ELECTRONIC MODULE (E-MODULE) TEACHING MATERIALS THROUGH GEOGEBRA SOFTWARE FOR MIDDLE SCHOOL ON FLAT-SIDED GEOMETRIC MATERIAL

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Article Info	Abstract
	Current developments are increasing rapidly which has an impact on education. Improving the quality of learning requires teachers and students to understand technology. Teaching materials in the form of electronic modules (e-modules) are one form or influence of technology on the world of education. The aim of this research is to produce e-module teaching materials for mathematics learning assisted by GeoGebra on flat-sided geometric material for class VIII SMP that are valid and practical. The type of research used is development research using the ADDIE model. The instruments used are validation and practical instruments (teacher and student response questionnaires). The research results show that (1) the average assessment of e-modules by material experts is 79.36% in the valid category and the average assessment by media experts is 81.58% in the valid category. (2) The average practicality of the teacher response questionnaire assessment e-module was 90.28% in the very practical category and the student response questionnaire assessment obtained an average of 80.96% in the practical category. Based on these results, it can be concluded that the e-module assisted by the GeoGebra software developed is valid and very practical.

INTRODUCTION

Education is one of the means used to advance all areas of human livelihood. The process of progressing human personality both in terms of knowledge and attitudes in education is instilled from values such as moral values, binding norms and rules (Ilham, 2019). Learning that has a connection or relationship in life and is identical to calculations is called mathematics. A science that studies how to think rationally and make sense in obtaining a concept is also called mathematics. In the world of education, development

is defined as a process that can create or produce teaching materials (Setyosari in (Nur & Masita, 2022)). Teaching materials can be used to support student activities during the learning process, because teaching materials are provided so that students are able to understand and master the material well (Meliani et al., 2022). Teaching materials are written and designed with instructional rules because they will be used by teachers in learning (Magdalena et al., 2020).

Based on the results of interviews conducted on Saturday 14 January 2023 with mathematics teachers, the teaching materials used at SMP in Pekanbaru use textbooks and LKPD. However, students in this class did not receive all printed books due to the availability of printed books at the school. Apart from that, the teaching material used as supporting material in mathematics learning is that he uses learning videos. According to him, the teaching materials used are not enough, so other references are needed. These results are confirmed by the following example of interview excerpts:"…. *For teaching materials, I use textbooks and LKPD available from the publisher. "Meanwhile, for students, one table and one book due to limited numbers is not sufficient for all students, while learning materials as support, I use relevant videos... (GR 1)".*

The results of interviews conducted with two students stated that the method used by the teacher in the learning process was the lecture method. Students still have difficulty understanding lessons and experience difficulty when given story questions. The minimum completion criteria (KKM) in this school, especially mathematics lessons, is 80. The number of students in class 8 is 40 people. If we look at the learning outcomes, there are 9 students who have exceeded the KKM, so there are 31 students who have not exceeded the KKM. This shows that mathematics learning outcomes in this class are still low. Therefore, something new is needed in learning activities.

Previous research related to the topic under study has been carried out by several researcher. For example, related to e-modules (Muzaki et al., 2022); (Rochsun & Agustin, 2020); (Wijayanto et al., 2023). Content is 3D geometry and also geometric shapes (Yaniawati et al., 2023), apart from that it is related to technology integration such as use software, games and multimedia have also been carried out (Nasir & Fakhruddin, 2023); (Pham, 2024); and (Buchori et al., 2023). The research that has been carried out apply several applications in the form of game-based software, as well as geogebra development of learning multimedia and videos in the form of Augmented reality, as well as emodule for ethnomathematics. Different from the research developed by researchers, namely an e-module assisted by Geogebra for geometric material content on shapes flat side space.

Additional teaching materials are needed because the teaching materials used are not varied enough according to the teacher even though they have used teaching materials other than printed books. The teaching materials used by teachers still have several weaknesses, namely the material presented uses language that is not well understood by junior high school students, and the explanations used are not detailed enough so that students are less able to learn individually or independently. Apart from that, the teaching materials do not contain learning objectives. One effort that can be made to deal

with this problem is to use additional teaching materials that are adapted to current developments using technology. The teaching materials that can be used using technology are teaching materials in the form of electronic modules (e-modules). Teaching materials that can be used independently containing material, limitations, methods and evaluation methods that are arranged regularly in order to achieve the expected competencies electronically are called e-modules (Restina et al., 2021). Based on statements from teachers and students, they stated that mathematics learning activities had never used e-module teaching materials.

