Indonesian Journal of Education & Mathematical Science
Vol. 7, No. 3, September 2026, pp. 339~353
ISSN: 2715-985X, DOI: 10.30596/ijems.v7i3.31020

Development of a Flipbook-Based E-Module for Junior High School Geometry Learning: Its Effectiveness in Enhancing Student Engagement and Learning Motivation

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ABSTRACT

Low student engagement and learning motivation remain challenges in geometry instruction in junior high schools because abstract geometric concepts are often presented through less interactive teaching materials. This study aims to develop a flipbook-based e-module for geometry using the ADDIE model and test its validity, practicality, and effectiveness in improving student engagement and learning motivation. The approach used was research and development with mixed methods. The study subjects included 125 seventh-grade students from a public junior high school in Palopo. Data were collected using expert validation sheets, interviews, practicality questionnaires, student engagement observations, and learning motivation questionnaires. The results showed that the e-module achieved 95.87% validity from media experts and 85.46% from material experts, categorizing it as very valid. Its practicality reached 83.38%, categorizing it as very practical. The effectiveness test showed an N-Gain of 70.79% for student engagement and 87.00% for learning motivation, both in the high category. These findings confirm that the flipbook e-module is a valid, practical, and effective learning medium for increasing student engagement and learning motivation in geometry learning.

Keywords: E-Module, Flipbook, Student Engagement, and Learning Motivation

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1. INTRODUCTION

Student engagement in mathematical pedagogy is evident in many areas of modern education. Immersion is defined by behavioral, emotional, and cognitive participation by learners (Sattar et al., 2022). It has been suggested that learners who demonstrate high levels of emotional, behavioral, and cognitive engagement are more likely to participate in lessons and persevere and maintain focus through the completion of learning tasks (Khan et al., 2023). In contrast, diminished engagement is characterized by low levels of participation in learning activities and focus, which, in turn, leads to low levels of achievement (Mizani et al., 2022; Santi et al., 2022). In the context of pedagogy specific to learning and teaching geometry, it is important to use resources that engagingly represent abstract concepts of mathematics. This is necessary because learners tend to experience mental exhaustion and cognitive and conceptual struggles (Mulyana et al., 2023).

Along with student engagement, academic drive is a core component of successful mathematical instruction (C. Wang et al., 2022). The drive to learn propels students to participate, break down the barriers of the learning process, and to develop a long-term love of learning. Unfortunately, the drive that lower-secondary students have for learning mathematics is very low, and is often worsened by lesson delivery methods, such as pedagogy that is monotone, boring, and devoid of modern instructional technologies (Cohen et al., 2023). Traditional instructional methods and materials that are overly text-based often fail to engage students and lead to the achievement of shallow and short-lived learning outcomes (Bryant, 2023). As a result, there is an urgent need to design instructional technologies that deliver teaching and learning content while capturing and sustaining students' interest, energy, and engagement at all levels of the learning process.

Understanding the design of flipbook-infused modules of digital mathematics within the context of digitally based learning systems provides an opportunity to conceptualize how the integration of

technology can disrupt and improve the learning (Kurnianto et al., 2022). An e-module is an electronically formulated unit that encourages individualized learning through the integrated and purposeful use of various forms of media, including text, images, audio, animations, and videos (Cavanagh & Kiersch, 2023). The use of these e-resources provides an enhanced level of ease of use, as they can be used from anywhere and at any time through the possession of portable, digital technology (Mesra et al., 2025). In addition, digital modules provide a more engaging and interactive format of the e-content compared to the traditional printed formats, thereby encouraging students to be more motivated to learn (Manggala et al., 2024).

Multimedia Learning Theory suggests that contemporary media comprising prose, graphics, and animations can help learners achieve higher levels of mastery with respect to a particular concept. This occurs because learners process information through the text and the graphics via their verbal and visual cognitive channels, respectively. According to Mayer, the most effective means of information transfer occurs when learners are presented with visual and verbal materials that work in tandem (Mayer & Moreno, 2003). This is especially true for the visual-based media of the mathematics discipline, namely, the spatial areas of the discipline, such as geometry, which requires a high level of spatial reasoning and the ability to visualize concepts internally. Therefore, the placement of interactive multimedia in electronic instructional units is relevant for the purpose of transforming the abstract nature of mathematical proofs and theorems into concrete and comprehensible representations that are sound and logical (Adiastuty et al., 2025).

Digital flipbooks are an innovative tool for electronic educational media that provide a near-real-world interface for content delivery that includes the sounds and motions of physically turning a page of a book (Elfina et al., 2024). In this framework, the medium itself provides higher levels of user interactivity, visualization, and navigation (Putri et al., 2025). Historically, research shows that flipbooks enhance student motivation to learn due to the combination of design and delivery that is visually stimulating and engaging (Artal-Sevil et al., 2020; Cevikbas & Kaiser, 2022; Kim et al., 2007). Additionally, digital flipbooks offer the opportunity to add instructional videos, fluid on-screen movement, and self-check assessments that promote user engagement (Reza et al., 2025; Tani et al., 2022). In the area of mathematics, flipbooks have been shown to deepen student interest by describing a measurement in a more contextualized and visually stimulating presentation (Amiruddin & Imama, 2025).

