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Design and Validation of a Canva-Enhanced Interactive E-Module to Promote Reflective Thinking in Secondary Geometry Instruction

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ABSTRACT:
Background: The integration of digital technologies in education has transformed the way instructional materials are developed and delivered, particularly in mathematics learning, where students often struggle with abstract concepts such as solid geometry. Interactive digital modules offer the potential to foster deeper engagement and enhance higher-order thinking, including reflective thinking skills.
Aims: This study aims to design, implement, and validate an interactive e-module enhanced with Canva to support geometry instruction and promote reflective thinking among middle school students.
Methods: Employing a Research and Development (R&D) approach with the ADDIE model, the study involved 38 eighth-grade students from a public junior high school in Indonesia. The development process included expert validation by six validators (three media and three subject matter experts), small- and large-group trials, and pre- and post-testing to assess learning effectiveness. Student perceptions were also collected using a Likert-scale questionnaire to evaluate engagement and attractiveness.
Results: Validation results indicated high feasibility, with media experts assigning an average score of 3.66 and subject matter experts rating the module 3.63 on a 4-point scale. Student response analysis showed high engagement, with attractiveness scores of 3.43 (small group) and 3.65 (large group). The module demonstrated moderate effectiveness in improving reflective thinking, as evidenced by an N-gain score of 0.59 or 59%, classified as "moderately effective."
Conclusion: The Canva-enhanced interactive e-module is a feasible, engaging, and moderately effective instructional tool for teaching solid geometry. Its implementation has the potential to improve students' reflective thinking abilities and support more meaningful learning experiences in mathematics education.

Keywords: Interactive E-Module, Reflective Thinking, Canva Application, Solid Geometry, Instructional Design (ADDIE Model)

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INTRODUCTION

The evolution of digital technology in education has accelerated the shift from traditional instruction to interactive, student-centered learning. In mathematics classrooms, particularly in geometry, learners often face difficulties grasping spatial and abstract concepts. One of the most challenging topics for middle school students is solid geometry, which demands visualization, reasoning, and reflective thinking. Traditional teaching tools such as printed textbooks are frequently insufficient to engage students or foster deep cognitive skills, resulting in low performance and motivation.

Observations from a public junior high school in Indonesia indicate that over 70% of eighth-grade students scored below the minimum proficiency standard in geometry-related assessments. Students reported feeling unmotivated, struggled to follow mathematical reasoning, and had limited exposure to instructional technologies. These issues signal an urgent need for more engaging and cognitively supportive materials. The integration of digital tools, such as interactive e-modules, offers promising solutions to address these instructional deficiencies. Canva, a widely accessible and user-friendly digital design platform, enables educators to create visually rich, interactive learning resources that align with modern pedagogical goals. The development of such a module, specifically designed to promote reflective thinking in geometry learning, is both relevant and urgent.

Recent studies emphasize the role of interactive instructional technologies in improving conceptual understanding, engagement, and higher-order thinking skills. (Haataja et al., 2025) for example, examined student visual attention during collaborative geometry tasks and underscored the importance of visually guided problem-solving to promote deeper thinking. Similarly, Miyauchi & Thamburaj, (2025) applied the Van Hiele framework to enhance geometric learning for visually impaired students, highlighting the need for instructional scaffolds that support reflective reasoning.

Naufal et al. (2025) assessed the geometric reasoning of pre-service teachers and concluded that digital interventions significantly support metacognitive development.Singh & Kaur (2025) showed that students learning with augmented reality applications displayed improved comprehension and motivation, reinforcing the value of interactive, visual media. Lu et al. (2025) demonstrated the effectiveness of 3D printing in biomedical education to facilitate spatial reasoning, a critical skill in solid geometry. Additionally, Pena et al. (2025) found that multimodal instruction activated abstract neural patterns conducive to cognitive engagement.