The rapid development of technology has an influence and impact on education. Existing technological developments can have a good influence in the field of education, such as improving the quality of education (Suripah & Susanti, 2022). The influence that can be felt with technology is that learning can be done using a computer or smartphone. The software features on smartphones or computers currently available are quite diverse. The software that is useful in learning mathematics includes SPSS which is useful in learning statistics, Maple, Mathlab, Microsoft Mathematic, GeoGebra, and others (Ekawati, 2016). The focus of this research is on GeoGebra software which is useful for helping students learn mathematics. In this school, especially mathematics, software has been used to support learning, namely Quizziz. The learning activities carried out by the teacher have never used GeoGebra. Therefore, GeoGebra is needed as a useful media to make it easier for teachers to provide learning and help students understand lessons. This is in line with Oktaria et al., (2016), stated that GeoGebra can be used as a visual medium so that students can more easily understand abstract mathematical material. Apart from that, using this software will increase students' curiosity because they have never studied it before.

Building a flat sided space is one of the materials that can be completed using GeoGebra software. According to one of the mathematics teachers at one of Middle School in Pekanbaru (SMP), the weakness experienced by students in the flat-sided geometric material was that it was difficult to distinguish flat shapes from spatial shapes. Apart from that, students lack accuracy in working on questions and think that it is difficult to differentiate between cubes and blocks. Students' lack of understanding of the material and the difficulty of imagining abstract, flat-sided spatial figures are weaknesses experienced by students. This is in line with (Sahara & Nurfauziah, 2021), the difficulty faced in the flat-sided geometric material is when solving research questions. This is due to a lack of understanding of geometric concepts and a lack of practice in solving problems in the form of stories. Therefore, tools are needed in the form of GeoGebra software that can visualize the desired image. Based on the previous description, the researcher is interested in developing teaching materials in the form of e-modules assisted by GeoGebra on the material Building Flat-Side Spaces for class 8 Middle School in Pekanbaru.

METHODS

This type of research is development research. This research uses the ADDIE model which consists of Analysis, Design, Development, Implementation and evaluation. The ADDIE model was chosen because the product produced is in the form of learning media-based development (Harefa et al., 2023).This research aims to produce e-module teaching materials for mathematics learning assisted by GeoGebra on flat-sided geometric material for class 8 SMP that are valid and practical. The research procedure using the ADDIE model is shown in Figure 1.

Figures 1
Scheme of research procedures
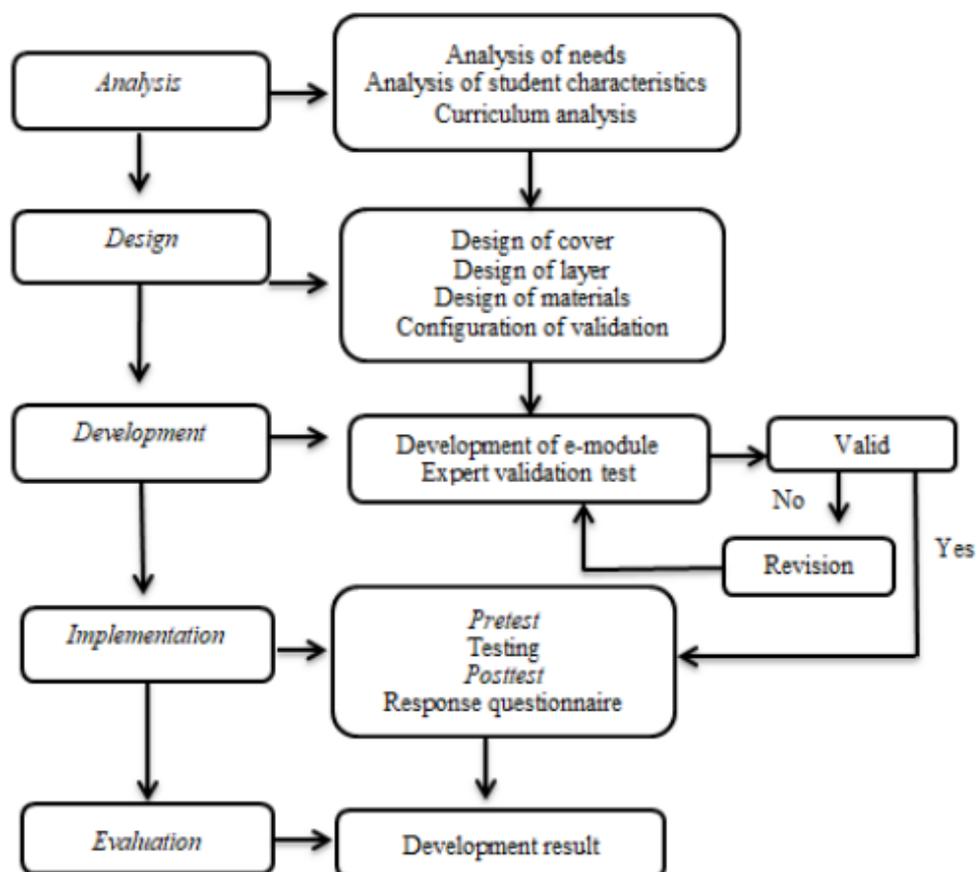
The research was conducted at SMP in Pekanbaru. The class studied was class 8 with 40 students. In this research, data was collected using validation sheets and response questionnaires (teachers and students). There are two types of research instruments used, namely validity and practicality. The assessment instrument used on the validation sheet and response questionnaire is the Likert scale (1-4).

