

Design and Evaluation of Canva for Education–Based Interactive Learning Media for Strengthening Students’ Mathematical Conceptual Understanding

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Abstract

Students’ difficulties in understanding mathematical concepts, particularly negative integer operations, are often rooted in teacher-centered instructional practices that provide limited opportunities for conceptual exploration and active engagement. This study aimed to develop and evaluate interactive mathematics learning media based on Canva for Education to enhance students’ conceptual understanding. Employing a Research and Development (R&D) approach guided by the ADDIE model, the study was conducted through five stages: analysis, design, development, implementation, and evaluation. The analysis stage involved diagnostic testing, classroom observations, and a review of school readiness, revealing that 65.62% of students experienced conceptual difficulties. The developed product was an interactive PowerPoint-based learning medium that focused on conceptual visualization, guided examples, and interactive quizzes. Expert validation confirmed high content validity and instructional quality, while revisions were made to improve interactivity and technical usability. The implementation involved a classroom trial with 32 Grade VII students at a junior high school in Karawang. Results indicated a significant improvement in learning outcomes, with average test scores increasing from 60.78 (pre-test) to 76.73 (post-test), representing a gain of 15.95 points (26.2%). The practicality evaluation yielded an overall score of 80.93%, categorized as practical, supported by positive student responses and adequate teacher readiness. These findings demonstrate that Canva for Education–based interactive learning media developed using the ADDIE model are valid, practical, and effective in supporting students’ conceptual understanding of mathematics, offering a promising instructional solution for secondary education contexts.

INTRODUCTION

Mathematics is a fundamental subject that plays a central role in developing students’ logical, analytical, and systematic thinking abilities (Nurhaswinda & Parisu, 2025). Mastery of mathematics is essential not only for academic achievement but also for the problem-solving and reasoning skills required in everyday life. However, mathematics learning in schools continues to face persistent challenges. Classroom observations conducted on Friday, 24 October 2025, at a private junior high school in Karawang indicate that mathematics instruction remains predominantly conventional. Teachers frequently rely on lecturing and question–answer methods, resulting in teacher-centered learning environments that limit students’ opportunities to actively construct mathematical knowledge (Pratiwi & Sudiarsa, 2023). Furthermore, the relatively large

class sizes make it difficult for teachers to provide individualized guidance and feedback. This condition directly affects students' limited understanding of mathematical concepts, as instructional time is primarily devoted to content delivery rather than conceptual exploration (Maspupah & U.S., 2025). Consequently, many students struggle to understand mathematics in meaningful ways, underscoring the need for more effective and engaging instructional approaches.

Previous studies consistently emphasize that conceptual understanding is a core component of mathematical learning, as it enables students to connect procedures with underlying principles and apply knowledge flexibly across contexts (Rittle-Johnson & Siegler, 2022; De Zeeuw et al., 2013). Empirical evidence shows that students often struggle with mathematical problem-solving due to weak conceptual foundations, particularly in interpreting problems, formulating solutions, and explaining reasoning processes (Tambychik & Meerah, 2010; Sodri, 2018). Research has further demonstrated that learning media play a significant role in supporting conceptual understanding, especially when abstract mathematical ideas are presented through concrete representations and visualizations (Imamuddin, 2020; Kusnandar & Yusuf, 2023). Interactive and multimedia-based learning media have been shown to improve students' engagement and conceptual comprehension across diverse learning contexts, including inclusive education settings (Suarsana et al., 2019; Safitri et al., 2025). In addition, technology-based instructional approaches are increasingly recognized as practical tools for enhancing mathematics learning when designed to support interaction, visualization, and active learning processes (Forster, 2006; Serlina et al., 2022).

Despite extensive research on interactive and technology-based learning media in mathematics education, several gaps remain evident. First, many classrooms continue to rely on conventional, teacher-centered instructional practices that do not optimally facilitate conceptual understanding, even though empirical evidence highlights the effectiveness of interactive media (Pratiwi & Sudiarsa, 2023; Maspupah & U.S., 2025). Second, although various studies have examined manipulatives and multimedia learning tools, limited attention has been given to accessible, teacher-friendly digital platforms that can be easily integrated into everyday classroom practice. Third, existing studies on Canva-based learning media have primarily focused on specific topics or teacher competencies, with less emphasis on systematic development aimed at improving students' mathematical conceptual understanding at the secondary school level (Feladi et al., 2023; Kurniasari et al., 2022). Moreover, there is a lack of empirical development studies that explicitly address how Canva for Education can be designed as an interactive mathematics learning medium to overcome the limitations of large class sizes and conventional instructional methods. This gap indicates the need for research that bridges pedagogical theory, digital media design, and classroom implementation.

