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Development of Interactive Mathematics E-Module Designed by Canva and Fliphtml5

Herani Tri Lestiana[1*], Andini Rohmah[2], Ermawati Putri[3], Candra Wijaya[4]
[1*,2,3,4]Mathematics Education Department, UIN Cyber Syekh Nurjati Cirebon
Jl. Perjuangan No.1, Cirebon, Indonesia
[1*]herani@uinssc.ac.id; [2]andinirohmah2713@gmail.com; [3]ermawatiputri456@gmail.com;
[4]chan030701@gmail.com

ABSTRAK

Penelitian ini bertujuan mengembangkan *e-modul* interaktif pada materi Transformasi Geometri di kelas IX SMP. *E-modul* ini dirancang menggunakan platform Canva untuk menciptakan konten visual yang menarik dan FlipHTML5 untuk menyediakan fitur interaktif. Pengembangan *e-modul* mengikuti model ADDIE yang mencakup tahap analisis, desain, pengembangan, implementasi, dan evaluasi. Validitas *e-modul* dinilai oleh dua validator yang menilai aspek media, isi/materi, dan bahasa. Hasil validasi menunjukkan rata-rata skor mencapai 86.5% dengan kriteria sangat valid. Evaluasi terhadap kepraktisan atau kemudahan penggunaan e-modul menunjukkan rata-rata sebesar 86% dengan kriteria sangat praktis. Hasil validasi dan kepraktisan ini menunjukkan bahwa *e-modul* yang dikembangkan sudah baik dan bisa digunakan dalam pembelajaran. Tantangan yang dihadapi mencakup ketergantungan pada koneksi internet dan perluasan motivasi siswa dalam pembelajaran mandiri.

Kata Kunci: Canva; *E-modul* Matematika; FlipHTML

ABSTRACT

This study aims to develop an interactive mathematics e-module on the Geometry Transformation topic at the 9th grade junior high school. This e-module is designed using the Canva platform to create attractive visual content and FlipHTML5 to provide interactive features. The development of the e-module follows the ADDIE model which includes the stages of analysis, design, development, implementation, and evaluation. The validity of the e-module was assessed by two validators who assessed the media, content/material, and language aspects. The validation results showed an average score of 86.5% with very valid criteria. Evaluation of the practicality or ease of use of the e-module showed an average of 86% with very practical criteria. The results of this validation and practicality indicate that the developed e-module is good and can be used in learning. The challenges faced include dependence on internet connections and expanding student motivation in independent learning.

Keywords: Canva; Mathematics e-module; FlipHTML5

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1. INTRODUCTION

Mathematics is still considered a difficult subject to understand (Langoban, 2020). Geometric transformations are a mathematical topic studied at junior high school level which covers various concepts and operations related to shifting, mirroring, rotating, and enlarging or reducing a geometric object (Marlissa et al., 2024). Students often have difficulty imagining changes in geometric objects through various types of transformations, thus hampering their overall understanding (Fitriana et al., 2022; Trisna et al., 2022). Teachers who still rely on textbooks and one-way methods often experience difficulties in explaining mathematical material that requires high levels of visualization (Fan et al., 2021; Rathour et al., 2022). As a result, many students experience difficulties in understanding the material.

On the other hand, the ideal condition expected is interactive, interesting mathematics learning that can help students understand abstract concepts visually. This is where there is a gap between the actual condition—namely static learning that does not support visualization—and the condition that should be, namely technology-based learning that can present visual and interactive content (Widyatama & Pratama, 2022; Ranila, Yunianta, & Prihatnani, 2023). One potential solution to bridge this gap is to develop technology-based e-modules.