Geometric concepts found at the lower secondary benchmark involve high degrees of abstraction and require a significant degree of internal visual imagination. This area challenges students to go beyond rote memorization of surface area and volume formulas. Instead, they must parse the complexity of the relational syntactic structures of the physical world (Mucti & Nurmala R, 2025). Attempting to learn geometry is associated with insufficient spatial visualization and is compounded by the use of pedagogical tools that provide insufficient concretization of the ideas (Hidayah et al., 2025). (Hidayah et al., 2025)Therefore, the use of an e-module with a flip-book structure that contains geometric simulations, illustrations, and animations is essential to enable learners to build an understanding of spatial systems (Supratman & Tundreng, 2025; Žakelj & Klančar, 2022).

This study is similarly founded on the idea of student engagement as a key indication of learning achievement. Student engagement encompasses three main dimensions, namely behavioral engagement, emotional engagement, and cognitive engagement (M.-T. Wang & Fredricks, 2014). Behavioural engagement refers to students' active participation in learning activities; emotional engagement represents students' interest and affective responses to learning; and cognitive engagement refers to students' efforts to comprehend the information (Martinjak, 2024). High levels of student involvement have been linked to increased motivation, learning persistence, and academic accomplishment (Torres & Statti, 2023).

Academic drive refers to a combination of internal motivators and external stimuli that influence the degree to which a student expends effort on academic tasks. Following the tenets of John M. Keller, this drive can be further developed by structuring educational environments that meaningfully and immediately connect to students, help them develop a sense of self-efficacy, and provide satisfaction (Bayounes Bayoudh Saâdi, I., & Kinsuk, 2022). Each of the educational tasks contained in flipbook-based e-modules is designed to be aesthetically pleasing, easy to use, and contain a wide variety of learning tasks. Therefore, it is reasonable to assume that flipbook technology can be used to improve

student motivation and engagement in the field of mathematics to a high level (Asmorowati & Pratama, 2025).

Other research on the use of flipbooks in mathematics learning reported an increase in learning motivation after using the media (Astuti & Andriani, 2025). Unayah et al., (2024) also highlighted that flipbooks are effective in increasing student engagement, as interactive features such as multimedia elements and simulations support various learning styles, which in turn increases student engagement. Although various studies have reported that the use of flipbook-based learning media still focuses on students' cognitive aspects and has not given adequate attention to simultaneously increasing student engagement and learning motivation. The implementation of flipbooks in geometry learning is generally still limited to presenting material in digital form without integrating various multimedia features that can encourage active student involvement during the learning process. In fact, the characteristics of geometry material require learning media that not only present information but also can visualize geometric objects dynamically, thereby building student engagement and motivation.

Based on these gaps, this study offers novelty through the development of a flipbook-based e-module that integrates various multimedia features, such as learning videos that can increase student's emotional engagement, animations to facilitate understanding of geometric concepts or cognitive engagement, interactive Wordwall-based exercises to increase behavioral engagement through direct feedback and interactive exercises, flexible digital navigation to increase learning motivation, and geometric visualization to strengthen cognitive engagement. In contrast to previous studies that mostly evaluated learning outcomes, this study analyzed the use of e-modules on student engagement that includes behavioral, emotional, and cognitive dimensions, as well as learning motivation. In addition, the developed product was evaluated based on aspects of validity, practicality, and effectiveness using the ADDIE development model, thus providing a more comprehensive picture of the quality of the resulting learning media.

Reflecting on the aforementioned theoretical and empirical currents, the engineering of a flipbook-infused e-module rests upon a solid foundational bedrock for deployment in junior high geometry classes. The orchestration of interactive multimedia inside this electronic capsule is projected to demystify complex geometric theorems through explicit visual modeling, while concurrently sparking a renaissance in student engagement and academic drive throughout the pedagogical lifecycle. This project aims to fill a significant gap by developing and validating the efficacy of a flipbook-based e-module as an innovative instructional tool designed to meet the changing needs of mathematics education in the age of digital technology.

2. RESEARCH METHOD

This study established an intensive mixed-methods framework that seamlessly integrated research and development (R&D) stages along with rigorous analysis of product effectiveness. The focus of the engineering pathway was on the construction of a digital module for teaching geometry that was interactive and integrated with flip books. This digital tool was then placed in an active teaching and learning environment to evaluate its effectiveness in increasing student engagement and motivation. The implementation of both of these strategies enabled the researcher to go beyond the simple construction of a teaching tool to evaluate its impact on the students' educational experience and academic performance.

