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Student Creativity in Developing Interactive Multimedia Using Kodular for Junior High School Mathematics Learning

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Abstract

This research is qualitative research that aimed to investigate the results of the development of learning media by students to improve school students' creative performance and students' creative thinking using the Kodular application. This study focuses on the problem of the lack of learning media at the junior high school level which is used as a means of independent learning for students at home. The subject was a class of The Department of Mathematics Education. The research subjects were 41 students in the department of mathematics education. data were taken using observation and documentation techniques that were adapted to mathematical creative thinking indicators. Interactive multimedia developed by students in the form of mathematical material presented in text form, containing equations, screenshots of graphics from the Desmos application, and video explanations of the material. Furthermore, practice questions and post-tests are presented using the help of Google Form, Quizziz, and Liveworksheets so that users get a direct response to the answers to the questions so that they meet the interactive characteristics of the learning media. The results obtained are 41 students are able to develop interactive multimedia that is run through an android application in junior high school mathematics learning. Creative thinking skills are achieved by using the dimensions of fluency, flexibility, and originality. This is achieved from media development carried out by students The creative performance of students reaches the usefulness dimension but has not been able to reach the novelty of the interactive multimedia that has been developed.

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INTRODUCTION

Interactive multimedia has an important role in learning mathematics. The use of interactive multimedia has been proven effective to get the attention of students at the elementary school level through the content of cartoon objects (Nusir et al., 2013). Mathematics learning for junior high school students is also effective when using interactive multimedia that contains mathematical concepts with a constructivist approach (Priambodo et al., 2017). Interactive multimedia that is applied using a contextual and cooperative approach is able to improve students' conceptual understanding, student activity in learning is quite high, learning skills and good learning motivation (Nasrulloh et al., 2021; Setyowati et al., 2020). The

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use of interactive multimedia in the form of android applications can improve student learning outcomes and student problem solving skills (Kartika et al., 2019; Mandalina et al., 2019; Prabowo et al., 2018).

The development of interactive multimedia is still being carried out in line with the increasing integration of technology in learning. This is done so that students have independent learning, the practicality of learning media to access, and an attractive appearance in the form of color combinations and animations. Trigonometry learning media was developed into multimedia by adding images, music, and animation so that students not only read trigonometry material but could listen to background sounds, visualizations, and material simulations through animation. (Bito & Ismail, 2021; Milovanović et al., 2013; Prabowo et al., 2018). The development of mathematics learning media also focuses on the applications used, for example Adobe Flash Pro CS6 (Adhitama et al., 2018), Adobe Flash CS3 Professional (Hayati et al., 2021), and EPUB3 integrated with PlatMat system (Pineda et al., 2022). The interactive developed on multimedia means that by using multimedia, students can change the appearance of the layer using one finger, mark important text, add notes to the material text, change the content of the material learned from the displayed menu list, and can see concept illustrations with animations, not a static image (Pineda et al., 2022).

This study emphasizes the principle of developing mathematics learning media in the form of interactive multimedia for further investigation of student creativity in developing these media. Students of the Department of Mathematics Education are prospective teachers who need to be briefed on the development of learning media. The integration of technology which is the main characteristic of 21st century learning needs to be mastered by prospective teachers through the creation of multimedia and interactive learning media for students who use it (Kobsiripat, 2015). Therefore, the development of learning media from the aspect of use, application, and learning approach still needs to be done to support the realization of technology integration.

Interactive multimedia, which is a form of learning media that is accessed using a computer or mobile phone, needs to be mastered by prospective teachers in making it. Based on the results of a survey conducted during March 2022, as many as 85% of mathematics teachers have not been able to develop interactive multimedia that can be accessed by students using Android applications. Teachers mostly develop media in the form of PowerPoint where important texts in student books are copied in PowerPoint without any animation or sound explanation from the teacher. In addition, during online learning, the teacher has been skilled in using the media whatsapp, google meet, zoom meeting, youtube and google classroom (Dwi Saputri et al., 2022; Halawati, 2021; Khaesarani, 2021). The media emphasizes interaction with students intensively. However, the media has not been able to increase the creativity of teachers in making interactive media or multimedia independently. Teachers rely on learning resources that are already available on the Youtube platform. Therefore, the use of the Kodular application is expected to help prospective teachers to be creative in developing interactive multimedia. Kodular applications have been widely used in the development of interactive multimedia, such as quadrilaterals and triangles (Rismayanti et al., 2022), Phytagoreann

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Theorem (Rizqiyani et al., 2022), history (Sarita et al., 2021) and Physics (Syarlisjiswan et al., 2021).