Advanced instructional systems, as discussed by Zhou et al. (2025) further suggest that interactive platforms enhance personalized learning by adapting to student behavior. Li et al. (2025) explored 3D editing tools that maintain geometric consistency, underscoring the significance of spatial reasoning in digital education tools. Wang et al. (2025) introduced spatial sequence modeling through CAD-GPT, showing the potential of integrating design logic into cognitive skill development. Finally, Kosaka et al. (2025) observed that visual technologies like motion sensors increased attention and comprehension in science education, further validating multimedia-rich instruction. These studies collectively support the integration of digital design tools such as Canva in educational contexts and underline the relevance of developing geometry instruction tools that promote reflective thinking and learner engagement.

Despite the growing body of research on digital learning tools, there remains a lack of instructional design studies that specifically focus on Canva-based e-modules tailored for solid geometry instruction. While previous works have explored augmented reality, 3D printing, or AI-

supported geometry learning, few have addressed how visually engaging, interactive modules can explicitly foster reflective thinking—a higher-order cognitive skill essential for mathematical reasoning. Asher, (2021), Rangarajan et al. (2024) and Sabiteka et al. (2025) Additionally, limited research has been conducted in the context of middle school students in low-technology environments, where tools like Canva could provide an accessible and scalable solution.

This study aims to respond to both pedagogical and practical needs in mathematics education. The development of an interactive e-module using Canva addresses the cognitive challenge of geometry learning by supporting visual-spatial understanding and reflective thinking. Furthermore, Canva's accessibility makes it a valuable tool for educators in resource-constrained settings. The research also contributes to the broader discourse on instructional design and the integration of digital creativity platforms in education. By aligning with the ADDIE framework, this study ensures a structured development process and provides empirical evidence for the module's validity, appeal, and effectiveness.

The primary purpose of this study is to develop and validate an interactive e-module enhanced with Canva to support geometry learning at the middle school level. The study also aims to explore the module's effectiveness in improving students' reflective thinking skills and its perceived attractiveness and feasibility by both experts and learners. It is anticipated that the Canva-enhanced e-module will offer a valid, engaging, and moderately effective tool for addressing conceptual gaps in solid geometry and fostering reflective engagement in mathematics classrooms.

METHOD

Research Design

This study employed a Research and Development (R&D) approach using the ADDIE instructional design model (Alim et al. 2020; Lee & Jang, 2014), which consists of five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. This model was selected due to its structured framework that supports continuous feedback and refinement during the development of educational products. The study aimed not only to develop an instructional product but also to assess its effectiveness and acceptability through quantitative validation.

Participants

The participants in this study were eighth-grade students enrolled at SMP Negeri 1 Katibung, Indonesia. A total of 38 students were involved in the research, divided into two groups: a small-scale trial group consisting of 10 students and a large-scale trial group consisting of 28 students. These participants were selected based on their availability and current enrollment in the mathematics curriculum covering solid geometry topics. The target population consisted of junior secondary school students studying solid geometry as part of the national curriculum. A purposive sampling method was adopted to ensure that the selected participants had previously demonstrated difficulties in understanding geometric concepts, as identified in the preliminary classroom assessment. This criterion aligned with the objective of evaluating the module's impact on reflective thinking in students with low to moderate achievement levels.

Instrument

The instruments used in this study were developed and validated to measure the feasibility, attractiveness, and effectiveness of the Canva-based interactive e-module (Astuti & Louise, 2024;

Wulandari & Yohanie, 2024). Expert validation instruments were in the form of Likert-scale questionnaires with four levels (1 = not good, 2 = fair, 3 = good, 4 = very good) assessing content relevance, presentation quality, visual layout, and media functionality. Psychometric evaluation was conducted to determine content validity through expert judgment. The module's effectiveness was measured using pre-test and post-test items that assessed reflective thinking, based on indicators of critical reasoning and spatial understanding in geometry. Scoring guidelines were standardized, and reliability was enhanced by peer review and inter-rater consistency checks. The main instruments used included: (1) expert validation questionnaires for media and content specialists, (2) pre- and post-tests to assess learning gains in reflective thinking, and (3) student perception questionnaires on module attractiveness. Each instrument underwent pilot testing and revision to ensure clarity and alignment with the study objectives. The reflective thinking test items were adapted from standard geometry assessment formats and revised based on Bloom's taxonomy, targeting higher-order thinking skills.