For this study, the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model was used. This framework was chosen for its systematic nature and for the fact that each of the stages can be revisited and/or adapted. These characteristics mean that this model lends itself easily to the development of digital learning modules. In addition, the ADDIE framework was designed in such a way that there can be continuous evaluations at each of the stages, thus ensuring that the learning module could be constructed and design improved in response to the findings and feedback collected throughout the study (Suwanto et al., 2023).

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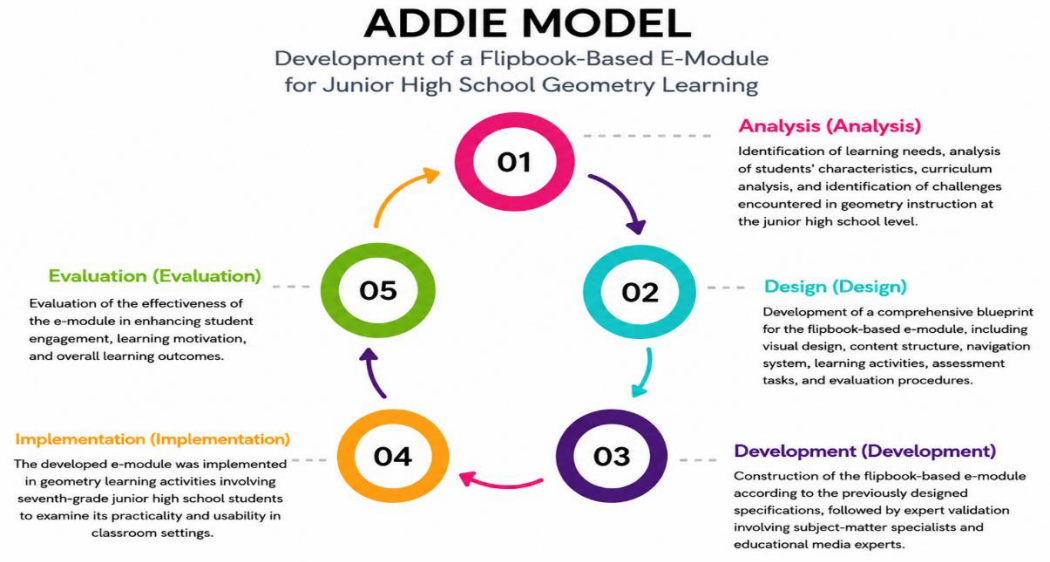

Fig. 1. ADDIE Model Procedure Design

This study's sample included 125 seventh graders at a public secondary school on A. Kambo Street in Salekoe Village, East Wara District, Palopo City, South Sulawesi Province, Indonesia. Focusing on this seventh-grade group was based on the belief that students in this age group (12-14) are in the process of moving from the concrete to the formal operational stages of thinking and reasoning based on Jean Piaget's theory of the stages of cognitive development.

The data gathered in this study included the following four categories: (1) qualitative interviews conducted to identify key product features and form, (2) expert credibility and usability evaluations conducted by interface and content specialists to assess the systemic integration of the flipbook-based digital learning resource, (3) participatory observations of students conducted before and after the geometry activity to assess the behavior, feelings, and thoughts level of engagement, and (4) participants' intrinsic engagement surveys conducted at the start and end of the geometry unit to evaluate the level of engagement in the learning activities.

The mean values of the validation and usability criteria were determined by calculating the percentage of scores assigned to each of the evaluation categories within the expert assessment and feedback forms. The baseline criteria of the validation and usability dimensions are presented in Table 1.

Table 1. Validity and Practicality Criteria

No	Criteria	Percentage (%)
1	Very Valid/Practical	81 – 100
2	Valid/Practical	61 – 80
3	Moderately Valid/Practical	41-60
4	Less Valid/Practical	21 – 40
5	Invalid/Impractical	0 – 20

Empirical metrics reflecting student engagement levels were collected using a quad-point assessment matrix. In the matrix, points were assigned as follows: 1 for no engagement, 2 for some engagement, 3 for considerable engagement, and 4 for outstanding engagement. The average percentage totals of these observational logs were reviewed as analytics of student engagement with the geometry curriculum. Table 2 describes the primary classification levels for the assessment of this particular type of multi-faceted learner engagement

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Table 2. Student Engagement Criteria

No	Criteria	Percentage (%)
1	Very High	$75 - 100$
2	High	$50 - 74{,}99$
3	Moderate	$25 - 49{,}99$
4	Low	$0 - 24{,}99$

Scholastic drive was quantified by computing the mean percentage metrics aggregated from the participants' self-reported feedback on the motivational inventory. The resulting numerical aggregates were subsequently categorized in alignment with established benchmarks to determine the precise intensity of the students' academic enthusiasm. The structural boundaries governing these learning motivation classifications are explicitly delineated in Table 3.

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Table 3. Learning Motivation Criteria

No	Kriteria	Persentase (%)
1	Very High	$85 - 100$
2	High	$69 - 84$
3	Moderate	$53 - 68$
4	Low	$37 - 52$
5	Very Low	$20 - 36$

The instructional potency of the flipbook-infused digital module in amplifying student immersion and academic drive was scrutinized utilizing the normalized gain (N-Gain) metric formula. The standardized N-Gain interpretive benchmarks harnessed within this analytical framework are explicitly detailed in Table 4.