According to a study by Sarnoto (2023), the application of technology in education can increase the efficiency and effectiveness of the learning process. The rapid development of information and communication technology offers enormous opportunities for improving the quality of education through the use of digital-based teaching materials. Printed modules can be varied in electronic form in the form of e-modules. Wijayanti (2016) explains the advantages of e-modules, namely that they can be varied with images, audio or video, as well as animation or interactive games to complement and add to the interesting side. By using this technology, geometric transformation material can be presented more dynamically and visually, allowing students to better understand complex concepts. The use of technology-based e-modules not only makes learning more accessible, but also encourages students to learn independently and interactively (Asfiya et al., 2024; Sari et al., 2021; Sidiq & Suhendro, 2021). In this digital era, independent learning skills are becoming increasingly important. With the many challenges that students have to face outside the school environment, the ability to manage time and the learning process becomes very important.

Several studies have shown the effectiveness of interactive teaching materials on student motivation and learning outcomes. Research by Pasaribu (2024) found that interactive teaching materials can increase student engagement in the learning process. Aini (2022) also showed that the use of technology-based applications in education can improve students' understanding of the subject matter. Well-designed e-modules can provide a variety of additional learning resources and interactive exercises that can be accessed anytime, anywhere (Hidayat et

al., 2023). In this way, students can flexibly manage their study time and more easily repeat material they do not understand. Recent research by Rhur et al. (2024) strengthens previous findings, that interesting and interactive teaching materials significantly contribute to students' learning motivation. When students feel interested and involved in the learning process, they tend to participate more actively in class and understand the material more easily.

Applications such as Canva and FlipHTML5 provide features for developing engaging and interactive e-modules. To increase the appeal of e-modules, FlipHTML5 can be used to convert PDF or image files into interactive e-books that can be accessed via a web browser. The resulting HTML5-based e-module resembles a printed book with flippable pages, and is equipped with animation, video and background music features to make it more interesting and interactive. Apart from that, Canva can be used to design e-modules by providing various templates and design tools that make it easy to create attractive visual content. According to (Rahmawati et al., 2024; Prabawati, Santika, & Mulyani, 2024), Canva is an online graphic design tool that provides various templates and features to integrate visual elements such as text, images and graphics.

Based on these problems, this research aims to develop interesting teaching materials, namely the FlipHTML5 e-module for learning geometric transformation mathematics. The e-module developed by researchers contains many interesting and interactive pictures, videos, quizzes and games to reduce students' boredom. The research carried out has similarities with research carried out by Mardiah (2023), namely developing an e-module based on FlipHTML5. The difference in this research is that it uses all interesting and interactive features such as complete material and quizzes which can increase student independence in learning. The Canva application also creates layouts in this module, so that each page has its own characteristics.

This research supports technology-based education policies which are currently being promoted by the government and various educational institutions. The use of technology in learning is considered a way to improve the quality of education and make the teaching and learning process more effective. This research can provide empirical evidence regarding the effectiveness of using technology in mathematics learning, especially in geometric transformation material. The results of this research can be a basis for formulating policies that better support innovation in the education sector.

2. METHOD

The type of research carried out in this research is research and development (R&D). The R&D research method is research used to produce a particular product and test the effectiveness of the product (Okpatrioka, 2023). The model chosen is the ADDIE model which consists of five stages, including: 1) analysis stage, 2) design stage, 3) development stage, 4) implementation stage, and 5) evaluation stage (Sugihartini & Jayanta, 2017), as can be seen in Figure 1.