The variety of interactive multimedia can be seen from the aspect of presenting the material, the use of animated objects, the constituent components, the learning approach, and the types of test questions as a comprehensive test. The creativity of interactive multimedia makers can use the dimensions of creative thinking. Creative thinking that focuses on fluency and flexibility of thinking and product authenticity can be measured during the development of interactive multimedia (Kobsiripat, 2015). Creative performance in interactive multimedia development is measured by the dimensions of novelty and usefulness (Chen et al., 2022). This means that the development of interactive multimedia can measure the creativity of students who become prospective teachers from the fluency dimension, namely how students can generate ideas related to the depth of the material, the completeness of the material, animated objects, and the choice of colors and fonts. The dimension of flexibility can be measured from the form of presentation of material and test questions, for example through video, full animation, or static text. The dimension of authenticity can be seen from the design of the multimedia display produced by students which is different from other students. The creative performance as measured by the novelty dimension is seen from the selection of simulations or visualization of materials in everyday life using animations that have never been made by others. The usefulness dimension is measured based on the ease and content of materials and questions that provide new knowledge and can be implemented in classroom learning.

Previous research focused on an interactive multimedia that measured the creative thinking aspect of students who were the test subjects (Hayati et al., 2021; Priambodo et al., 2017; Puji et al., n.d.). In addition, creativity is measured based on aspects of the ability to think creatively in answering test questions contained in the media (Kartika et al., 2019; Sulistyowati & Sugiman, 2014; Yuliani et al., 2018). This study focuses on a variety of interactive multimedia for junior high school mathematics learning and measures aspects of creative thinking as well as students' creative performance in interactive multimedia developed using Kodular Applications. Problems related to the need for provision of interactive multimedia development skills assisted by computer applications and measuring students' creative thinking skills and students' creative performance are the urgency of this research. Therefore, the purpose of this research is to investigate the creativity of students in developing interactive multimedia for junior high school learning using the Kodular application. This research is expected to provide information about a variety of interactive multimedia using Kodular applications, students' creative thinking skills and students' creative performance in developing interactive multimedia.

RESEARCH METHOD

This type of research is descriptive using a qualitative approach. Data was obtained from the results of developing learning media by students to measure creative thinking abilities. The learning media developed by students is used to measure students' creative performance at school as test subjects. The research

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subjects were 41 students of the Department of Mathematics Education consisting of 6 male students and 35 female students with an age range of 19 – 22 years. The subjects of this research are Semester IV students for the Academic Year 2021-2022.

Data collection techniques are observation and documentation. Observations are made by observing interactive multimedia which is a product of lectures to be adjusted to the dimensions of thinking and creative performance of students. Documentation is done by collecting multimedia evidence developed by students in the form of interactive multimedia component videos on the Youtube Channel.

Data in the form of observation notes and video documents are then analyzed in the following way:

1) Interactive multimedia overall display video is observed
2) Each display is adjusted to every aspect of the dimensions of students' creative thinking and performance as shown in Table 1.

Table 1. Indicators of Student Creative Thinking and Performance

Indicators	
Creative Thinking of University Students	**Creative Performance of Students**
Fluency 1. Completely compiled material 2. Loading Object 3. Animation/simulation/visualization 4. Use consistent colors/gradations 5. Use a consistent type of font	**Novelty** 1. Interface not found on any media 2. Material visualization or simulation has never existed on other media platforms
Flexibility 1. The form of presentation of the material is adjusted to the content of the material 2. The test is presented using a platform that is appropriate to the type of question	**Usefulness** 1. Interactive multimedia is easy to use by users 2. The material and types of questions provide a new learning experience for students 3. Can be implemented in junior high school learning
Originality Interactive Multimedia has a different design from other students in the same class	

Adopted by (Chen et al., 2022; Shoit & Masrukan, 2021)

3) Interactive multimedia products that have been adjusted to the indicators are then discussed by comparing them with the findings of similar product developments related to the design and depth of the material

Drawing conclusions based on indicators of creative thinking and performance that appear.