Table 4. Learning Motivation Effectiveness Criteria

No	Criteria	Skor (%)
1	High	$g > 70$
2	Moderate	$30 \leq g \geq 70$
3	Low	$g < 30$

3. RESULTS AND DISCUSSION

This research and development endeavor culminated in the synthesis of a flipbook-infused electronic module designed as an innovative pedagogical vehicle for lower-secondary geometry instruction. The empirical insights harvested across each successive milestone of the ADDIE developmental framework are systematically detailed below:

A. Analysis Stage

The first step in the research and development process for the flipbook-based electronic module is the diagnostic stage. As part of this first step, two major activities were conducted: a needs assessment and a curriculum review. The needs assessment was mainly based on data obtained from observations of a state secondary school in Palopo City. The data collected showed that the school had a very limited collection of digital instructional media, resulting in the lack of many digital learning resources. From the observations, it was found that the school had a sufficient ICT infrastructure and a policy to permit the use of smartphones for educational purposes, thus enabling the use of digital resources in the school. Given the lack of digital resources, the use of an electronic module to create a digital learning resource was a valid option. The existing materials for geometric instruction at the school were very limited, so the provision of a flip book-based e-module would be the very first resource of this type for the 7th grade at this public junior high school in Palopo City. There were no interactive multimedia resources or audio-visual materials available for instruction in plane geometry.

According to findings from this investigation, the institution appears to have some satisfactory infrastructural scaffolding that includes access to smartphones, with internet connectivity that may be

used during instruction. However, these resources remain largely unutilized for foundation-driven technology in the realm of mathematics education. As a result, the provision of a flipbook-type e-module is a highly warranted intervention in the construction of a more interactive and dynamic learning environment that is in demand.

Qualitative interviews with seventh-grade math teachers in Palopo City public junior high schools were conducted to set boundaries for the curricular audit. From the interviews, it was found that the school implemented the Merdeka Curriculum with a high level of implementation. However, there are still some problems with the realities of the psychology of students who consider some of the math subjects trivial, and some even dislike math. From the baseline audit of student participation in learning geometry, the level of participation of students was found to be moderate. This condition is not permanent and varies with the learning media used to sustain student interest and motivation to learn. Students show relatively high levels of interest, participation, and focus in learning geometry, proportional to the learning media used by the teachers. This condition is a big challenge for teachers to provide geometry learning media to overcome the challenge of low student engagement and low student motivation to learn geometry. Overall, the findings show that the level of student engagement in learning is highly dependent on the learning media used by the teachers. If the learning media used are attractive and highly interactive, students are highly engaged and motivated to learn geometry.

Recent discoveries provide empirical evidence where studies show that electronic modules enhance students' immersion because they integrate elements of design, clarity, and frameworks that foster communication incredibly. Further, digital learning media provide an opportunity for students to take charge of their learning in a more fulfilling manner and, therefore, are completely in line with the learning styles of the digital age (Anggitarachmawati, 2025). In the teaching of geometry, the use of visual and interactive tools is a must, since the teaching and learning of plane geometry theorems requires clear visual images to aid the learners in understanding the relations of concepts and the forms of the geometric figure (Žakelj & Klančar, 2022).

Given the reported findings, the development of a flipbook-based e-module for the teaching of geometry is a great step forward for the school in meeting the needs of the learners, the requirements of the school as a whole, and the demands of contemporary teaching for the 21st century as it relates to the use of technology. For this reason, the information collected in this functional study represents the basis for the development of a teaching tool that is effective, relevant, and highly catered to the needs of the target users.

B. Design Stage

As part of this architectural milestone, the design of the pedagogical content and the digital tools was aligned with the seventh-grade learners' cognitive profile at the State Secondary Schools in Palopo. The design of the digital learning platform was developed through a number of strategic initiatives, including the following: (1) alignment of the structural elements of the teaching and learning modules; (2) articulating the expected learning outcomes and the relevant curriculum components to be embedded in the digital learning platform; (3) sourcing credible literature to support the content of the digital learning platform; (4) creating a Canva graphic design platform and a secured workspace; (5) creating an author account on the Heyzine Flipbook; (6) selecting an appropriate interface template; (7) designing using the graphic elements in the Canva workspace; (8) adding animations in Canva that aligned with the design theme and content with the focus on the target audience for the user testing of the design; (9) adding content headings, navigation instructions, learning outcomes, core content, solved examples, placeholders for supplementary media related to the practical exercises, and graphic placeholders for the Wordwall games; and adding a bibliography; (10) after completing the design in Canva, the layout was exported so that the Heyzine Flipbook was created with no effort once the first layouts were saved; (11) once the Heyzine Flipbook was created, the animated prototype was finalized by layering games and activities on the graphics and the instructional videos; (12) embedded the instructional videos. YouTube hyperlinks would integrate into the live digital presentation instantaneously. Additionally, Wordwall diagnostic quizzes would embed via Wordwall's HTML code sequencing. (13) After all multimedia elements are incorporated, the e-module will be finalized and ready for distribution as a stand-alone digital application, a web link, or a QR code.