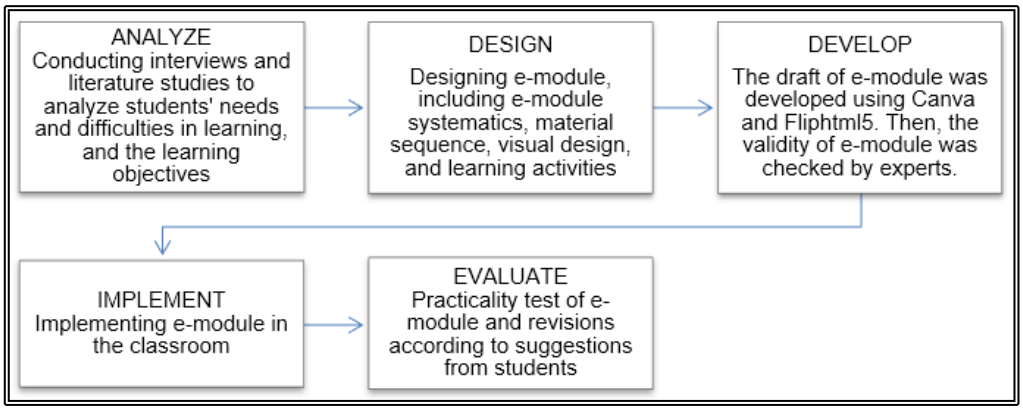


Figure 1. Research Flow

The validity of teaching materials is a crucial aspect that determines whether the teaching materials can be used effectively in the learning process. Based on research by Agustyaningrum (2017), validation of teaching materials is important to ensure the effectiveness and suitability of the materials with the curriculum. The validators consisting of 1 Mathematics Education lecturer at UIN Siber Syekh Nurjati Cirebon who is an expert in media, materials and language and 1 mathematics subject teacher at MTs Al-Ikhlas Setu Patok as a practitioner. The validation sheet aims to determine the validity of the e-module in several aspects, such as media, material and language as presented in Table 1.

Table 1. Validation Indocators of E-module

Aspect	Indicator	Item Number
Media	The visual and aesthetic aspects of the e-module cover, including size, illustrations, letter combinations, color contrast and layout.	1, 2, 5, 6
	Evaluate the consistency of the layout and design of the e-module content, as well as the use of letter variations that are not excessive. Apart from that, the quality of the images and the suitability of the instructional terms were also assessed.	7, 8, 9, 10, 11, 12, 13, 14, 15
Material	The suitability of the material to the learning objectives, completeness and sequence of the material, ease of understanding for students, and learning motivation resulting from the presentation of the material.	16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28
Language	Assessment of the clarity of the illustrations in describing the contents of the e-module, the use of letter combinations, and the ease of understanding the language in accordance with Indonesian language rules, as well as in accordance with the student's level of development.	3, 4, 29, 30, 31, 32, 33, 34

Likert scale measurements are used to assess the validity of e-module in media, material and language aspects with a four scale model. The formula used to analysis the level of validity is as follows.

$$V = \frac{TS}{TSm} \times 100\%$$

Information:

V = Validation

TSm = Total expected maximum score

TS = Total Empirical Score (obtained from validators)

The trial subjects were limited to a small group consisting of 12 of 9th grade junior high school students. The level of practicality of a product can be measured based on its ease of use and the way the product is presented to users (Agustyaningrum & Yusnita, 2017). The e-module practicality questionnaire was completed by students regarding six aspects as presented in Table 2

Table 2. Practicality Indocators of E-Module

Aspect	Indicators	Item Number
Visuals and Media	The visual appearance, image quality and attractiveness of e-module.	1, 3, 4
Readability and Comprehensibility	Text clarity, ease of understanding for students, and clarity of presentation of material.	2, 12
Ease of Use	Evaluation of ease of use e-module, both used on devices and in various learning situations.	5, 6, 7
Independent Learning Support	The role of e-module on students' independent learning, such as the availability of example questions, exercises and other interactive materials.	8, 13, 15, 16
Motivation and Engagement	The role of e-module to increase student motivation and involvement in learning.	9, 10
Language and Relevance	The clarity of instructions, good and correct grammar, and the relevance of the material to students' daily lives.	11, 14

The assessment score on the practicality questionnaire uses a 4-interval Likert scale. The data is analyzed to obtain the e-module practicality criteria using the following formula.

$$P = \frac{\sum F}{(N \times I \times R)} \times 100\%$$

Information:

P = Percentage figure

∑ F = Total score of all respondents

N = Number of respondents

I = Maximum score

R = Number of indicators

The level of validity and practicality of the e-module is determined by adapting to the validity and practicality criteria as described in Table 3.