In response to these gaps, this study proposes developing interactive mathematics learning media using Canva for Education as an innovative instructional solution. The novelty of this research lies in integrating conceptual understanding theory with an accessible digital design platform to create interactive learning media that support visualization, engagement, and student-centered learning. Unlike previous studies that focus solely on technology use or media effectiveness, this study emphasizes the systematic development of media tailored to students' learning needs and classroom constraints. Canva for Education is selected due to its flexibility, ease of use, and capacity to support various forms of interactive content, such as presentations, infographics, videos, and digital quizzes (Pratama et al., 2023; Naipospos et al., 2025; Putri et al., 2025). Therefore, the primary objective of this research is to develop and implement Canva-based interactive mathematics learning media that can enhance students' conceptual understanding of

mathematics. This development is expected to contribute both theoretically and practically by offering an effective alternative to conventional instruction and advancing innovation in digital mathematics learning at the school level.

METHODS

This study employed a Research and Development (R&D) methodology, as the primary objective was not merely to examine the effectiveness of an instructional treatment, but to design, validate, and evaluate the practicality of a mathematics learning media product aligned with classroom needs. The R&D approach is particularly appropriate when research is intended to generate applicable pedagogical solutions grounded in authentic educational problems through iterative cycles of design, implementation, evaluation, and refinement (Okpatrioka, 2023). In line with this perspective, Ramot and Bialik (2023) conceptualize educational R&D as a systematic process aimed at developing educational artefacts that are grounded in users' needs and supported by empirical validation to ensure their relevance, usability, and acceptance in authentic learning contexts. Accordingly, the R&D approach was considered suitable for addressing students' low mathematical conceptual understanding, as it enables the structured, context-sensitive development of learning media that are responsive to learners' characteristics and instructional demands.

The development process in this study was guided by the ADDIE instructional design model, comprising five sequential stages: *Analysis, Design, Development, Implementation, and Evaluation*. The ADDIE model was selected due to its systematic yet flexible structure, which supports technology-based instructional media development by integrating needs analysis, instructional planning, media production, implementation, and continuous evaluation (Rustandi & Rismayanti, 2021). Previous studies have identified ADDIE as one of the most widely adopted instructional design models because it provides a clear framework for instructional decision-making and media development (Ozdilek & Robeck, 2009). Moreover, ADDIE has been empirically demonstrated to be effective in technology-enhanced learning contexts, as its interconnected stages facilitate continuous improvement based on evaluative feedback (Cheung, 2016). These characteristics render the ADDIE model appropriate for developing interactive mathematics learning media using Canva for Education at the junior secondary school level, where alignment among pedagogical needs, media design, and classroom implementation is essential.

The analysis stage focused on identifying instructional needs, learner characteristics, and the targeted basic competencies. The design stage involved constructing the learning media blueprint and research instruments, including achievement tests, observation sheets, and a practicality questionnaire. During the development stage, the learning media product was produced in accordance with the approved design and subsequently validated by subject-matter and media experts. The implementation stage consisted of a limited classroom trial to obtain empirical data on the media's practicality and students' responses. Finally, the evaluation stage was conducted to assess the trial results and refine the product to enhance its alignment with instructional objectives.

The study was conducted at a private junior high school in Karawang during the first semester of the 2024/2025 academic year. The research participants comprised 32 students from class VII-B. The selection of a single class was based on the characteristics of early-stage development research, which prioritizes feasibility and practicality testing in authentic classroom settings rather than population-level generalization. Grade VII students were chosen because, at this level, learners begin to encounter increasingly abstract mathematical concepts, thereby

necessitating the support of visual and interactive learning media to strengthen conceptual understanding.

The research instruments included achievement tests, observation sheets, and a practicality questionnaire. The achievement tests, comprising a pre-test and a post-test, were administered to measure students' improvement in mathematical conceptual understanding before and after using the developed media. Observation sheets were used to document students' learning activities and responses during instruction and were validated by learning media experts regarding the Canva-based interactive PowerPoint product. The practicality questionnaire was administered to collect data on the media's ease of use, attractiveness, and acceptability from the students' perspective. The questionnaire was developed based on an indicator framework adapted from Nurfauzia (2023) and employed a four-point Likert scale.