Procedures and Time Frame

The study followed the ADDIE model's five phases. In the Analysis phase, classroom observations and interviews with teachers were conducted to identify learning gaps. During the Design phase, a blueprint of the e-module was created using Canva. In the Development phase, the module was populated with visual content, 3D animations, learning videos, and interactive quizzes. This prototype was validated by six experts, including three media and three subject matter specialists. Implementation was carried out over a three-week period, during which students used the e-module in place of conventional textbooks. Pre-tests were administered before exposure to the module, followed by post-tests and questionnaires after two weeks of use. The final Evaluation phase involved data analysis and interpretation of learning outcomes and user feedback.

Analysis Plan

Quantitative data were analyzed using descriptive and inferential statistics. Expert validation scores and student perception responses were presented as mean values and interpreted using predefined categorical thresholds (e.g., "valid," "very valid"). The effectiveness of the e-module was analyzed using the N-gain score formula to determine normalized learning improvement (Hamida & Utami, 2024; Hamidah et al. 2024). The criteria used for interpreting the N-gain values followed standard benchmarks: low (<0.3), moderate (0.3–0.7), and high (>0.7). Reliability and validity of the instruments were verified through expert triangulation and item analysis.

RESULTS AND DISCUSSION

Results

The research resulted in the development and validation of a Canva-based interactive e-module designed to support reflective thinking in the context of solid geometry instruction for eighth-grade students. The findings are structured based on the ADDIE development phases and summarized through both qualitative and quantitative data. The validation process involved assessments by media and content experts. The expert review evaluated the module's instructional design, clarity, visual aesthetics, functionality, and alignment with learning objectives. Table 1 summarizes the average scores obtained from six validators (three media experts and three content experts) using a 4-point Likert scale.

Table 1. Expert Validation Results of the E-Module

Aspect Evaluated	Media Experts (Mean)	Content Experts (Mean)
Module layout and design	3.67	–
Visual content and aesthetics	3.86	–
Instructional clarity	3.60	–
Technical functionality	3.67	–
Content relevance and accuracy	–	3.57
Language and presentation style	–	3.67
Curriculum alignment	–	3.67
Overall Average Score	3.66	3.63

These scores indicate that the e-module was rated as "Very Valid" by both media and content experts, demonstrating its feasibility and alignment with instructional standards. To assess attractiveness and student engagement, the module was implemented with two groups: a small group of 10 students and a large group of 28 students. After using the e-module for two weeks, students completed a user perception questionnaire. Table 2 shows the average scores for attractiveness.

Table 2. Student Response Scores on Module Attractiveness

Group	Mean Score	Interpretation
Small Group	3.43	Very Attractive
Large Group	3.65	Very Attractive

Both groups responded positively, suggesting that the e-module was engaging, visually appealing, and effective in motivating independent learning. Effectiveness was evaluated using a pre-test and post-test on reflective thinking abilities. The normalized gain (N-Gain) was calculated to assess learning improvement. Table 3 and 4 shows the effectiveness results.

Table 3. Pre-Test and Post-Test Results on Reflective Thinking

Test Type	Total Score	Mean Score
Pre-Test	1047	37.39
Post-Test	2066	73.79

Table 4. N-Gain Score Analysis

N-Gain Score	Percentage	Effectiveness Level
0.59	59%	Moderately Effective

These results indicate a moderate improvement in reflective thinking among students after using the Canva-based e-module.

Discussion

The development and implementation of a Canva-enhanced interactive e-module showed strong feasibility, attractiveness, and moderate effectiveness in improving students' reflective thinking skills in solid geometry. The validation scores from media and content experts confirm that the module met educational design standards in terms of layout, clarity, and instructional alignment. This is consistent with previous findings by Haataja et al. (2025). which emphasized the role of visual interactivity in promoting engagement and metacognitive reflection in geometry learning.