Table 3. Categorization of Validity and Practicality of E-module

Validity Criteria	Validity Level	Practicality Level
80,01% - 100%	Very valid	Very practical
60,01% - 80,00%	Valid	Practical

Validity Criteria	Validity Level	Practicality Level
40,01% - 60,00%	Not valid	Not practical
20,01% - 40,00%	Invalid	Not practical
00,00% - 20,00%	Very invalid	Very impractical

3. RESULT AND DISCUSSION

a. Research Findings

1) Analysis

The analysis stage aims to examine the mapping of geometric transformation material in the curriculum, students' difficulties in geometric transformation material, student needs regarding teaching materials, student characteristics, and teaching materials used in the current learning process in mathematics subjects. Based on the result of the analysis, it was found that teachers have used e-module as learning supports in addition to printed books and also worksheets in face-to-face and online learning. However, the e-module developed is only in PDF file format and only contains material and quizzes, without any interactive designs. The design used in the e-module it relies merely on the Microsoft Word application. This is because there are limited teachers in mastering technology. In addition, teachers and most students can operate smartphones, while only a small number of students own computers or laptops, so it is important to develop e-module that is suitable for students to use, which can be accessed via smartphones. From the analysis of students' learning difficulties, it was found that the concept of geometric transformation was difficult for students who did not have strong abstract thinking skills to understand because the concept of geometric transformation involved abstract concepts such as translation, rotation, reflection and dilation. Therefore, more dynamic and visual teaching materials are needed to enable students to better understand and visualize complex concepts. So based on this analysis, it was concluded that teachers and students need electronic teaching materials in the form of e-module that is presented attractively and can be accessed via smartphone to be used in learning both online and offline.

2) Design

At this stage, there were 3 steps taken, including component content design, material design, and media design. At the component content stage, it included foreword, table of contents, introduction, material, games, final evaluation, answer key, glossary, and bibliography. In the material design stage, the researchers explored geometric transformation material from various reference sources, such as textbooks and modules. After the material was structured, the researchers began to design the presentation of the materials by using Canva platform.

3) Development

The first draft of e-module was then developed and downloaded in PDF file format. Next, development was carried out on the FlipHTML5 website by uploading e-module which were still in PDF file format so that it could be accessed online by students via computers or smartphones. The e-module has 120 pages with four sub topics included, namely translation, reflection rotation, and dilation.. The learning activities consist of 4 activities which contain the learning objectives for each material, material descriptions, example questions and discussions, summaries, self-reflection and practice questions. Apart from that, there is a games page, final evaluation, answer key, glossary and bibliography.

Each learning activity in the e-module contains activities for reasoning, observing, discussing, listening, remembering, practicing and summarizing. There are also other supporting activities, such as concepts, tips, info, motivation, and learning videos with a display as shown in Figure 2.