Table 1. Practicality Questionnaire Blueprint

No.	Aspect	Indicator	Item No.
1	Usability	Media can be used easily anywhere	1
2	Attractiveness	Instructional display is visually appealing	2
3	Content	Clarity of material and language	3
		Interest in the learning media	4
4	Learning	The material is easy to understand	5
		Material is connected to real-life contexts	6
5	Media Use	Menus are easy to understand	7
		All buttons function properly	8

Data were collected through tests, observations, questionnaires, and documentation. Quantitative data from the pre-test, post-test, and practicality questionnaire were analyzed using descriptive comparative analysis to identify trends in learning outcomes and media practicality. Qualitative data from classroom observations were analyzed descriptively to portray students' responses, engagement, and participation during the learning process. This analytical approach was selected as it is consistent with the objectives of development research, namely to evaluate the feasibility, practicality, and potential effectiveness of the developed learning media rather than to conduct inferential hypothesis testing.

RESULT

The development research was implemented using the ADDIE model across five main stages: analysis, design, development, implementation, and evaluation. Each stage was adapted to the real conditions of a junior high school in Karawang to ensure that the developed learning media met the actual needs of students and teachers. Overall, the results of each stage indicate that the Canva for Education-based learning media supported student engagement and improved students' conceptual understanding of mathematics.

1. Analysis Stage

The analysis stage was conducted through classroom observations, a diagnostic test, and a review of school facilities. The diagnostic test results revealed that 65.62% of students experienced conceptual difficulties in operating negative integers, particularly in applying operational rules and explaining their reasoning. Classroom observations further indicated that mathematics instruction

was predominantly teacher-centered, with limited use of interactive media and minimal opportunities for conceptual discussion. From an infrastructural perspective, observations and documentation confirmed that the school possessed adequate digital facilities, including projectors, computers, and stable internet access. In addition, teacher observations indicated sufficient digital competence and a strong willingness to integrate Canva-based learning media, indicating strong feasibility and sustainability for product implementation.

Table 2. Results of Diagnostic Test on Negative Integer Operations (n = 32)

Indicator of Conceptual Understanding	Number of Students	Percentage (%)
Correctly apply the rules of negative integer operations	11	34.38
Incorrect application of operation rules	14	43.75
Unable to explain the reasoning behind the answers	7	21.87
Total students with conceptual difficulties	21	65.62

As shown in Table 2, a substantial proportion of students (65.62%) exhibited conceptual difficulties in negative integer operations, particularly in understanding and explaining the underlying operational rules rather than merely committing procedural calculation errors. This finding indicates that the learning problem is predominantly conceptual in nature and requires instructional support that emphasizes conceptual clarity and meaning-making.

Consistent with these findings, the classroom observation results presented in Table 3 provide contextual evidence explaining the emergence of such conceptual difficulties. The observations reveal that mathematics instruction prior to the media development phase was largely teacher-centered, with limited use of visual or interactive learning media and minimal opportunities for students to engage in conceptual discussion. Consequently, students tended to adopt a passive learning role, which restricted their active involvement in exploring and constructing mathematical concepts.

Table 3. Classroom Observation Results Prior to Media Development

Observed Aspect	Observation Result
Teaching approach	Dominantly teacher-centered
Use of visual or interactive media	Minimal
Student participation	Low to moderate
Student engagement during explanation	Many students passive
Opportunities for conceptual discussion	Limited

Instruction was predominantly teacher-centered, with minimal opportunities for conceptual exploration and classroom discussion, a condition that potentially reinforced students' difficulties in developing conceptual understanding. In contrast to these instructional limitations, the findings presented in Table 4 indicate that the school environment was adequately prepared to support the integration of digital learning media. The availability of essential infrastructure, such as classroom projectors, computers, stable electricity, and internet access, suggests that the constraints in learning were not primarily caused by technological limitations. Therefore, the observed conceptual difficulties are more likely attributable to instructional practices rather than

infrastructural barriers. This readiness of school facilities provides a supportive context for implementing digital and interactive learning media, enabling the development and application of technology-enhanced instructional solutions without significant technical obstacles.

Table 4. School Infrastructure Readiness for Digital Learning Media

Facility	Availability	Condition
Classroom projector	Available	Good
Computer/laptop for the teacher	Available	Good
Internet connection	Available	Stable
Classroom electricity	Available	Stable
Audio-visual support	Available	Adequate

The school facilities were sufficiently adequate to support the implementation of Canva-based digital learning media without significant technical constraints. In addition to infrastructural readiness, the results presented in Table 5 indicate that teachers demonstrated an adequate level of technological competence and a high degree of readiness to integrate Canva-based learning media into classroom instruction. Teachers showed familiarity with presentation software, moderate experience with the Canva platform, and strong willingness to adopt instructional innovations.