The prototype of the electronic module was developed using the combined collaborative capabilities of Canva and Heyzine Flipbook. Both tools facilitate the creation of highly engaging,

flexible educational software. The thoughtful placement of design and motion elements within the e-module aims to engage learners and stimulate interest in learning. This design philosophy supports historical research that shows how design and aesthetic elements in instructional materials can capture student interest and improve engagement at every level of the educational system (Reza et al., 2025; Tani et al., 2022). In the teaching of mathematics and especially in the teaching of spatial concepts of plane geometry and figures, one must internalize and visualize concepts. This helps students interpret the structural and abstract propositions of geometry and supports them in developing more tangible and more integrated mental constructions (Žakelj & Klančar, 2022).

This segment of the research aims to explore the efficacy of a flipbook-style e-module in enhancing a learner's ability to construct and deconstruct knowledge. Flipbook-style e-modules containing video vignettes, together with clickable links to PlayPosit, provide a dual-channel learning experience. Gamified Wordwall tasks encourage the active participation of learners during self-assessments. The combination of video, animation, and gamified diagnostics within an e-module is especially powerful for reinforcing the understanding of core concepts and motivating learners. Additionally, this study sought to enhance the usability and navigational ease of the flipbook-style e-modules. This approach is in line with the consensus among instructional design experts that the e-modules and media used must adhere to principles of design and usability to maximize the efficacy of the instructional content (Carroll & Kop, 2016; Cavanagh & Kiersch, 2023).

C. Development Stage

During the advancement milestone, an authentication procedure was carried out to preserve the structural and educational integrity of the built module. This procedure was carried out mainly through two methods: instrument calibration and the authentication of the final product. From the calibration of the instruments, it was evidenced that the qualitative interview schedule reached a benchmark of 83.93%, the student immersion observation matrix was rated valid at 85.72%, and the learning motivation inventory was rated valid at 90.65%. With the same line of thought, the subject matter expert rubric, the interface design evaluation, and the operational usability evaluation were all ranked within the top tier of validity.

Continuing on systematically, the authentication of the product was sought to furnish a valid pedagogical tool. To ensure the validity of the design, an evaluation panel of two experts was engaged: an interface design specialist and a subject matter expert. The validation of the interface design specialist stated that the digital resource was valid with an authenticity index of 95.87%, and the critique from the subject matter expert confirmed a valid status at 85.46%. Overall, these evaluations and critiques reinforced that the newly designed flipbook-integrated e-module has passed the stringent tests of both interface design and educational content. These findings are aligned with previous studies showing that academically validated flipbook e-resources provide a great enhancement to the quality of teaching (Amiruddin & Imama, 2025).

The authentication of peer experts has potential to elevate the quality of modern education. While subject-matter validation is critical to ensure technical accuracy and relevance of educational content, validation of the interface design is essential to guarantee that the digital medium is visually appealing and provides a user-friendly ergonomic design. Notably, the interface designer made some strategic suggestions and recommendations for corrections to refine the geometry flipbook e-module, which demanded some thorough structural revisions. Although the mathematical assessment criteria classified the prototype as having high validity, these qualitative recommendations were recognized as an essential component of the product design development. The responsive structural critiques and design revisions to the geometry flipbook e-module based on the recommendations of the interface designer are presented systematically in Table 5.

Table 5. Revisions Based on Media Expert Suggestions

No.	Suggestions	Before Revision	After Revision
1	Replace the object image to better suit the age of the e-module users.	The e-module cover used an illustration that did not adequately represent the characteristics and age of the target users, making it	The cover illustration was replaced with an image that better reflects the characteristics of junior high school students, making the e-module more

		less suitable for junior high school students.	relevant, attractive, and appropriate for the target users.
2	Revise the content of the user instructions.	The user instructions consisted of relatively long and less systematic sentences, which could potentially make it difficult for students to understand the steps for using the e-module.	The user instructions were revised using simpler, clearer, and more systematic language, making them easier for students to understand and follow.
3	Increase the font size of the material by one or two levels.	The font size used in the learning material was relatively small, causing some parts of the text to be less clear and less comfortable for students to read.	The font size of the learning material was increased by two levels, making the text clearer, more comfortable to read, and improving readability for students.

The study's outstanding authenticity metrics indicate that the design process was performed with careful precision and in accordance with the standard operating procedures of research and development. Further improvements to the design, as a result of the evaluators' qualitative feedback, increased the structural integrity of the educational tool. This finding is consistent with the opinion of the experts that in the process of developmental research, the purpose of making iterative changes to the research is to refine a prototype, and as a result, it becomes more functional, expressive, and customized to the needs of the users (Rosman & Hidayati, 2023).