Validity

This validation instrument is useful for testing the feasibility of the e-module that has been developed by researchers. The validation sheet contains appropriateness of content, appropriateness of presentation, appropriateness of language, appropriateness of graphics and software engineering. This validation sheet is given to validators (experts and media) as many as 3 lecturers. The validation sheet grid for material experts and media experts is presented in Table 1 and Table 2.

Table 1
Grid of e-module validation sheets by material experts

No.	Assessment Indicators	Statement number	Number of statements
1.	Suitability of material with KD and KI	1	1
2.	The material presented is systematic	2-7	6
3.	Presentation support	8-15	8
4.	Conformity to language rules	16-21	6

Table 2
Grid of e-module validation sheets by media experts

No.	Assessment Indicators	Statement number	Number of statements
1.	E-module cover design	1-8	8
2.	Design e-module content	9-16	8
3.	Software engineering	17-20	3

The data analysis technique used is descriptive analysis. The formula used:

$$validity\ level = \frac{the\ total\ score\ obtained}{total\ score} \times 100\%$$

To get conclusions, the researcher used combined analysis, namely adding up the results of the existing validity levels and then dividing by the amount of data.

$$combined\ validity = \frac{validity\ 1 + validity\ 2 + \cdots}{total\ validity}$$

Table 3
Validity Criteria

Intervals	Validity criteria

(Zetriuslita et al., 2022)

Practicality

The practicality test is useful for determining the level of practicality obtained from the teacher and student response questionnaire to the e-module teaching materials that have been developed. The teacher and student response questionnaire grids that researchers have modified are:

Table 4
Teacher and student response questionnaire grid

No.	Assessment Indicators	Statement number	Number of statements
1.	Ease of use	1-9	9
2.	Time efficiency	10	1
3.	Benefit	11-14	4
4.	Attractiveness	15-18	4

The data analysis technique used is the percentage data analysis technique. The formula used is:

$$P = \frac{\Sigma x}{N} \times 100\%$$

P= percentage score
Σx= total score
N = maximum score

Table 5
Practicality Criteria

Interval (in %)	Criteria
85.01-100	Very practical
70.01-85.00	Practical
50.01-70.00	Not practical
01.00-50.00	Not practical

(Zetriuslita et al., 2022)

FINDINGS AND DISCUSSION

FINDINGS

This research produces a product in the form of electronic module teaching materials (e-modules) assisted by GeoGebra software on flat-sided geometric material (cubes and blocks) in class 8 SMP. The appearance of the e-module that has been developed is: cover, foreword, table of contents, concept map, description and instructions for using the e-module, getting to know GeoGebra software, learning activities (consisting of basic

competencies and competency achievement indicators, learning objectives, activities learning), answer key (specifically for teacher e-modules), summary, competency test, bibliography and glossary. ADDIE is a model used by researchers in developing electronic module (e-module) teaching materials assisted by GeoGebra software, namely Analysis, Design, Development, Implementation and Evaluation.

Analysis

The first stage carried out is analysis. At this stage, what is done is needs analysis, student characteristics analysis and curriculum analysis. The needs analysis carried out in this research aims to determine the problems experienced by students. Analysis data was obtained from unstructured interviews conducted with mathematics teachers at junior high schools in Pekanbaru. Analysis of student characteristics was carried out to determine the condition and level of students' cognitive development. The curriculum used at SMP for class 8 uses the 2013 curriculum (K13). Curriculum analysis aims to design indicators and learning objectives based on basic skills applied at SMP in Pekanbaru. Briefly, the results of the analysis are summarized in the following Table 6.