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RESULTS AND DISCUSSION

The learning media developed by students is tested on students through the operation of learning media. Students are asked to explore information on learning media needs in schools around the university. Next, students try out the media that has been developed on students. By working on questions that are group discussions, students are observed for their creative performance in solving mathematical problems. This was then adjusted to indicators of achievement of creative performance that emerged from students as test subjects.

1. Interactive Multimedia Using the Kodular Application

Kodular application is a means of making interactive learning media that can be exported in the form of .apk. This web-based application can be used without the need to install an application on a laptop or PC so that by registering, users can create learning media directly in the browser. The Kodular web page is https://www.kodular.io/. Furthermore, the user can create a collection of images and objects that will later be imported into the project into an Assets Manager. Media users are high school students determined by the student group that develops the media.

Users can check the projects created by installing Companion on the Playstore. Next, checking is done by scanning the barcode or filling in the project code. The initial view of the project in Kodular is as shown in Figure 1.

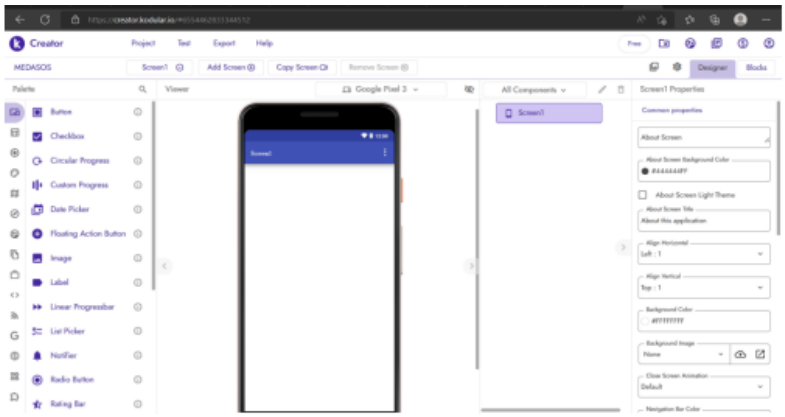

Figure 1. Kodular preview

The developed interactive multimedia is classified based on the aspect of presenting the material, the form of interaction with the user, and the presentation of test questions. The number and forms of interactive multimedia developed are presented in Table 2.

Table 2. Variety of Interactive Multimedia Using Kodular

Material Presentation (A)	Forms of Interaction with Users (B)	Presentation of Test Questions (C)
1. Static text	1.Navigation buttons	1.Google Form
2. Video adopted from Youtube	2.Solving Test	2.Quizziz
3. Self-made videos		3.Liveworksheets

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4. Graphic animation	4.Kodular

Based on Table 2, interactive multimedia is then presented according to the code. For example, A1-B2-C4 means that the interactive multimedia has the characteristics of presenting material using static text and images, the form of interaction with the user is only in the part of filling out the test where the test is presented using the Kodular application. Examples of interactive multimedia developed by students are:

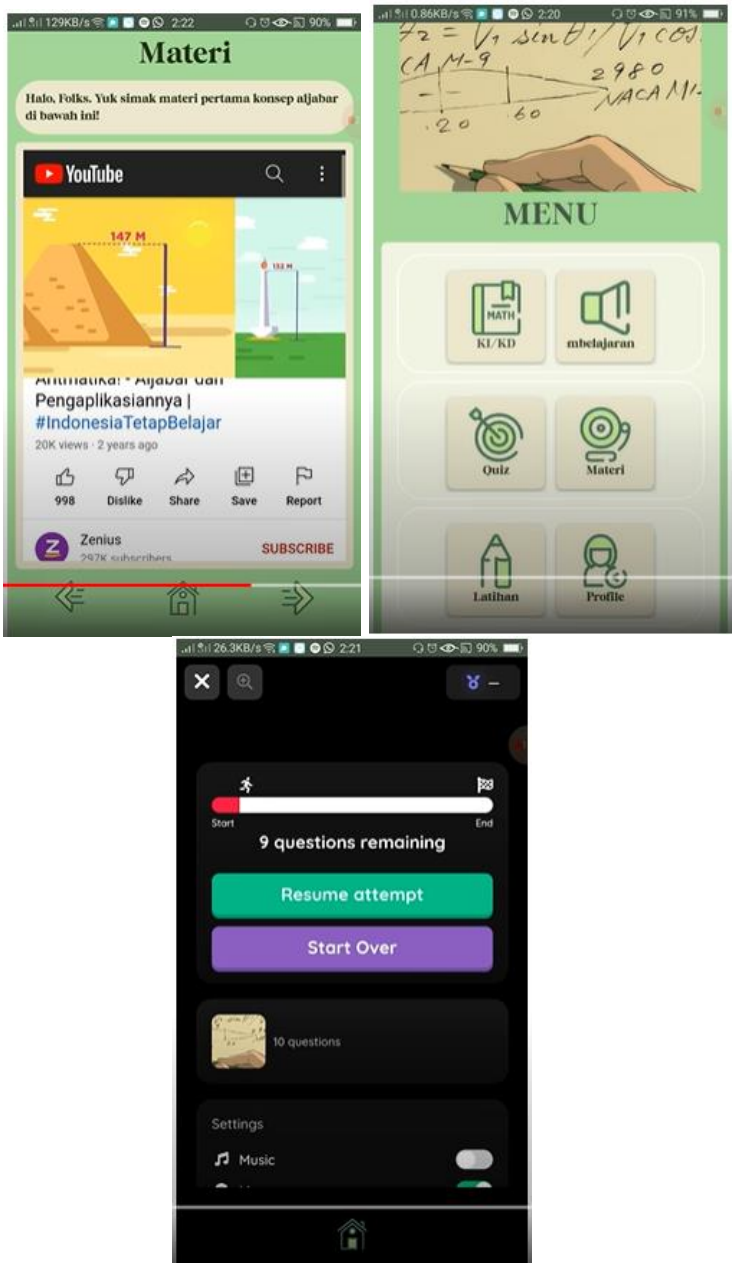

Figure 2. Interactive Multimedia A2-B12-C2

Figure 2 shows interactive multimedia made by RR students where the material contained is algebra. The presentation of the material by RR is to adopt

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Youtube videos as shown in Figure 2 (left) there is a Youtube account name, namely Zenius. For code B12, it means that this multimedia can interact with the user through the buttons on the menu and filling out the test answers. The compiled tests are loaded on another application, namely Quizziz by including external links to the developed multimedia.

Based on the results of the identification of interactive multimedia characteristics using the Kodular application, a recapitulation of the number of media with the characteristics it has can be made as shown in table 3.

Table 3. Recapitulation of the Number of Interactive Multimedia and their characteristics

No	Variety of Interactive Multimedia	Total
1	Static text, interaction with users from navigation buttons and filling out tests and presenting tests using Quizziz	7
2	Video adopted from Youtube, interaction with users from navigation buttons and filling out tests and presenting tests using Quizziz	16
3	Video adopted from Youtube, interaction with users from navigation buttons and filling out tests and presenting tests using Google Forms	11
4	Video adopted from Youtube, interaction with users from navigation buttons and filling out tests and presenting tests using Liveworksheets	3
5	The video is made by myself, interacting with the user from the navigation buttons and filling out the test and presenting the test using Quizziz	1
6	The video is made by myself, interacting with the user from the navigation buttons and filling out the test and presenting the test using Google Form	1
7	Self-made videos, interaction with users from navigation buttons and filling out tests and presenting tests using Liveworksheets	1
8	The video is made by myself, interacting with the user from the navigation buttons and filling out the test and presenting the test using Kodular	1

Based on Table 3, it can be concluded that students mostly adopt material from Youtube. The reason for choosing material from Youtube videos is the lack of student confidence in their ability to make interesting animations. In addition, students stated that by adopting, the focus of multimedia development was on the interaction with the user generated. The test application selection, Quizziz, is also easy to use and attractive in terms of background composition and color combinations.