Student response data also affirmed the module's appeal, with both groups rating the learning experience as "very attractive." This outcome aligns with findings by (Singh & Kaur, 2025), who noted that technology-enhanced media positively influences learner motivation. The module's visual

interactivity, including 3D models and integrated quizzes, likely contributed to this positive response. The use of Canva as a development platform made the instructional material both professional and accessible, as supported by (Lu et al., 2025) . who highlighted the importance of visualization tools in spatial learning.

In terms of learning outcomes, (Selviana & Sunarno, 2022; Sukatiman et al., 2024) the moderate N-Gain score of 0.59 demonstrates that the e-module had a meaningful impact on students' reflective thinking. This result is in line with research by (Naufal et al. (2025), which emphasized that digital instructional tools can effectively develop higher-order thinking when used consistently within structured instructional frameworks.

Implications

The findings of this study suggest that Canva-enhanced e-modules can serve as an effective alternative to traditional textbooks in geometry instruction. Their integration into classroom learning has the potential to foster metacognitive skills, promote independent learning, and increase engagement in abstract mathematical topics. For educators in resource-limited settings, this approach offers a scalable and accessible means of integrating digital innovation into teaching practices.

Research Contribution

This study contributes to the growing body of literature on digital instructional design by demonstrating how a user-friendly tool like Canva can be systematically employed to develop validated, interactive learning modules. It also highlights the role of reflective thinking as a measurable cognitive outcome in mathematics education, providing a model for future research on the cognitive impact of e-learning tools.

Limitations

The scope of the study was confined to one school and a single grade level, which may limit the generalizability of the results. Additionally, while the module's effectiveness was measured quantitatively, qualitative insights into student learning experiences were not explored in depth. The study also did not isolate which specific features of the module (e.g., videos, quizzes, animations) had the greatest impact on learning.

Suggestions

Future research should consider larger and more diverse samples across different schools and regions to validate the findings. Including qualitative methods such as interviews or think-aloud protocols could enrich the understanding of how students interact with and benefit from digital modules. Moreover, comparative studies that examine different design platforms (e.g., Canva vs. Google Sites or Adobe Express) could help determine the most effective tools for instructional media development in various educational contexts.

CONCLUSION

This study successfully developed and validated an interactive e-module using Canva to support the teaching of solid geometry and promote reflective thinking among eighth-grade students. The application of the ADDIE development model ensured a systematic approach to instructional design, implementation, and evaluation. Expert validation results confirmed the module's high quality in both content and media design, with average ratings of 3.66 from media experts and 3.63

from content experts—both categorized as "very valid." Students' perceptions further demonstrated the module's attractiveness, as evidenced by high scores in both small and large groups. The module also proved to be moderately effective in improving students' reflective thinking skills, as indicated by an N-Gain score of 0.59. The increase in post-test performance compared to the pre-test suggests that the integration of visual elements, interactive quizzes, and digital learning tools significantly contributed to cognitive engagement and deeper learning. The Canva platform, with its accessible design features, proved to be a viable tool for educators seeking to develop engaging and pedagogically sound digital learning materials.

Overall, the study highlights the potential of combining user-friendly design platforms with instructional theory to produce digital modules that are not only feasible and engaging but also cognitively impactful. The findings suggest that Canva-based interactive e-modules can be a valuable addition to secondary mathematics education, particularly in contexts where student motivation and reflective thinking need to be strengthened.

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AUTHOR CONTRIBUTION STATEMENT

Regita Indah Cahyani was responsible for the conceptual design of the study, development of the Canva-based interactive e-module, coordination of data collection in the field, and the initial drafting of the manuscript. She also served as the corresponding author and led the integration of expert feedback into product revisions.

Fredi Ganda Putra contributed to the theoretical framework and literature review, assisted in the construction and validation of research instruments, and supported data interpretation and statistical analysis, particularly in evaluating the module's effectiveness through N-Gain calculations.

Iip Sugiharta was involved in supervising the implementation phase in the classroom setting, facilitating communication with participating teachers and students, and reviewing the manuscript for content consistency, clarity, and alignment with educational research standards. He also ensured that the module aligned with the national curriculum objectives.

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