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# Developing Android-Based Transformational Geometry E-Module Using Adobe Animate CC

**Nanang Nabhar Fakhri Auliya[1]*, Ahmad Zulfikri[1]**
*[1]Mathematics Education Department, Institut Agama Islam Negeri Kudus, Kudus, Indonesia*
**Correspondence: nanangnabhar@iainkudus.ac.id*

## Abstract

This research aims to develop android-based Transformational Geometry e-module teaching material meeting the media eligibility criterion so that it can be implemented as teaching materials for the Transformational Geometry lecture. The research method is Research and Development referring to one of models or learning system design approaches namely the ADDIE model that has been developed by Raiser and Mollenda in the 1990s consisting five stages including analysis, design, development, implementation, and evaluation (feedback). The research subjects involved are two media experts, two teaching materials experts, and thirty 5th semester students of Mathematics Education, IAIN Kudus. The results show that the media experts obtain a total score of 159 with an average score of 79,5 and categorized as "proper". Based on validation result, the teaching material experts obtain a total score of 166 with an average score of 83 and categorized as "very proper". Meanwhile, based on limited and large-scale trials, the total score is 434 with an average score of 86,8 having "very proper" category and 1941 with an average score of 77,64 having "proper" category. Thus, it can be concluded that the android-based Transformational Geometry e-module is suitable to be implemented in learning process in and outside the classroom.

**Keywords**: ADDIE; Android; E-module; Transformational Geometry

## Abstrak

Penelitian ini bertujuan untuk mengembangkan bahan ajar e-module Geometri Transformasi berbasis android yang memenuhi kriteria kelayakan media agar dapat diimplementasikan sebagai bahan ajar mata kuliah Geometri Transformasi. Jenis penelitian yang peneliti gunakan adalah metode Research and Development yang mengacu pada salah satau model atau pendekatan desain sistem pembelajaran yaitu model ADDIE yang telah dikembangkan oleh Raiser & Mollenda pada tahun 1990-an, yang terdiri dari 5 (lima) tahap meliputi Analysis (analisis), Design (desain atau perancangan), Development (pengembangan), Implementation (implementasi atau eksekusi), Evaluation (evaluasi atau umpan balik). Subjek uji coba yang terlibat adalah dua orang ahli media, dua orang ahli materi, dan mahasiswa semester 5

program studi Tadris Matematika IAIN Kudus yang berjumlah 30 mahasiswa. Hasil penelitian menunjukkan bahawa ahli media yaitu memperoleh jumlah skor 159 dengan skor rata-rata 79,5, yang termasuk pada kategori "Layak". Hasil validasi ahli materi memperoleh jumlah skor 166 dengan skor rata-rata 83, yang termasuk pada kategori "Sangat Layak". Sedangkan pada uji coba terbatas dan uji coba skala besar memperoleh jumlah skor keseluruhan sebesar 434 dengan rerata skor 86,8 dengan kategori "Sangat Layak" dan 1941 dengan rerata skor 77,64 dengan kategori "Layak". Maka, hal tersebut dapat diambil keputusan bahwa e-module Geometri Transformasi berbasis android layak untuk digunakan dalam proses pembelajaran di dalam kelas maupun di luar kelas.

**Kata Kunci**: ADDIE; Android; E-module; Geometri Transformasi

## Introduction

Education has an important role in everyday life, especially education in mathematics. It is one of the compulsory subjects in formal education and it is also as a branch of science. According to Siregar, mathematics is a science that is the root of many fields in life. The development on science, social studies, accounting, and other subjects is influenced by mathematics (Naim et al., 2021: 162). Knowing the importance of mathematics in life, so learning mathematics at every level of formal education from elementary school to college is encouraged (Wahyuni, 2018: 28). It aims to prepare students to be able to implement mathematics for critical thinking skills in order to solve problems in the real-life situation. In reaching the goal, it is necessary for teachers to use suitable teaching media and tools.