2. Creative Thinking

a. Fluency

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The fluency aspect that most students achieve is the selection of colors, font types and objects that are attractive and consistent. All objects that are used as menu symbols and navigation buttons are located in a consistent position. A total of 41 interactive multimedia produced shows consistency in terms of layout, multimedia components consisting of home, KI-KD, indicators, profiles, materials, practice questions, and quizzes. The aspect of depth and completeness of the material was only achieved by 19 students by adopting Youtube videos. The presentation of the material in static text does not contain the right mathematical notation. This is in accordance with previous research which states that the Kodular application cannot load mathematical formulas (Rismayanti et al., 2022; Rizqiyani et al., 2022). An example of the use of static text and the absence of set notation can be seen in Figure 3.

Figure 3. Interactive Multimedia without math notation

b. Flexibility

In this aspect, it is focused on the presentation of material and tests where as many as 36 students have been able to present the material according to its form, while 5 students choose to present the material in the form of static text even though it will be more interesting if it is presented in the form of animation. For example, the material about the set then the presentation of the material using static text. Illustrations should be able to be added by adding Youtube videos about set illustrations in daily life (Purwanto & Rizki, 2015). The presentation of the test is in accordance with the application used. For example, in AKM type questions, as many as 31 students use Google Forms. In fact, research shows the effectiveness of solving AKM questions using the Quizziz and Topmarks applications. An example of presenting material that is suitable for applications and test questions can be seen in Figure 4.

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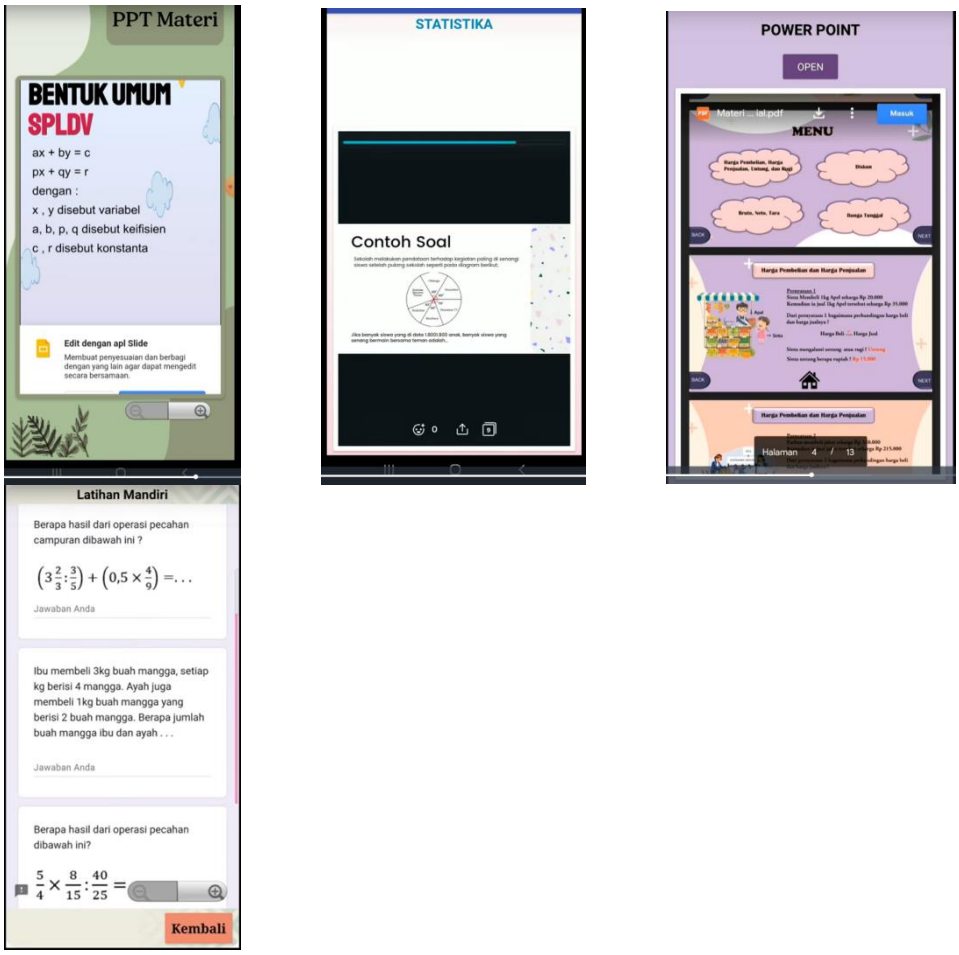

Figure 4. Interactive Multimedia that has the right presentation of material and tests

c. Originality

The authenticity dimension was achieved by 3 students where the entire material and test questions were made independently, not adopted from others. This differs from the way the material is presented by classmates who adopt learning videos from Youtube.