Table 5. Teacher Readiness in Using Canva-Based Learning Media

Indicator	Observation Result
Experience using presentation software	Adequate
Familiarity with the Canva platform	Moderate
Willingness to use digital media	High
Openness to instructional innovation	High
Ability to operate interactive media	Adequate

Teachers demonstrated sufficient pedagogical competence and technical proficiency, suggesting that the developed learning media can be implemented smoothly and sustained within routine instructional activities.

2. Design Stage

The design stage focused on formulating learning objectives that emphasized students' ability to understand, apply, and explain the conceptual rationale underlying negative integer operations. The learning media were designed as an interactive PowerPoint consisting of conceptual explanations, worked examples, interactive exercises, and digital quizzes. Visual elements such as colors, icons, and animations were carefully selected to enhance student attention while maintaining conceptual clarity. The product design was aligned with the applicable basic competencies and learning objectives in the junior high school curriculum. At this stage, evaluation instruments were also developed, including expert validation sheets, student response questionnaires, and pre-test and post-test items. The test instruments were constructed to measure students' conceptual and operational understanding of negative integers. The pre-test and post-test

design was employed to capture students' learning progress before and after using the developed media.



Figure 1. Interface and Features of the Canva for Education–Based Interactive Mathematics Learning Media on Integer Operations

3. Development Stage

The developed product was an interactive PowerPoint entitled “*Petualangan Dunia Bilangan Bulat*”, designed for Grade VII students and focused on integer concepts. The media emphasized conceptual visualization to support students’ understanding. After completion, the product was subjected to expert validation by material and media experts. The validators assessed five main aspects: language, visual appearance, interactivity, technical suitability, and completeness of instructional content.

Table 6. Validation Scoring Scale

No.	Score	Description
1	4	Very Good
2	3	Good
3	2	Fair
4	1	Poor

The scoring scale indicates that a score of 4 represents an excellent level of quality, reflecting optimal fulfillment of the assessed criteria. A score of 3 denotes good quality, indicating that the criteria are generally met with minor aspects requiring improvement. A score of 2 indicates a fair level, suggesting that the criteria are partially met but require substantial revision. A score of 1 indicates poor quality, indicating that the criteria are not adequately met and substantial improvement is necessary. The detailed results of media validation are presented in Table 5.

Table 7. Media Expert Validation Results

No.	Assessed Aspect	Score	Description
1	Language	4	Language was communicative, standard, easy to understand, and free from inappropriate content.
2	Visual appearance	3	The visual design was generally attractive; minor revisions were suggested to improve text legibility.
3	Interactivity	2	Navigation required improvement; additional navigation buttons were recommended.
4	Technical suitability	3	The media functioned properly; automatic slideshow activation is recommended.
5	Completeness of materials	4	Instructional content was complete, and learning objectives were clearly stated.

The validation results indicate that the learning media demonstrated excellent performance in language use and instructional material completeness, as reflected by scores of 4 in both aspects. The visual appearance and technical suitability of the media were rated as good, indicating that the design was generally effective and the media functioned properly; however, minor technical and visual refinements were recommended. In contrast, the interactivity aspect received a fair rating, indicating that improvements in navigation features were necessary to enhance user interaction and ease of use. Overall, the results show that the learning media met the essential quality criteria, with revisions primarily required in technical and interactivity components. Material validation results are presented in Table 6.

Table 6. Material Expert Validation Results

No.	Aspect	Criteria	Score	Description
1	Content Quality	Completeness of material	4	The material was assessed as very complete, indicating that all required subtopics were adequately covered.
		Breadth of material	4	The material was considered to have a vast scope, providing comprehensive conceptual coverage.
		Depth of material	4	The material demonstrated substantial depth, as concepts were explained thoroughly rather than superficially.
		Accuracy of content	4	The material was judged to be highly accurate, confirming the correctness of the integer concepts presented.
2	Appropriateness of Coverage	Alignment with Core Competencies, Basic Competencies, and Indicators	4	The material was highly aligned with the specified Core Competencies, Basic Competencies, and learning indicators.