The rapid development of the times, especially in technology also affects the form or model of teaching materials existing today. Teaching materials today are not only in printed form, such as books, student worksheets (LKS), modules, and others, but also switched to the form of artificial electronics, such as electronic books (e-books) and electronic modules (e-modules). According to Sunismi, textbooks have weaknesses, namely the concepts presented are still abstract, it affects students having difficulties to understand the materials, which will have an impact on students' interest and motivation to learn (Sunismi, 2015: 203). It obviously does not help students to understand materials containing abstract logic so it lacks of interesting and it is boring for students. Teachers must be able to minimize abstraction by displaying real material in every learning process (Masyfuq, 2017: 2). Therefore, it is necessary to develop teaching materials like e-modules because they clearly provide convenience for students and they are easier to access and learn. The e-module application development is also expected to make students to learn independently (Irawati et al., 2021: 3149). The use of e-modules as learning

materials or resources is one of the components affecting the learning process. This is supported by the research finding from the research conducted by Maryam. The finding shows 70% students want to have interesting and exciting learning materials and facilities using computers like e-modules (Prastowo, 2013: 107). This statement is reinforced by Suryadie's research (2014).

The electronic modules are innovative media that can improve students' interest in learning. In the e-module, the learning material has to be adjusted to the learners' situation and teachers' learning strategy. However, students' work sheet (LKS) and textbooks electronic modules used by teachers when presenting mathematics learning material have not helped students to understand the material concept. The students do not use LKS and students' manual books provided by the school as references to help them to understand mathematics. The use of technology in the form of e-modules is one of the efforts to improve students' learning quality and to minimize students learning difficulties. Allah says in Surah (Chapter) Ar-Ra'd (The Thunder) verse 11: "For man there are angels who always follow him in turn, in front of him and behind him; they guard him at the command of God." "Surely God does not change the condition of a people so that they change the situation that is in themselves." An "e-module" is a module having complexity electronically or a module that is converted into digital format. Thus, the e-module also has a function as a printed module (Ula et al., 2018: 203). An e-module can also be interpreted as a module based on information communication technology; its advantages compared to printed modules are its interactive nature makes easier navigation, it allows to display and load images, audio, video and animation, and it is equipped with formative tests and quizzes that allow automatic feedback immediately (Suarsana, 2013: 266). The e-module as a people literacy medium is expected to be able to divert the people attention who initially use smartphones only for social media, and with attractively packaged material in the form of electronic book equipped with video and audio, it is also expected to improve people's literacy (Gufran, 2020: 14). In mathematics learning process, the use of android-based e-module is an innovation that is expected to increase students' interest, motivation, and enthusiasm in learning mathematics. In the android-based e-module, an interaction is available that allows a two-way relationship between students and teaching material being studied, so that students become active in the learning process and the teachers are only as facilitators (Yulia, 2021: 5). In addition, in this android-based e-module an interactive quiz is also available where all users will be able to measure how deep the students understand the material.

The educational system supported by technology is able to improve students' motivation and interest in mathematics (Ozdamli et al., 2013: 1064). One of the

applications that can be used to create android-based e-modules is Adobe Animate CC. The use of Adobe Animate CC as a learning medium has a positive effect on students' enthusiasm for learning because it is able to help students to learn independently anytime and anywhere with interesting material presentation. (Zahroh et al., 2019). The use of Adobe Animate CC as a learning medium is able to help students to understand the material more real and clear and to relate the learning and everyday life (Yusuf, 2019: 43). The learning medium is very helpful for students to learn mathematics that has an abstract nature or characteristics. Adobe Animate CC is a computer program that can be implemented as an m-learning-based learning medium. The functions of Adobe Animate CC are to create interactive and non-interactive animations and also to create learning applications. Through various animation variations, it is expected to encourage students' interest in learning mathematics. The Adobe Animate CC is chosen as a learning medium because it has several advantages, namely it can be used to create complex animations and navigations; it has small file size but good quality; it supports and can also be equipped with programming language that allows it to be used in games; however, this software is not easy for beginners, and it is necessary to memorize all commands used and it is also necessary to have certain skills. Unfortunately, college students so far are still rarely taught the use of android-based e-modules; existing e-modules rarely contain lecture materials, and only 25% students are able to understand mathematical material using e-modules (Sari, 2018): The same thing occurs on Mathematics Education study program students. The students have difficulties to find a literacy for Transformational Geometry lecture, especially a literacy in the form of e-modules. In Transformational Geometry, the materials or topics include transformation, translation, reflection, half-turn, rotation, isometric multiplication, isometry, and congruence. Therefore, the researcher tries to develop teaching materials and to look for feasibility like android-based e-modules, especially on transformational geometry material.