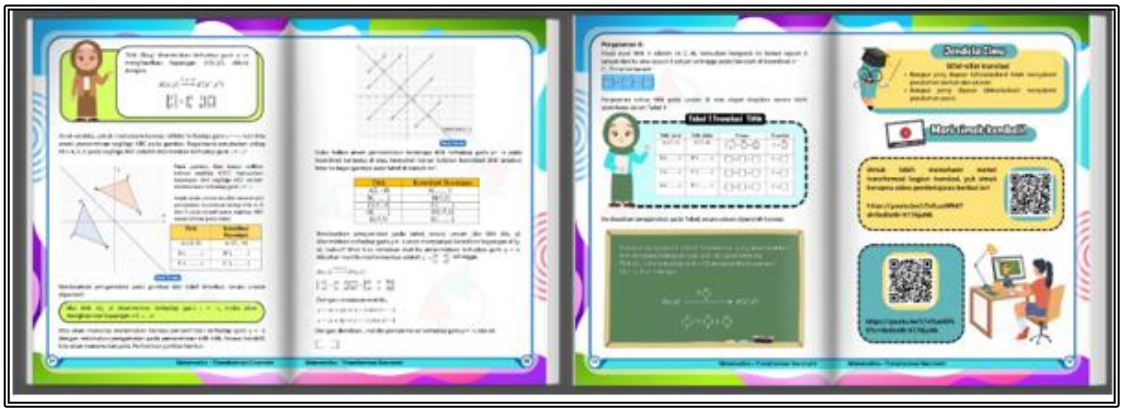


Figure 2. Display of Materials and Activities in E-Module

FlipHTML5 has various superior features that make e-module more interactive and interesting. At the bottom of the screen, there is a thumbnail feature which is very useful for navigation. This feature displays thumbnail images of each e-module page, so students can easily preview the content and jump directly to the desired page just by clicking on the thumbnail. This thumbnail display does not interfere with the main page, because it is displayed in the form of a side panel or at the bottom of the screen.

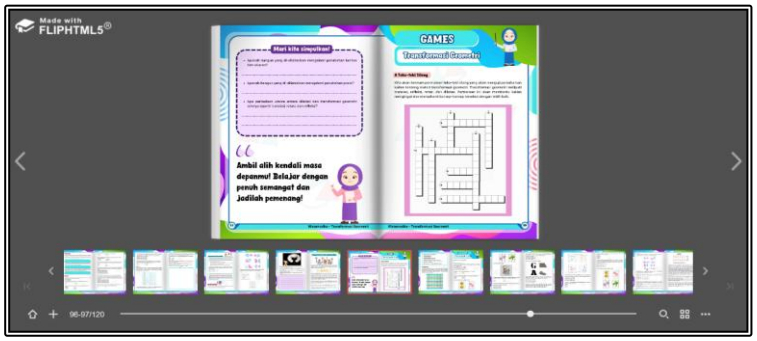
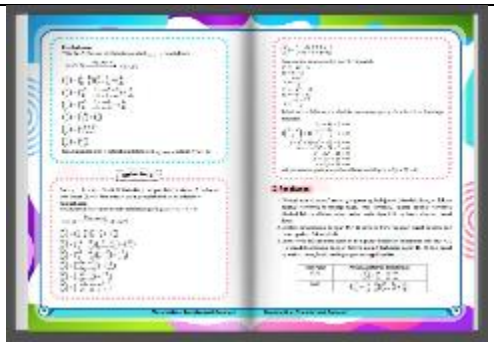
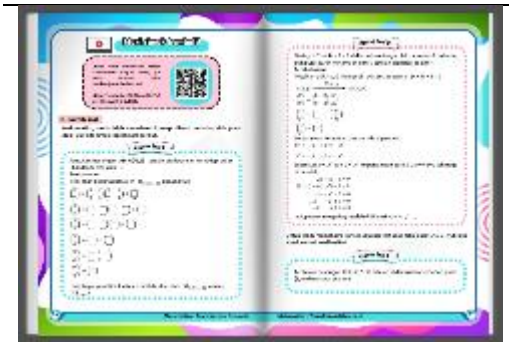


Figure 3. FlipHTML5 Thumbnail Feature on E-module

FlipHTML5 also allows adding animations and visual effects that enrich content, making it more lively and interesting for readers. Students can include multimedia elements such as video, audio, and interactive images, which help explain the material more deeply and effectively. The design of FlipHTML5 ensures that e-module can be easily accessed on various devices, be they computers, tablets or smartphones, making it easier for students to learn anytime and anywhere. With these features, FlipHTML5 helps create e-module that are not only informative but also interesting and interactive, increasing student engagement and understanding of the material being taught.

After the e-module was developed, the validators provided comments and suggestions. The results of this feedback are then used as a basis for improvements to improve the e-module being developed. Suggestions and improvements to the e-module are presented in Table 4.

Table 4. Suggestions and Improvements for E-module

Before Revision	Suggestions
	E-module should provide blank sections, such as tables or example questions that students can fill in themselves. This aims to ensure that students not only receive information passively, but also actively fill in and participate in the learning process, so that they are more independent in learning.
After Revision	**Improvements**
	This improvement has been made by inserting tables and empty spaces in certain sections e-module, allowing students to complete the material themselves and apply the concepts they have learned directly.

