Valid
	I enjoy learning mathematics through this learning media because it is interesting.	3.85	Valid
	This learning media makes me love mathematics	3.50	Valid
	This learning media makes me actively learn mathematics	3.20	Valid
	This learning media makes me want to understand mathematics further.	3.25	Valid
II	<b>Language and Display</b>		
	The instructions and information presented are easy for me to understand.	3.80	Valid
	Attractive learning media display	3.60	Valid

Based on data analysis, the student response questionnaire showed that the average result for material presentation was 3.42; language and appearance were 3.70; while the overall average of the student response questionnaire data analysis was 3.49, which means that the media developed was able to meet the criteria of being effective and useful.

Before conducting the media test to the designated class, at almost the same time, the researcher also gave a questionnaire for the practicality test to two mathematics teachers who teach at the same level (grade XI), the following table 3 shows the results of the practicality test that has been carried out.

Table 3 Results of Practicality Tests on Rainbow Matrix Learning Media

No.	Aspect	Assessment criteria	Observer		Average Score	Information
			1	2		
1	Material	a. Suitability of media to material on determinants and matrix multiplication	4	4	4	Practical
		b. The suitability of the concepts of determinants and matrix multiplication presented in the media	4	3	3.5	Practical
		c. The conformity of the displayed image with the material on determinants and matrix multiplication	3	4	3.5	Practical
<b>AMOUNT</b>			11	11	3.67	Practical
2	Language Aspects	a. Ease of language to understand	4	4	4	Practical
		b. Effectiveness of sentences	4	3	3.5	Practical
		c. Completeness of sentences/information required	4	4	4	Practical
<b>AMOUNT</b>			12	11	3.83	Practical
3	Student involvement	a. Learning activities during the use of media can fully involve students.	4	4	4	Practical
		b. Student activities that are taught using selected learning media are better than student activities in conventional learning.	4	4	4	Practical
		c. Learning media can increase students' motivation in learning	4	4	4	Practical
<b>AMOUNT</b>			12	12	4	Practical
4	Sufficient time	a. All learning activities in the use of media can be carried out according to the planned time allocation.	3	4	3.5	Practical
		b. The learning media used is able to achieve learning objectives according to the time allocation.	4	4	4	Practical
<b>AMOUNT</b>			7	8	3.75	Practical
5	Benefits of learning media	a. Rainbow matrix learning media can be applied in class	4	4	4	Practical

b. Ease of teachers in implementing rainbow matrix learning media was developed	4	3	3.5	Practical
c. Rainbow matrix learning media can improve the quality of learning	4	4	4	Practical
d. The ability of the rainbow matrix learning media can motivate teachers to create other learning devices.	4	4	4	Practical
<b>AMOUNT</b>	16	15	3.88	Practical
<b>TOTAL NUMBER</b>	55	57	57.5	Practical
<b>AVERAGE</b>	3.67	3.80	3.83	Practical

Based on data analysis, the practicality test questionnaire by teachers showed that the average result for content/material was 3.67; language aspect was 3.83; student involvement was 4.00; time adequacy was 3.75; the usefulness of learning media was 3.88. While the overall average of the practicality test questionnaire data analysis was 3.83, which means that the media developed was able to meet practical criteria (easy to use and apply).

### ***Product Revision***

Product revisions were made in several aspects, both in terms of media and materials. Some of the revised things are as follows: (1) The use of colors in the rainbow can be given meaning. This is necessary to make it easier for students to remember the concept of determinants or matrix multiplication; (2) In relation to tools and materials, perhaps a light but strong board can be used so that it is easy to carry; (3) The place or container for small pieces of rainbow is made into a better place and easy to carry.

The revisions in terms of material need to be fixed as follows: (1) In terms of practice questions on multiplying two matrices, questions can be enriched where students can draw conclusions about the conditions for the two matrices to be multiplied; (2) The font size must be increased to make it easier for students to read and work on the questions; (3) Material on determinants and matrix multiplication and discussions are included in the LKPD; (4) HOTS questions related to determinants and matrix multiplication need to be added.

### *Final Product Analysis*

The final product in the form of Rainbow Matrix Manipulative Learning Media has gone through expert validation and field testing/trial stages (all female grades XI-9 at SMA Al Hikmah Surabaya). Based on the results of product validation, it was obtained: (1) Validation of media content reached an average score of 3.70 and was considered valid, so that this Rainbow Matrix Learning Media, based on the assessment of media experts, is worthy of being used as a mathematics learning media in class; (2) Validation of the usefulness of learning media reached an average score of 3.83 and was considered valid. Through this learning media, students can learn the concept of determinants and the conditions for the two matrices to be multiplied so that based on the evaluation of material experts, it is worthy of being applied; (3) Validation of the form and appearance of the media reached an average score of 3.83 and was considered valid. Based on the assessment of the expert team, this media is easy to assemble and easy to carry, so that this learning media can be used in other classes; (4) Validation of the language and symbols used reached an average score of 3.25 and was considered valid. According to the team of experts, the language and mathematical symbols used in this media are in accordance with writing rules, but perhaps the language used is less communicative when used by students, but in general this media is ready to be used.