## Method

The method used by the researcher is research and development method. Research and Development method is a research method used to produce and test the effectiveness of certain products. To be able to produce and test the certain products, analysis and test are required (Sudaryono, 2016: 15). The research and development method conducted refers to one of the models or learning system design approaches namely the ADDIE model that has been developed by Raiser and Mollenda in the 1990s. The ADDIE model is selected because the model is easy to understand. The model is systematically developed and it is also developed based on theoretical learning tools development. ADDIE stands for analysis, design,

development, implementation, and evaluation (see Figure 1) (Charissudin, 2021: 13).

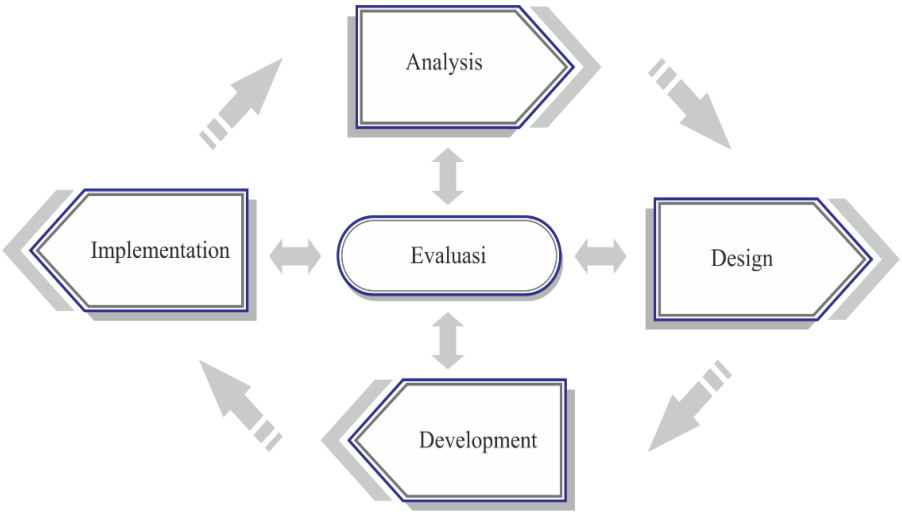



Figure 1. R & D ADDIE Model R&D Procedures

In this research, to see how feasible the learning media made by the questionnaire and the average score obtained are changed into qualitative value category. The way is to compare the average score with the ideal assessment criterion by converting the score to a scale of 5. The conversion of scores to a scale of 5 according to Slameto can be seen in Table 1.

Table 1. Scale 5 of Score Conversion

| Score Interval | Score | Categories |
|---|---|---|
| $\bar{X} > M_i + 1{,}5\ SD_i$ | A | Very High |
| $M_i + 0{,}5\ SD_i < \bar{X} \leq M_i + 1{,}5\ SD_i$ | B | High |
| $M_i - 0{,}5\ SD_i < \bar{X} \leq M_i + 0{,}5\ SD_i$ | C | Moderate |
| $M_i - 1{,}5\ SD_i < \bar{X} \leq M_i - 0{,}5\ SD_i$ | D | Less |
| $\bar{X} \leq M_i - 1{,}5\ SD_i$ | E | Very Less |

Slameto (2001: 186)

Information:

$\bar{X}$ = Mean Score (actual score)

$M_i$ = Average score

$SD_i$ = Standard deviation or standard deviation score

In this research, there are 20 statements on the questionnaire with a scale value of 5, so that the ideal maximum score is 100, the ideal minimum score is 20,

$M_i$ is 60, $SD_i$ is 3,3. Furthermore, the data are classified into Table 1. The criteria for the eligibility category of learning media are as follows.

Table 2. Learning Media Eligibility Criteria

| No. | Score Interval | Categories |
|---|---|---|
| 1. | $\bar{X} > 79{,}995$ | Very Proper |
| 2. | $66{,}665 < \bar{X} \leq 79{,}995$ | Proper |
| 3. | $53{,}335 < \bar{X} \leq 66{,}665$ | Pretty Proper |
| 4. | $40{,}005 < \bar{X} \leq 53{,}335$ | Less Proper |
| 5. | $\bar{X} \leq 40{,}005$ | Very Less Proper |

## Results

The ADDIE model developed by Raiser & Mollenda in the 1990s has 5 (five) phases including Analysis, Design, Development, Implementation, Evaluation. In this research, the model has been modified based on the needs. The ADDIE model is selected because based on the consideration the model is easy to understand and it is also developed based on theoretical learning tools development.