The validation results for each aspect of the e-module based on media, content/material and language are contained in Table 5.

Table 5. Validation Results Based on 3 (Three) Aspects

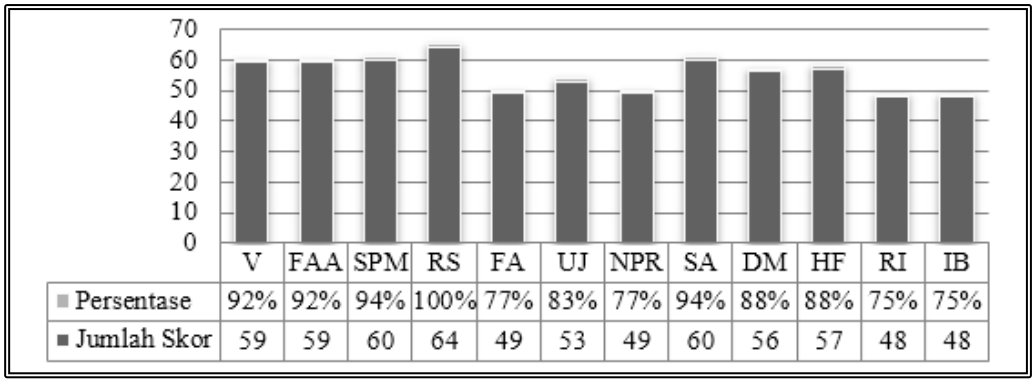
Validator	Aspect			Average	Category
	Media	Content/Material	Language		
1	90%	79%	83%	85%	Very valid
2	90%	88%	83%	88%	Very valid
Average	90%	83.5%	83%	86.5%	Very valid

As shown in Table 5, the results of the e-module validation based on three main aspects (media, content/material, and language) by two different validators received a very positive assessment. The media aspect is considered very valid with a validity percentage of 90%, indicating that the layout and use of media in the e-module supports effective and interesting learning. Meanwhile, the content/material aspect is assessed "Very Valid", with a validity average percentage of 83,5%, indicating that the material presented is complete, relevant and can be well understood by users. The language aspect was also rated "Very Valid" with a validity percentage of 83%, confirming that the use of language in this e-module supports a clear understanding of the material.

4) Implementation

After the e-module validation test has been carried out and improvements have been made to the validator's feedback, the next step is the implementation stage. The e-module was carried out in a limited trial on a small group consisting of 12 of 9th grade junior high school students from various schools. The trial was carried out on students who own and are proficient in using smartphones, and have a good internet connection. To start the trial activities, the researcher explained to students how to operate the e-module and presented what activities and components were contained in the e-module, including watching videos and working on the available practice questions.

At the end of the lesson, students are asked to fill out an e-module practicality questionnaire. The questionnaire assessment was analyzed to determine data on the practicality of using e-module teaching materials in the form of the combined average percentage of all respondents involved. From the practicality assessment, this e-module as a whole received an average percentage of practicality of use of 86%. The results of the percentage of e-module practicality are presented in Figure 4.



	V	FAA	SPM	RS	FA	UJ	NPR	SA	DM	HF	RI	IB
Persentase	92%	92%	94%	100%	77%	83%	77%	94%	88%	88%	75%	75%
Jumlah Skor	59	59	60	64	49	53	49	60	56	57	48	48

Figure 4. Practicality of E-module

5) Evaluation

E-module improved based on validation test results and practicality. In the media aspect, revised line and paragraph spacing settings for all content on e-module, as well as

gifts highlight on some important material to emphasize. For the content/material aspect, deficiencies in the effectiveness of teaching materials intended to enable students to learn independently are corrected. Regarding the language aspect, there are improvements to several words or greetings that are not in accordance with good and correct Indonesian language rules.

b. Discussion

Based on development of e-module through five stages of the ADDIE model, it can be concluded that e-module using Canva And FlipHTML5 in the Geometry Transformation material for class IX SMP is included in the "very valid" and "very practical" categories. This shows that the e-module has good delivery and presentation of material and is easy for students to use. Utilization Canva for visual design and FlipHTML5 for interactive features to support a more interesting learning experience for students. The analysis stage in ADDIE ensures that e-module designed meets the curriculum needs and learning characteristics of students at the junior high school level, especially in understanding geometric transformation concepts interactively and in depth.