		Alignment with students' cognitive, affective, and psychomotor domains	3	The material was rated as good because it addressed the three learning domains; however, minor optimization could yield a more balanced integration.
		Relevance to everyday life	4	The material was highly relevant and easily connected to students' real-life experiences and contexts.
3	Inquiry-Based Method	Building new knowledge based on students' prior knowledge	4	The learning media were very effective in constructing new knowledge by connecting the content to students' prior understanding.
		Problems presented are relevant to real-life contexts	4	The examples and problems used were highly appropriate and closely related to students' everyday life situations.
4	Language	Use of communicative language	4	The language used was highly communicative and conveyed instructional messages clearly.
		Clarity of explanatory sentences	4	The sentences used to explain the material were very clear and easy for students to understand.
		Absence of ambiguity	4	The language was exact and did not generate ambiguous meanings.
		Compliance with Indonesian language conventions	4	Language usage fully complied with standard Indonesian language rules (PUEBI).
		Appropriateness to the students' cognitive development level	4	The language was highly appropriate to students' cognitive abilities and level of understanding.
5	Material Presentation	Systematic presentation of content	4	The sequence of content presentation was very well structured and logically organized.
		Attractive and motivating presentation	4	The presentation of the material was highly engaging and effectively motivated students to learn.
		Consistency in the use of terms and symbols	4	Mathematical terms and symbols were used very consistently throughout the learning media.

The expert validation results indicate that the learning material demonstrated a very high level of quality across almost all assessed aspects. Content quality was rated very good in terms of completeness, breadth, depth, and accuracy, indicating that the material comprehensively and accurately covered the required integer concepts. The appropriateness of content coverage was also

evaluated favorably, with strong alignment with curriculum competencies and real-life contexts. Although alignment with students' cognitive, affective, and psychomotor domains received a good rating, the results suggest only minor potential for further optimization. Furthermore, the inquiry-based approach was assessed as highly effective in supporting knowledge construction based on students' prior understanding. Language use and material presentation achieved consistently excellent ratings, reflecting clear, precise, and developmentally appropriate communication, as well as a systematic, engaging, and consistent presentation of content. Overall, these findings demonstrate that the learning material met the established quality criteria and was suitable for classroom implementation.

4. Implementation Stage

The implementation stage involved a classroom trial with 32 Grade VII students at a private junior high school in Karawang. The interactive PowerPoint media was applied in actual learning activities to assess its practicality and effectiveness. The implementation consisted of pre-test administration, instructional treatment using the developed media, and post-test administration. The learning activities were conducted using school facilities, including computers and projectors, to simulate authentic classroom conditions. The achievement test results showed an increase in students' scores. The average pre-test score was 60.78, while the average post-test score increased to 76.73, indicating an improvement of 15.95 points (approximately 26.2%).

Table 7. Pre-test and Post-test Results

Pre-test	Post-test
60.78	76.73

Classroom observations indicated that students were enthusiastic, focused, and actively engaged in learning activities. Students were able to operate the media independently with minimal guidance, and the instructor encountered no technical difficulties during implementation. Students actively responded to interactive elements such as quizzes and animations, demonstrating high engagement and sustained attention. To measure media practicality, student response questionnaires were analyzed. The results are presented in Table 8.

Table 8. Practicality Questionnaire Results

No.	Percentage
P1	82.03
P2	83.59
P3	82.81
P4	80.47
P5	82.03
P6	76.56
P7	78.13
P8	82.81

The practicality scores ranged from 76.56% to 83.59%, with an overall average of 80.93%, placing in the “Practical” category. These results indicate that the developed media was easy to use, visually attractive, and supportive of students’ independent and interactive learning.

5. Evaluation Stage

The evaluation stage was conducted to synthesize and critically review the findings obtained from the validation process, classroom implementation, learning outcome measurements, and practicality assessment, to identify both the strengths of the developed media and aspects requiring further improvement. The evaluation results indicate that the interactive PowerPoint learning media demonstrated strong content validity and media feasibility, as reflected by expert validation scores that were predominantly in the *very good* category across content quality, curriculum alignment, language use, inquiry-based approach, and material presentation. Minor revisions identified during the validation process were primarily technical in nature, particularly related to navigation consistency and visual readability, and were subsequently addressed prior to classroom implementation.

From an implementation perspective, evaluation of learning outcomes revealed a measurable improvement in students’ conceptual understanding, as evidenced by an increase in the average test score from 60.78 on the pre-test to 76.73 on the post-test, representing a gain of 15.95 points (approximately 26.2%). This improvement suggests that the media effectively supported students in understanding negative integer concepts beyond procedural computation. In addition, the practicality evaluation yielded an overall average score of 80.93%, placing the media in the *practical* category. Students consistently reported positive perceptions regarding ease of use, clarity of material, visual attractiveness, and functionality of interactive features.