Table 6
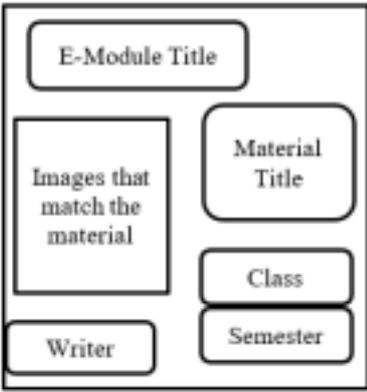*Recapitulation of Preliminary Analysis Results*

No	That aspect dianalysis	Results
1	Analysis Need	1. One of the obstacles faced is the lack of student interest in learning mathematics and the number of students in one class reaches 40 people, so the teacher has a little difficulty paying attention to all students.
		2. The teaching materials used by teachers are in the form of textbooks and LKPD.
		3. Teachers have used the Quizziz application, but have never integrated it into the learning process with the help of Geogebra software.
		4. One of the materials studied is constructing data side spaces. In this material, there are still difficulties faced by students, such as distinguishing between solid shapes and flat shapes. In addition, students have difficulty distinguishing space diagonals and plane diagonals.
		5. The learning used still predominantly uses the lecture method. Apart from that, students still have difficulty when given questions in story form.

2	Characteristics Student	1. Students who are used as trials are aged 13-14 years. 2. According to Piaget, students at this age are included in the formal operational phase (can already think abstractly, logically and idealist). 3. At the age of 13-14 years, students can also imagine and look for systematic ways to solve a problem so that they can draw conclusions.
3	Analysis Curriculum	1. The school that is the object of research uses the 2013 curriculum. 2. Basic competencies and indicators of achievement of competencies at the school include: Basic competency 3.9 (Distinguish and determine the surface area and volume of flat sided shapes (cubes, inverts, prisms and pyramids); and Basic competency 4.9 (Solving problems related to area surfaces and volumes of flat-sided figures (cubes and beams, prisms and limas, as well as their combinations). 3. Based on these basic competencies, competency achievement indicators are created.

Design

The second stage carried out is the design stage based on the analysis results obtained. At this stage, researchers will design products in the form of electronic module teaching materials (*e-mode*) with flat-sided geometric material (cubes and blocks). The results of the design that has been carried out are summarized in the following Table 7.

Table 7
Recapitulation of Design Results

No	Aspect Design	Design
1	Design Cover E Module	

No	Aspect design	Design
2	Design*layout e-module*	1. Use the appropriate paper format 2. Use icons that are easy to understand aims to emphasize that point special or important. 3. Display the concept map according to the content material found in the module. 4. Front cover with combination colors, picture illustrations, shapes as well appropriate font size. 5. Simple shape and size of letters read according to student characteristics. 6. Comparison of letters between titles and subtitles and the contents of the manuscript are proportional as well avoid capital letters for the entire text. 7. Use consistent letterforms on each page. 8. Use spacing, layout consistent typing, like a pattern typing or margins/boundaries typing.
3	Design Material	The materials used in this research are flat-sided shapes, especially cubes and blocks. Learning sources or references used in making It is module in this research, namely class 8 student textbooks, semester 2, internet and e-mode.
4	Design assessment	Assessment e-mode carried out in the form of validation by material experts, media experts, teacher and student response questionnaire sheets.

Development

The third stage in this research is development or development, where the design that has been carried out in the previous stage is developed at this stage. The activities carried out are: At this stage, researchers develop e-mode which was designed in the previous stage, namely design by using canva. After the finishing stage, the e-module is given to material expert validators and media experts. Framework development It is module that has been designed is described as follows.

E-Module Validation by Material Experts

Aspects assessed by material expert validators include suitability of material with KD and KI, material presented systematically, supporting presentation and conformity with language rules. The validation results from material experts are presented in Table 8.

Table 8
Material Expert Validation Results

Validator	Total Score	Percentage	Category
V1	64	76.19048 %	Valid
V2	59	70.2381 %	Valid
V3	77	91.6667%	Very Valid
Combined Validation		79.365%	Valid

Based on the results of the validation analysis of the flat-sided building e-module (cubes and blocks), a combined validation of 79.365% was obtained with a valid category. From the data above, it can be seen that the lowest total score is 59. This is because the presentation of the mathematical symbols used is still not standard.