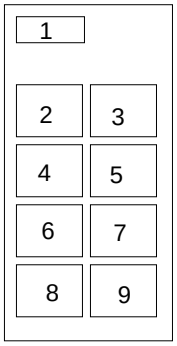
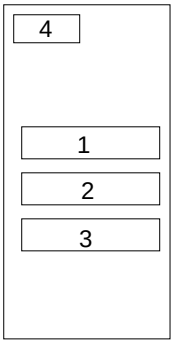
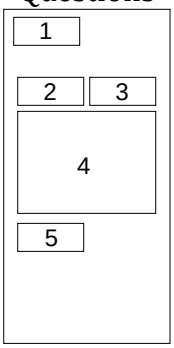
### *Analysis Phase*

The analysis phase is the first phase in the research. The observation is conducted at IAIN Kudus, especially in the Mathematics Education study program focusing on teaching and learning activities in the classroom for transformational geometry lecture. The results show that many students have difficulties to understand transformational geometry concept, and the lecturers still use textbooks as learning references.

### *Design Phase*

The researcher creates a storyboard for transformational geometry e-module in this phase.

Table 3. Storyboard

| Storyboard View | Information |
|---|---|
| Storyboard Main Menu   | 1 = Menu Button<br>2 = Transformation Material Button<br>3 = Sliding Translation button<br>4 = Half Turn Material Button<br>5 = Reflection Material Button<br>6 = Rotation Material Button<br>7 = Multiple Product Isometry Material Button<br>8 = Isometry Material Button<br>9 = Similarity Material Button |
| Storyboard Sub Material   | 1 = Material Button<br>2 = Video Button<br>3 = Practice Questions Button<br>4 = Menu Button |
| Storyboard Practice Questions   | 1 = Menu Button<br>2 = Previous Button<br>3 = Next Button<br>4 = Questions and Boxes to answer<br>5 = Answer Button |

*Development Phase*

In this phase, the researcher transforms the storyboard into a flowchart. The product design is in the form of application using Adobe Animate software. The followings are the steps to create the application (see Figure 2):

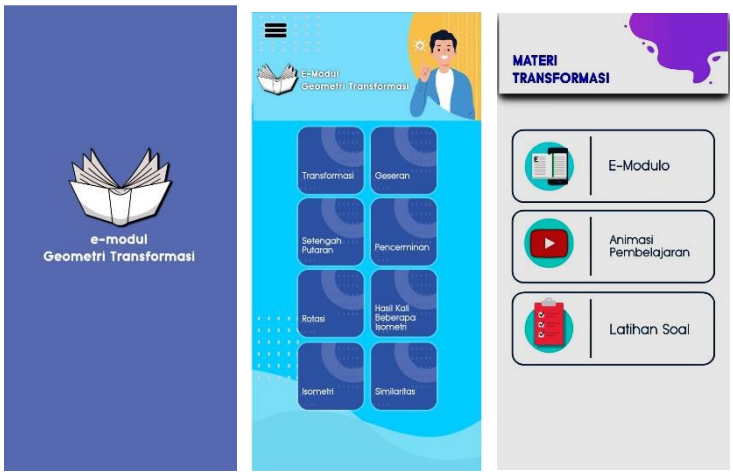



Figure 2. Transformational Geometry E-module Display

After the e-module is created, the next step is to validate the product. Here is the specification for instrument validation and the assessment instrument for users.

Table 4. Questionnaire Specifications for Media Experts

| No | Aspects | Indicators | Total Number of Items | Number of Item |
|---|---|---|---|---|
| 1 | Media Display | Using learning media for the first time | 1 | 1 |
| | | Text/font Format | 2 | 8, 9 |
| | | Use of color | 2 | 2, 10 |
| | | View Program | 3 | 4, 5, 6 |
| | | Use of images | 1 | 3 |
| | | Language Use | 1 | 7 |
| 2 | Programming | Instructions for using Learning media | 1 | 15 |
| | | Ease of Operation | 1 | 16 |
| | | Buttons/Navigations | 1 | 17 |
| | | Practice question program | 1 | 18 |
| | | Effect | 1 | 19 |
| | | Interactivities | 1 | 20 |