The results of student assessment based on the analysis of student response questionnaire data showed that the average effectiveness test was 3.49. This shows that the rainbow matrix manipulative learning media is worthy of being used as a learning media in the classroom. Students feel happy using this media and feel challenged to complete the determinant and matrix multiplication material using this media. This is in line with previous research that media can have an emotional influence on children (Mares & Kretz, 2015). Based on the responses of the students' questionnaire results obtained: (1) The average score for the presentation of the material is 3.42 and is considered valid. Students enjoy learning mathematics through this learning media because it is interesting so that this media is worthy of use; (2) The average score for language and appearance is 3.70 and is considered valid. The instructions and information presented in the LKPD are easy for students to understand, so that this LKPD is very helpful for students in completing the tasks given. Overall, the average of

the results of the student questionnaire obtained is 3.49 and is considered valid so that this media is worthy of use in learning determinants and matrix multiplication in class, but perhaps the use of rainbow can be replaced with other items that are more practical and not easily damaged such as magnetic boards and items that can be attached using magnets but still maintain the color elements used to remain attractive to students.

The results of teacher assessment based on the analysis of questionnaire data responses of two mathematics teachers who teach at the same level show that the average practicality test is 3.83. This shows that the media developed in the form of rainbow matrices is feasible and easy to use in learning the matrix chapter, sub-topic of determinants and matrix multiplication and is supported by the existence of LKPD which can direct students to achieve the learning objectives that have been set. Based on the responses of the questionnaire results of the practicality test by the teacher, the following were obtained: (1) The average score for the material is 3.67 and is considered valid. The suitability of the media developed with the material of determinants and matrix multiplication can lead students to understand the concepts taught; (2) The average score for the language aspect is 3.83 and is considered valid. The language used in the LKPD is easy to understand and the sentences used are also effective so that students can easily work on the LKPD according to the instructions given; (3) The average score for student involvement is 4.00 and is considered valid. That with the existence of this rainbow matrix learning media, it is proven to directly force all students to be actively involved in group discussions and is able to motivate students in matrix learning activities; (4) The average score for time adequacy is 3.75 and is considered valid. This rainbow matrix media is implemented with a one-shoot system that is able to achieve the predetermined learning objectives. Some notes that may need to be added regarding evaluation activities may be done by giving students homework; (5) The average score for the usefulness of learning media is 3.88 and is considered valid. The media developed can be easily applied in learning determinant and matrix multiplication materials, improving the quality of learning and being able to motivate teachers to create other learning devices. Overall, the average of the results of the practicality test questionnaire by teachers was 3.83 and was considered valid so that this media was declared practical (easy to apply) for use in learning determinants and matrix multiplication in the classroom.



The existence of this rainbow learning media makes students feel active while studying in class so that they no longer feel bored in studying and playing it in class. In addition, students can find the concept of the second condition of the matrix can be multiplied by themselves. This is in line with the findings of previous research (Kiili et al., 2018; Prasetyo & Hardjono, 2020), which states that games in learning can improve students' mathematics learning abilities. In addition, it also supports the results of previous research conducted by Maria Angelina Weo Edo et al. entitled Analysis of Errors in Solving Mathematics Problems in Matrix Material for Class XI IPS Students of SMA Negeri 1 Ende which states that one of the teacher's efforts to overcome student errors in completing matrix arithmetic operations is to use rainbow matrix learning media (Edo et al., 2021), but in this study only limited to 15 students with male and female gender and without going through the stages of the ADDIE development model in its creation, while what the researcher did was create learning media with the ADDIE stage development model and applied it in one class totaling 29 students with all female gender. The results of the study stated that both the research conducted by Edo et al. and by the researcher both showed that the rainbow matrix learning media was effective for use with both heterogeneous gender and homogeneous gender with a research object scale of 15 students and 29 students.

## CONCLUSION

Rainbow Matrix learning media has been developed for Mathematics learning of SMA Al Hikmah Surabaya class XI. This is based on the validation results by the validator where the media is classified as valid. The results of the media's feasibility at the trial stage by students show a practical and useful classification. In this study, the development of Rainbow Matrix Manipulative Learning Media for mathematics learning has several limitations as follows: (1) The trial of the Rainbow Matrix Learning Media is limited to only one school in class XI-9 with all female gender. If the trial is also carried out in several other schools or other genders, perhaps better or more appropriate learning media can be obtained; (2) Limited school time to carry out the trial. The trial was carried out in only one meeting, and (3) The questions presented in the LKPD to support the use of the Rainbow Matrix media need to be added so that students really understand the concept of determinants and matrix multiplication.

The rainbow matrix learning media is expected to be applied and utilized optimally by mathematics teachers to improve students' learning motivation, especially in solving problems. For researchers who will conduct other research that is relevant to this research, it is expected that this rainbow matrix media can be further developed in terms of breadth, depth, and the latest learning materials in accordance with the applicable curriculum to become a useful learning resource for students.

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