3. Creative Performance

a. Novelty

Dimension does not appear in the entire interactive multimedia developed. This is because the interactive multimedia developed adopts layouts and cartoon objects that are used as menus and navigation buttons on other media. The findings of this study are in line with previous research where the novelty aspect appears in the media design which was developed from aspects of layout, typeface, and objects used. (Chen et al., 2022)

b. Usefullness

The usefulness dimension of the whole multimedia is shown from the novelty of students' experiences in operating Android-based media. In addition, the types of questions presented on the quiz use the AKM type so that it becomes a new experience for students.

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Discussion

The use of the Kodular application in making interactive multimedia for mathematics learning in junior high schools begins with the fulfillment of assets as media materials. Assets can be in the form of image, audio, video or animation files in the .gif file format. Furthermore, these assets are arranged in learning media templates by adjusting the display size of the cellphone. Multimedia is said to be interactive if it can respond to user activities in accessing multimedia via mobile phones. Based on the results of this study, the multimedia characteristics of the interactive aspect are generated from navigation buttons that can respond directly to the user to continue to the next page. In addition, displaying quizzes using another application, namely Quizziz, can make users get quick responses from the answers they input. This is in accordance with previous research where interaction through multimedia can be seen from the responsiveness of the application to user use (Prabowo et al., 2018; Wiana, 2018; Wirawan et al., 2020). The results of this study emphasize reducing the appearance of static text by replacing the description of the subject matter in the form of YouTube shows. The Youtube show was developed from making a PowerPoint which was inserted with an audio recording explaining the material and then being exported in video form. Graphic animation has not been mastered by students so that it is interactive. This is because the animation for material simulation is realized in the form of YouTube shows so there is no interaction with the user. This is different from previous research which used full graphic animation in interactive multimedia (Ghofur & Youhanita, 2020; Pineda et al., 2022).

Students' creative thinking ability is measured by the variety of interactive multimedia developed. The fluency aspect arises from the use of mathematical notation which cannot be fulfilled by Kodular Applications. This is also stated by previous research where mathematical notation is embedded in multimedia with Kodular Applications by adding image assets in .jpg or .png format. (Kholifah & Imansari, 2022; Rizqiyani et al., 2022). The aspect of flexibility can be seen from the various types of quiz applications used. All research subjects have various presentations of test questions, for example Quizziz and Google Forms. This is different from previous research where the variety of quiz presentations uses another application, namely Topmarks (Kurmalasari, 2022; Soffa, 2022). Aspects of originality can be seen from the layout of the menu and navigation buttons. In addition, coloring is more dominated by pastel colors so that it is comfortable in terms of appearance to read.

Creative performance does not emerge from novelty or newness aspects. This is because the display of mathematical content in multimedia adopts more videos from Youtube. In addition, the user interface uses a matrix arrangement of buttons and is not yet dynamic. However, the usefulness aspect can be said to be feasible from the results of the limited trials on students. This usefulness is demonstrated by the completeness of the material contained, the accuracy of the mathematical notation used and the accuracy of the AKM question concepts presented.

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CONCLUSION

The variety of interactive multimedia in learning mathematics assisted by Kodular Applications is based on aspects of material presentation, forms of interaction with users, and presentation of test questions. Interactive multimedia is dominated by the presentation of material in the form of videos adopted from Youtube. The creative thinking ability achieved by students in developing multimedia is the dimension of flexibility where the presentation of material is diverse and students are able to present material according to an attractive presentation form. Creative performance does not create novelty in terms of interactive multimedia design, but all interactive multimedia has benefits in terms of novelty of user experience in solving AKM type questions. This study suggests that further research focuses on the implementation of interactive multimedia in junior high school students.

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