The e-module has a significant impact in enhancing students' learning experience. This research confirms findings from previous studies. For instance, Kholisah et al. (2024) and Puspitasari et al. (2021) found that interactive e-modules significantly improved students' motivation and facilitated independent learning. In line with that, this study also observed that students responded positively to the interactive features embedded in the e-module, which helped maintain their focus and engagement with the content. Moreover, this finding is also supported by Sidiq and Suhendro (2021), who emphasized that digital learning materials empower students to manage their own learning pace, which is critical in fostering self-regulated learning. The use of e-modules does not only serve as a medium for knowledge transmission but also functions as a learning scaffold that promotes autonomy.

The main advantage of e-module is its ability to integrate multimedia such as videos and interactive images, which can explain mathematical concepts in a visual and interesting way. Canva allows users to create attractive visual designs (Alia et al., 2024), while FlipHTML5 offers interactive and responsive features that enrich the content e-module with animation, multimedia and navigation elements that are easy to understand (Sama & Hartanto, 2021). Additionally, the responsive design of FlipHTML5 allow the e-module to be accessed via a variety of devices, such as computers, tablets, or smartphone, depends on students' preferences and learning needs.

On the other hand, while many studies emphasize the benefits of interactive e-modules, there are also perspectives that caution about their limitations. One of them is dependence on an internet connection to access e-module, which can be an obstacle for students in areas with

limited internet access. In addition, as revealed by Pan (2020), the success of technology-based learning tools still largely depends on students' prior digital literacy and intrinsic motivation. While e-module provides promising outcomes in terms of validity and practicality, further refinements and complementary strategies are necessary to address access disparities and ensure deeper learning outcomes for all students.

4. CONCLUSION

The mathematics e-module on Geometry Transformation material for class IX SMP which was designed using Canva and FlipHTML5 succeeded in achieving very good results. Overall, this e-module has an average percentage of practicality of use of 86%, while the average percentage of validity reaches 87%. This shows that this e-module not only has high validity, but is also suitable for use in the learning process. However, there are several challenges that need to be considered, such as dependence on an internet connection and the need for high motivation from students to learn independently. By continuing to evaluate and adjust based on feedback from users, this e-module can become a more effective teaching material in supporting mathematics learning in schools in accordance with technological developments and educational needs.

Based on the findings of this study, several suggestions can be proposed for future implementation and development. Teachers are encouraged to utilize interactive e-modules such as those developed in this study to enhance the visualization and understanding of abstract mathematical concepts, especially geometric transformations. Educational institutions should facilitate access to technology and the internet, especially in areas with limited connectivity, to ensure equitable use of digital learning resources. In addition, further studies is suggested to explore the development and implementation of interactive e-modules for other challenging topics in mathematics. Further studies can compare the effectiveness of various interactive platforms beyond Canva and FlipHTML5 to determine which platform offers the most pedagogical benefits for different contents or learner groups.

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AUTHOR BIOGRAPHY

	**Herani Tri Lestiana, M.Sc.** Born in Pemalang, on 25 March 1988. Lecturer at UIN Siber Syekh Nurjati Cirebon.
	**Andini Rohmah** Active undergraduate student in Mathematics Education Department at UIN Cyber Syekh Nurjati Cirebon.
	**Ermawati Putri** Active undergraduate student in Mathematics Education Department at UIN Cyber Syekh Nurjati Cirebon.
	**Chandra Wijaya** Active undergraduate student in Mathematics Education Department at UIN Cyber Syekh Nurjati Cirebon.