Table 5. Questionnaire Specifications for Material Experts

| No | Aspects | Indicators | Total Number of Items | Number of Item |
|---|---|---|---|---|
| | Material Completeness | Material Suitability of CPL | 1 | 1 |
| | | Material Suitability on students' needs | 1 | 2 |
| | | Material relevance to the indicators | 1 | 3 |
| | | Material format | 1 | 5 |
| | | Material Presentation | 2 | 4, 6 |
| | | Supporting material (images/videos) | 1 | 8 |
| | | Question Samples and discussion | 1 | 7, 9, 10 |
| 2 | Material Accuracy | Scientific truth and science development conformity | 2 | 11, 12 |
| | | Material Relevance to students must-master competencies | 1 | 13 |
| | | Sample suitability with the material | 1 | 17 |
| | | Learning objectives clarity | 1 | 15 |
| | | Motivating students | 2 | 16, 18 |
| | | Material correlation and everyday life | 1 | 14 |
| | | Ease of language to understand | 2 | 19, 20 |

Table 6. Questionnaire Specifications for Students Responses

| No | Aspects | Indicators | Total Number of Items | Number of Item |
|---|---|---|---|---|
| 1 | Facilities | Ease of Use | 2 | 1, 2 |
| | | Text/writing clarity and readability | 1 | 3 |
| | | Images quality | 1 | 4 |
| | | Interactive quizzes | 1 | 5 |
| 2 | Understanding | Materials | 2 | 6, 8 |
| | | Examples | 1 | 7 |
| 3 | Motivation | Motivation | 1 | 9 |
| | | Curiosity | 1 | 10 |
| | | Spirit | 1 | 11 |
| 4 | Benefit | Positive impact | 3 | 12, 14, 16 |
| | | Study aids | 2 | 13, 17 |
| | | Passion for learning | 1 | 15 |
| 5 | Pull | Animations | 1 | 19 |
| | | Pictures | 2 | 18, 20 |

After the Transformational Geometry e-module is validated by media experts, the material and several inputs are obtained. The following are the results of eligibility performed by the validators, the media and material experts.

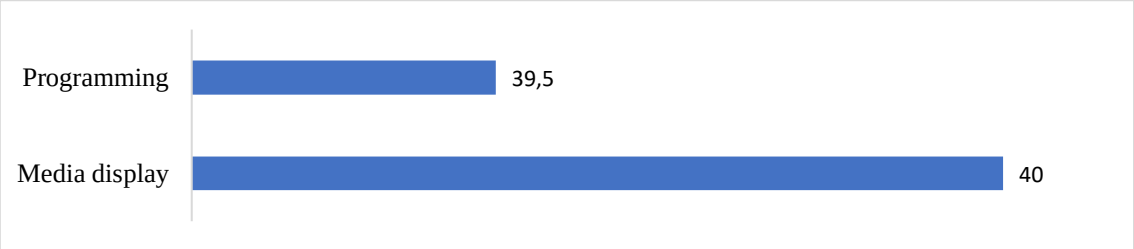



Figure 3. Validation Average Result performed by Media Expert for Every Aspect

Based on Figure 3, the average for overall validation results performed by media experts is 79,5. Based on Table 2, the average score of 79,5 is between the score range of $66{,}665 < \bar{x} \leq 79{,}995$ and it is in the "proper" category. Learning media instrument is also validated by material experts and the figure below is the assessment result.

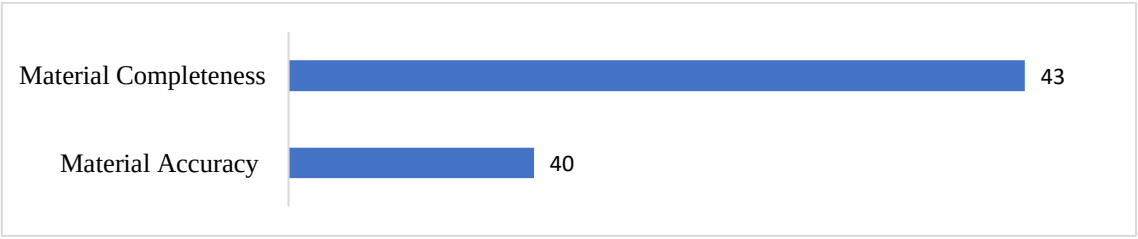



Figure 4. Validation Average Result performed by Material Experts for Each Aspect

Based on Figure 4, the overall average for overall validation results performed by media experts is 83. Based on Table 2, the average score of 83 is more than 79,995 ($\bar{x}$>79,995) and it is in the "very proper" category. At the validation step, all objectives are reached and further improvements are made. The followings are some inputs from media and material experts.