E-Module Validation by Media Experts

Aspects assessed by media expert validators include e-module cover design, e-module content design and software engineering. Validation results from media experts are presented in Table 7.

Table 6
Media Expert Validation Results

Validator	Total Score	Percentage	Category
V1	59	77.6315%	Valid
V2	57	75 %	Valid
V3	70	92.105%	Very Valid
Combined Validation		81.578%	Valid

Based on the results of the e-module validation analysis of flat-sided building blocks (cubes and blocks), a combined validation of 81.578% was obtained. From the data above, the lowest score was obtained at 57. This score was caused by several shortcomings in the GeoGebra software available in the e-module, such as there being no command to adjust the shape of a cube or block.

E-module which has been validated by experts, then continued with improvements in accordance with the suggestions given. The advice given by the validator is, when writing mathematical symbols, it is best to use equations. Apart from that, there are still some people who don't have instructions for using it, namely the GeoGebra software. When completed, the e-module is checked again by experts until it is declared suitable for use, which is then continued at the next stage. The following is the appearance of the e-module cover that has been developed:

Figures 2
E-module cover

Implementation

The fourth stage is implementation. E-modules that have been validated and declared feasible can be realized or used in classroom learning. The trials carried out are useful for determining the feasibility or practicality of the e-module that has been developed. To see the practicality of the product being developed, instruments were used in the form of teacher response questionnaires and student response questionnaires. The results of the teacher response questionnaire and student responses are shown in Tables 8 and 9.

Table 7
Teacher Response Questionnaire Results

Indicator	Total Score	Percentage (%)	Category
Ease of Use	32	88.8889	Very practical
Time efficiency	3	75	Practical
Benefit	15	93.75	Very practical
Attractiveness	15	93.75	Very practical
Total		87.8472	Very practical

Based on the analysis results obtained from the teacher response questionnaire, a score percentage of 87.8472% was obtained in the very practical category. The lowest percentage value is in the time efficiency aspect, namely 75%. This was due to the lack of tools such as laptops or computers when the research was carried out, so it took time to operate the learning aided by GeoGebra software.These findings indicate that facilities and infrastructure are needed to facilitate learning. Apart from that, teachers' mastery skills in integrating technology are very much needed (Suripah & Susanti, 2022).

Table 8
Student Response Questionnaire Results

Indicator	Total score	Percentage (%)	Category
Ease of Use	1394	96.8056	Very practical
Time efficiency	136	85	Practical
Benefit	554	86.5625	Very practical
Attractiveness	570	89.0625	Very practical
Total		89.3576	Very practical

Based on the results of the average student response questionnaire, a percentage of 89.3576% was obtained in the very practical category. Time efficiency is the aspect that has the lowest percentage in the student response questionnaire. Trials using GeoGebra software require more time, because in practice only a few students can try the software in turn. Apart from that, students also need time to write important things that are conveyed. Activity illustration is presented in Figure 4.

Figures 3
Students learn using e-modules

Evaluation

The final stage is the evaluation stage. At this stage, an assessment of the results obtained from the teacher and student response questionnaires is carried out. This evaluation serves to measure the level of practicality of the e-module used. According to Hendrawansyah et al., (2022), at this stage an analysis of the results obtained at the implementation stage is carried out. The results obtained in the teacher response questionnaire were 87.8472% in the very practical category. Meanwhile, the average results obtained in the student response questionnaire were 89.3576% in the very practical category.

DISCUSSION

This research is development research. The model used by researchers in developing electronic module teaching materials (*e-mode*) help*GeoGebra software*is the ADDIE model. ADDIE consists of 5 stages, namely analysis, design, development, implementation and evaluation.

The first stage carried out is analysis. According to Meliana et al., (2022), the purpose of the analysis is to analyze and collect information obtained about students' problems and needs in learning activities. This analysis stage was obtained from interviews conducted by teachers and students. According to Maulana et al., (2021), the analysis stage is used with the aim of finding out who the learning media is aimed at and knowing what the purpose of this development. At the analysis stage, identifying student characteristics is something that must be done and adjusted to the level of education on the basis of student development theory. Based on the analysis, it was found that teachers needed additional teaching materials used in learning to help them convey the material to students. The flat-sided building material is the material that will be used in this research. This material requires useful tools to demonstrate the shape of the flat-sided spatial figures. So, in this research we use tools, namely GeoGebra software, to demonstrate flat-sided images of flat space shapes. According to Novilanti & Suripah (2021), using GeoGebra software is easier to operate when compared to other mathematics software, especially in geometry material. This is in line with opinion Lestari et al., (2023), that the use of GeoGebra can help students in learning mathematics procedurally and conceptually.