D. Implementing Stage

The subsequent operational milestone involved the classroom deployment of the flipbook-infused electronic module during geometry instruction for seventh-grade pupils at a state secondary academy in Palopo City. Throughout the instructional cycle, structured observations of student immersion were systematically executed. The empirical diagnostics emanating from this student engagement efficacy trial are explicitly detailed in Table 6.

Table 6. Results of the Student Engagement Effectiveness Test

No	Assessment Aspect	Total Score Obtained		N-Gain (%)
		Before Implementation	After Implementation	
	Behavioral Engagement Indicators			
1	Students attend class on time and are ready to participate in learning activities	49	85	70
2	Students actively participate in learning activities	39	86	77
3	Students focus on the teacher's explanation and learning media	42	85	74
4	Students actively use the flipbook-based e-module	40	95	92
5	Students complete the assigned exercises/tasks	60	93	82
6	Students ask or answer questions during the learning process	52	83	64
	Emotional Engagement Indicators			
7	Students show enthusiasm during the learning process	42	89	81
8	Students are interested in using the flipbook-based e-module	30	85	78
9	Students demonstrate positive expressions while learning	33	79	69

10	Students appear to enjoy the learning process	43	80	65
11	Students show confidence when completing tasks or participating in discussions	40	87	78
	Cognitive Engagement Indicators			
12	Students make efforts to understand geometry concepts	38	90	84
13	Students actively seek solutions to the given problems	38	79	66
14	Students learn independently using the e-module	36	65	45
15	Students continue trying to complete tasks despite experiencing difficulties	33	70	55
16	Students use specific strategies to understand the material	40	73	55
	Average	40,94	82,75	70,79
	Category	Moderate	Very High	High

Analyzing the quantitative data of student immersion matrices, the baseline mean score in the absence of flipbook-infused e-modules was just 40.94%. Following the use of e-modules in instructional design, that mean jumped to 82.75%. The normalized gain (N-Gain) empirical measure positioned that particular instructional design element in its high range at 70.79%. These findings indicate that the use of the flipbook-based digital module successfully created a high degree of learner involvement at all levels of the instructional design process. A high degree of learner engagement at multiple levels indicates that the digital educational module was extremely effective in capturing learners' attention, eliciting active behavioral participation, and committing learners affectively and cognitively to the instructional design process in the area of geometry. These findings support the earlier work on the positive impact of flipbook-based e-resources on learner engagement by providing an instructional resource that is visually appealing and engaging and eliminates boredom (Nafiah et al., 2023)**.**

The increase in student engagement in this study was not solely influenced by the use of digital media, but was integrated through various learning features in the flipbook-based e-module, such as learning videos, animations, interactive wordwall-based exercises, flexible navigation, and geometry visualizations. The integration of these features encouraged behavioral, emotional, and cognitive student engagement, as proposed by Erawati et al., (2024). These findings suggest that increased student engagement is influenced by learning designs that accommodate learning needs more interactively than conventional media.

The presentation of learning videos and animations plays a role in increasing emotional engagement through the visual and verbal delivery of information. According to the Cognitive Theory of Multimedia Learning, the combination of images and narrative facilitates the process of forming mental representations, while animation helps reduce extraneous cognitive load, making it easier for students to understand abstract geometry concepts (Mayer, 2024)**.** Furthermore, interactive wordwall-based exercises provide immediate feedback and gamification elements that encourage active student participation, while interactive navigation allows students to revisit the material as needed. This aligns with Self-Determination Theory, which states that self-directed learning contributes to increased student engagement and motivation (Saeed & Zyngier, 2012)**.**

The results of this study extend previous research findings, which generally only report improvements in learning outcomes or conceptual understanding through the use of flipbooks. This research demonstrates that the integration of various multimedia features within a single e-module supports the understanding of geometry concepts through more concrete spatial visualizations, but also increases overall student engagement across behavioral, emotional, and cognitive dimensions. Therefore, this study's contribution lies in demonstrating the effectiveness of flipbooks, driven by the

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ISSN: 2715-985X, DOI: 10.30596/ijems.v7i3.31020

digitization of teaching materials and the application of multimedia learning principles, which can provide a more active, meaningful, and student-centered learning experience.

After studying geometry with the flipbook-based digital module, seventh graders completed an operational feedback survey to assess the module's design and usability. The survey included multiple dimensions of design and usability including the logic of the pedagogical module and the degree of understanding the module facilitated. The survey of usability and design of the module received a score of 83.38%, thus landing it in the high range of evaluative tools. This score indicates that the module facilitated smooth instruction and understanding of the concepts of geometry. An absence of cognitive and mechanical friction in the design of the digital learning interface confirms that the interface was best utilized as intended, throughout the education timeline - even after the design and development teams had exited the project (Nurhayati et al., 2025).