Table 7. Media Display Before and After Improvement

| No | Menu | Reviews and Feedback | Improvements |
|---|---|---|---|
| 1 | Screen size | It would be nice if the screen is shown in Full Screen mode, so that if it is installed on any mobile phones the screen display will automatically adjust. | Full screen resetting |
| 2 | Mobile phone's default back button | It would be nice for mobile phone's default back button to be returned to the original function | Providing code to all programs/apps so that the mobile phone's default back button functions as the initial function. |

Table 8. Material Display Before and After Improvement

| No | Menu | Reviews and Feedback | Improvements |
|---|---|---|---|
| 1 | Writing errors | 1. Fixed typography<br>2. The use of the affix "in" is as a verb or place word<br>3. The use of slashes for writing fractions, the use of equations is better<br>4. The use of the symbol of degree instead of 0s | Checking all writing errors according to the material experts' advice. |
| 2 | E-module PDF resolution | E-module PDF resolution still needs to be improved so that users are able to see clearly | Replacing the old image (PDF) with an image having larger resolution. |

## *Implementation Phase*

After the product is declared as a feasible product based on the validation test result, it is examined upon the 5th semester Mathematics Education study program students of IAIN Kudus. Five students are for limited (small-scale) trial and twenty five students are for large-scale trial. The trial aims to find out whether the product is able to be used as a learning reference for students or not through questionnaire. The first small-scale trial result can be seen in Figure 5.

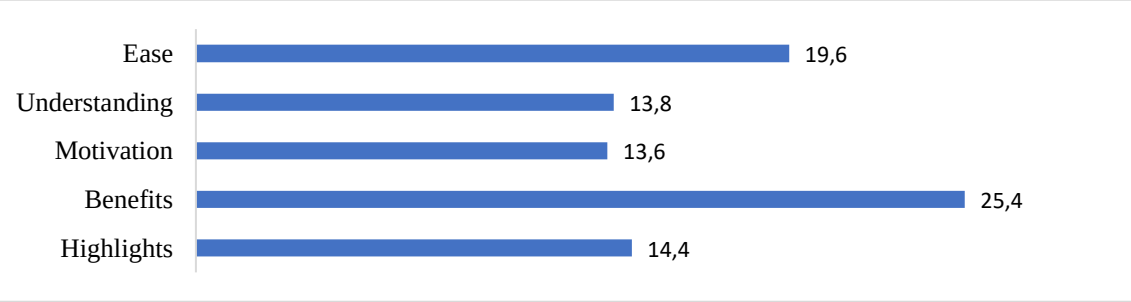



Figure 5. The Small-Scale Trial Average Result for Every Aspect

The overall score result of small-scale trial is 4,34 with an average score of 86,8 and it is in the "very proper" category where 86,8 is more than 79,995 ($\bar{x}$>79,995). Then it will proceed to conduct a large-scale trial upon 25 students and the result can be seen in Figure 6.


Figure 6. The Large-Scale Trial Average Result for Every Aspect

The overall score result of small-scale trial is 1941 with an average score of 77,64 and it is in the "eligible" category where 77,64 is between 66,665 and 79,995 ($66{,}665 < \bar{x} \leq 79{,}995$).

## *Evaluation Phase*

All evaluation results for every phase show that the students need innovation and renewal on learning media in the learning process, so the researcher has

developed the Transformational Geometry e-module and the development is stated as a feasible medium to be implemented in learning process.

## Conclusion

The research and development method in this research produces a teaching medium or learning material in an android-based Transformational Geometry e-module application. This teaching medium or learning material is applicable on the Transformational Geometry lecture for the topics of transformation, translation, reflection, half-turn, rotation, isometric multiplication, isometry, and congruence. The phases used in this research are based on the ADDIE development model having five phases namely analysis, design, development, implementation, and evaluation. The result shows that the teaching medium or learning material produced by the researcher is categorized as "very proper" product.

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