After the analysis process is carried out, it continues with the design stage of the e-module framework that will be created. According to Ulfa & Suripah (2021), in this design stage, an outline of the media to be developed is carried out, starting from choosing the format to making the media. According to (Coenraad et al., 2022), the modules developed should be designed with attractive colors and designs so that they can support student activities. Apart from creating a design for the e-module, at this stage, researchers will complete the learning tools. The tools or instruments needed are syllabus, lesson plans, validation sheets, teacher response questionnaire and student response questionnaire. This

instrument or device is useful for assessing the quality of the electronic module (e-module) that has been developed (Aspriyani & Suzana, 2020). Researchers also design what materials will be studied in the e-module.

The next stage is development. At this stage the plans have been made at the stagedesign arranged in such a way as expansioncover or cover, foreword, table of contents and so on are developed. Based on research Zetriuslita et al., (2022), states that in the development stage, the conceptual framework is then translated into the product being developed. Aftere-mode completed, it is checked first by the supervisor before being given to the material expert validator and media expert. If there are still errors based on suggestions and comments from the supervisor, the researcher will correct them first. The revision given by the supervisor is to improve the sizefont to 12pt and add description questions to the competency test. After improvements are made, thene-mode what was developed was revised by experts, namely validation by material experts and media experts. The overall score obtained from material expert validators was 79.365%, which is classified as valid. Meanwhile, the values obtained were obtained from the three media expert validators namely 81.578% with the valid category. Apart from that, the validator validates the questions pretest and posttest. The average validation score for the questions was 0.560606 with quite valid criteria. After receiving suggestions and comments from the validator, improvements are made according to these suggestions before continuing at the implementation stage. This is in line with Widyasari et al., (2021) which states that researchers should make improvements in accordance with suggestions by validators so that the media developed is better.

The next stage is implementation. E-module which have been revised or improved in the previous stage, are tested in class. This trial is useful to see the practicality of e-mode which has been developed.According to Khalisa et al., (2021), stated that in conducting product trials, students filled out response questionnaires in order to obtain practical data processing. In addition, before learning to use e-mode, students are given questions first, namely pretest. Then, when the learning has been completed, students will be given questions, namely questions posttest. After all learning is complete, students are asked to fill out a student response questionnaire sheet. Apart from students, teachers will also fill out a questionnaire sheet regarding teacher responses to electronic module teaching materials help GeoGebra software.

The final stage is stage evaluation. At this stage, an assessment is carried out on the results obtained from the teacher, student and teacher response questionnaires pretest andposttest. This evaluation is useful for measuring practicality and effectivenesse-moduleused. According to Maharani et al., (2022)**,** we can find out whether The product developed is efficient according to the criteria determined by practicality. The results obtained in the teacher response questionnaire were 87.8472% in the very practical category. The results of the student response questionnaire were 89.3576% in the very practical category. The combined results of the teacher and student response questionnaires obtained a result of 88.6026% in the very practical category. Meanwhile, in giving questions pretest and posttest obtained an average of 0.52528% in the medium

category. The teaching materials developed have been tested for their practicality and effectiveness.

Based on the evaluation results of the teaching module assisted by GeoGebra, it has been declared practical in the very practical category. The results of this practicality analysis show that the product developed can be used to assist the learning process. Apart from that, based on the characteristics of the Geogebra software, the teaching module developed can be an alternative interactive media recommended for learning geometry, especially plane shapes and space shapes. Apart from that, Geogebra software is also an integration between algebra and geometry, thus allowing direct integration to represent the relationship between mathematical formulas and related geomaterial objects (Şimşek & Yaşar, 2019; Uwurukundo et al., 2020). Therefore, apart from visualizing images, GeoGebra can also help users to carry out algebraic calculations as well as calculus and statistical analysis (Zulnaidi et al., 2020). Based on the findings and also support from previous findings and theories, the results of this research can have implications for improving the learning process. Apart from that, it is hoped that in the long term it can improve student achievement, especially in plane material.

CONCLUSIONS

Based on the results of research on the development of electronic module teaching materials (e-modules) assisted by GeoGebra software on flat-sided geometric material, especially cubes and blocks for class 8 SMP, we have produced products in the form of electronic modules for students and teachers assisted by GeoGebra software on flat-sided geometric material for class 8 SMP which has been proven valid and practical.

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