E. Evaluation Stage

The efficacy testing of the newly engineered pedagogical tool represented the terminal phase within the systematic ADDIE developmental model. Within this empirical framework, to systematically appraise the instructional potency of the developed learning medium, a student scholastic drive inventory was administered to map the relative growth in the participants' academic enthusiasm prior to and following the digital intervention. The empirical diagnostics emanating from this learning motivation effectiveness trial are explicitly detailed in Table 7.

Table 7. Results of the Learning Motivation Effectiveness Test

No	Indicator	Items	Total Score Obtained		N-Gain (%)
			Pratest	Post-test	
1	Desire and willingness to achieve success	2	78	92	64
2	Learning drive and learning needs	1	77	96	83
3	Future aspirations and goals	3	82	99	94
4	Appreciation in learning	1	79	99	95
5	Engaging learning activities	1	80	100	1
6	A conducive learning environment	1	80	98	90
	Total	9	476	584	
	Average		79,00	97,00	87,00
	Criteria		**High**	**Very High**	**High**

The motivation index for students expressed a 79.00% baseline metric before the integration of the flipbook-infused electronic modules, compared to the 97.00% observed after the integration. The High concern level for the motivation index was further substantiated by a positive normalized gain (N-Gain) value of 87.00%. This finding demonstrates that e-modules function as a medium for delivering material and a tool capable of building student's interest, self-confidence, and willingness to actively engage in mathematics learning. This increased motivation is supported by the integration of various multimedia features, such as text, images, instructional videos, animations, interactive wordwall-based exercises, and geometric visualizations, making learning more engaging, interactive, and understandable. According to the Cognitive Theory of Multimedia Learning, presenting information through a combination of visual and verbal representations can increase attention and facilitate knowledge construction (Mayer, 2024). Thus, students gain a more positive learning experience and are motivated to continue participating in the learning process.

The interactive design of flipbooks also contributes to increased learning motivation through a more enjoyable learning experience. Appealing visuals, easy navigation, and easy access to materials through various devices help maintain student attention, as explained in the ARCS Motivation model (Fuadi & Aulia, 2025)**.** Furthermore, interactive Wordwall-based exercises that provide immediate feedback boost student's confidence in their abilities, while the flexibility to revisit the material

independently provides a more independent learning experience. This aligns with Self-Determination Theory, which emphasizes that independent learning is a crucial factor in enhancing students' intrinsic motivation (Saeed & Zyngier, 2012; Yengkopiong, 2025).

The findings of this study reinforce previous research showing that flipbook-based learning media can enhance learning motivation through more engaging and interactive presentations. However, this study makes a broader contribution by demonstrating that increased motivation is influenced not only by the digitalization of teaching materials but also by the integration of various multimedia features designed based on modern learning principles. Specifically, in geometry, rich visualizations help reduce the abstractness of concepts, making it easier for students to understand the relationships between shapes and fostering a positive perception of mathematics learning. Therefore, flipbook-based e-modules have a positive impact on engagement and learning motivation, which are key factors in learning success, because students who have high engagement and learning motivation will more easily overcome challenges in learning and can obtain better results (Asmorowati & Pratama, 2025; Chairunnisa et al., 2025; Ghifari & Linggowati, 2024). In addition to adding to the collection of teaching and learning resources of the institution, the design of this flipbook-based digital resource for teaching geometry may also have the potential to form a positive disposition towards mathematics among younger students.

Although this study shows that flipbook-based e-modules are effective in increasing student engagement and learning motivation, the results need to be interpreted with several limitations in mind. This study was conducted only in one public junior high school with subjects limited to seventh-grade students, so generalization of the findings to other educational levels still requires further verification. Furthermore, the effectiveness of the e-modules was only evaluated based on increases in student engagement and learning motivation using Normalized Gain (N-Gain) analysis, thus not providing a picture of the magnitude of the influence or causal relationships between variables. This study also did not examine the impact of the e-modules on other mathematical abilities relevant to geometry learning, such as spatial ability, conceptual understanding, critical thinking, and problem-solving. According to Design-Based Research, the validity of a learning innovation will be stronger if it is tested repeatedly in various contexts, student characteristics, and different implementation cycles Design-Based Research Collective (Ghosh & Kumar, 2025). Therefore, further research is recommended to implement e-modules in a more diverse population, using more comprehensive analyses such as effect size, ANCOVA, or Structural Equation Modeling (SEM), and integrating technologies such as Augmented Reality (AR), Artificial Intelligence (AI), and learning analytics to evaluate their effects on students' engagement, motivation, and various mathematical abilities more comprehensively.

The final phase of the development of this product entailed the successive modification of the flip-book style electronic module in accordance with the qualitative comments and recommendations provided by the expert evaluation panel during the validation process, and the feedback obtained from end-users during the live teaching process. This final phase resulted in the production of a complete geometry learning e-module for seventh-grade students, which is accessible by scanning the QR code or by clicking on the link provided:

Fig. 2. E-Module QR Code

https://heyzine.com/flip-book/5a8ab63247.html

Indonesian Journal of Education & Mathematical Science
Vol. 7, No. 3, September 2026, pp. 339~353
ISSN: 2715-985X, DOI: 10.30596/ijems.v7i3.31020

(E-module presented in Indonesian.)

The revised version of the flipbook-based e-module based on the improvement suggestions is presented in the figure below

Fig. 3. Cover Animation Display

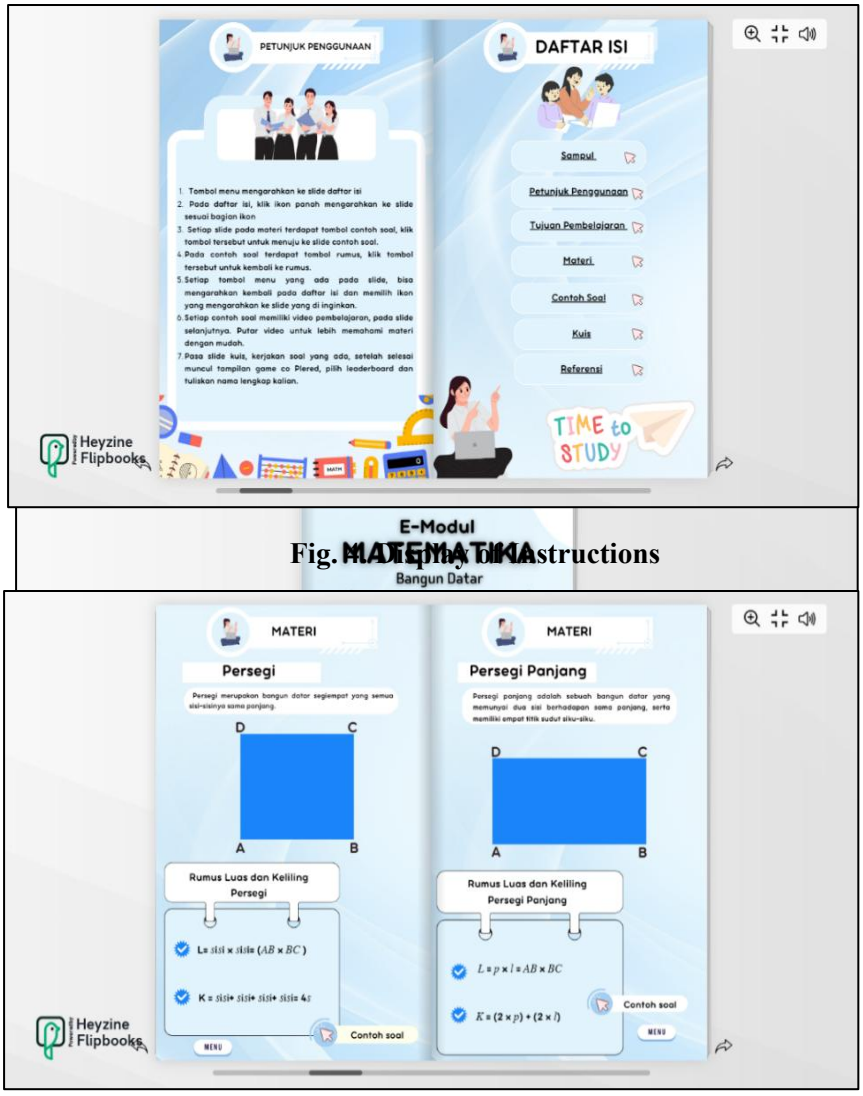

Fig. 4. Display of Instructions

Fig. 5. Font Size Display

4. CONCLUSION

This study utilized the ADDIE instructional design framework and is the first to develop a flipbook-based electronic module for lower-secondary geometry that integrates flipbook technology as an example of modular design. The use of the flipbook-based module is warranted within the secondary mathematics curriculum due to its positive user experience and functionality, as well as its empirically substantiated potential for increasing student focus and engagement, as evidenced by the student-centered approach of the module. The findings suggest that the integration of technology within a modular design framework provides a means of promoting student engagement in the learning process and encourages students to take more responsibility for their learning.

The use of flipbook technology in the design of the electronic module positively influenced participants' perceptions of mathematics as a motivating factor in their learning. The findings indicate

that a flipbook-based electronic module can be used as a motivator for secondary students to learn difficult concepts within geometry. The findings support the premise that secondary mathematics teachers may utilize a flipbook-based electronic module to promote a self-directed and engaged learning environment. The module may also be used to address unmotivated learning behaviors within the geometry classroom.

Future research should design electronic modules that use flipbooks and are focused on different branches of mathematics. These will incorporate interactive elements that include augmented reality and sophisticated pedagogical game designs. In addition, future research may examine the potential of these digital tools for teaching children of different ages and/or conduct more in-depth empirical investigations of their possible effects on students' ability to think critically, creatively solve problems, and their overall success in school, that is, their academic performance.

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