Classroom observation data further supported these findings, showing increased student engagement, independent interaction with the media, and smooth instructional flow without technical disruptions. Teachers were able to operate the media effectively, indicating adequate pedagogical and technical readiness. However, despite these positive outcomes, the evaluation stage also identified limitations related to the scope of implementation, which was confined to a single class and a limited instructional duration. Consequently, broader testing across different classes, topics, and school contexts is necessary to strengthen the generalizability of the findings and to further refine the media based on diverse learner characteristics. Overall, the evaluation stage confirms that the developed learning media are valid, practical, and promising in terms of effectiveness, while also highlighting the need for continued iterative development and wider-scale application.

DISCUSSION

The findings of this study provide empirical evidence that an ADDIE-based development of Canva for Education-supported interactive learning media can effectively address students’ conceptual difficulties in mathematics. The diagnostic results, which show that 65.62% of students struggled to explain and justify operations with negative integers, indicate that the learning problem was fundamentally conceptual rather than procedural. This pattern is consistent with research emphasizing that genuine mathematical understanding is reflected in students’ abilities to represent, explain, and justify concepts, rather than merely execute algorithms (Niemi, 1996; Kholid et al., 2021). Consequently, the observed gap between students’ conceptual needs and prior instructional practices underscores the limitations of predominantly teacher-centered approaches for fostering deep mathematical understanding.

Classroom observation data further illuminate the instructional conditions contributing to these conceptual difficulties. Limited opportunities for mathematical discussion, conceptual exploration, and student interaction constrained students' engagement in meaning-making processes. Prior studies have consistently shown that conceptual understanding in mathematics develops through discourse, interaction, and active cognitive engagement rather than passive reception of information (Pirie & Schwarzenberger, 1988; Jojo et al., 2013). Importantly, the present findings indicate that these learning challenges cannot be attributed to technological constraints, as adequate digital infrastructure and teacher readiness were already in place. This reinforces the argument that instructional design quality, rather than mere access to technology, plays a decisive role in shaping students' conceptual learning outcomes.

The design and development stages of this study responded directly to these instructional needs by emphasizing conceptual visualization, interactivity, and curricular alignment. The use of visual representations, guided examples, and interactive quizzes was intended to support students in understanding the underlying rationale of negative integer operations. Such an approach aligns with prior research demonstrating that interactive and contextualized learning media can bridge abstract mathematical concepts and students' prior knowledge, thereby enhancing conceptual understanding (Asfar et al., 2019; Etyarisky & Marsigit, 2022). The strong expert validation results across content quality, curriculum alignment, language clarity, and inquiry-based design further indicate that the developed media met established instructional quality standards. Similar outcomes have been reported in ADDIE-based development studies, which highlight the model's effectiveness when iterative validation and revision are systematically applied (Widyastuti, 2019; Putra et al., 2024).

Evidence from the implementation stage strengthens the argument for the instructional effectiveness of the developed media. The substantial improvement in students' test scores suggests that the media supported conceptual understanding beyond procedural practice. This finding is consistent with studies reporting that well-designed interactive digital media can significantly improve both conceptual learning and student engagement in mathematics classrooms (Rahmawati & Jamaluddin, 2024). Moreover, increased student engagement and independent interaction observed during implementation reflect learning conditions that are widely recognized as prerequisites for meaningful conceptual change (Green & Blankenship, 2015).

The high practicality rating and positive student perceptions further support the feasibility and sustainability of the developed media. Students' evaluations of ease of use, visual attractiveness, and functional interactivity indicate that the media were accessible and supportive of independent learning. Teachers' pedagogical and technical readiness also played a critical role in ensuring successful implementation. This finding aligns with recent evidence showing that Canva-based instructional tools can enhance engagement and learning outcomes when teachers possess adequate digital literacy and openness to instructional innovation (Hutapea et al., 2024; Zainal Abidin et al., 2025). Additionally, recent studies suggest that integrating Canva with interactive assessment platforms can further promote higher-order mathematical thinking and problem-solving skills (Fajriah et al., 2025; Margareta & Karimah, 2025).

Despite these promising findings, several limitations must be acknowledged. The implementation was limited to a single class and focused on a specific mathematical topic, which constrains the generalizability of the results. Furthermore, the short duration of the intervention precluded analysis of long-term retention and transfer of learning. Future research should therefore extend this development approach across multiple contexts, mathematical domains, and instructional durations to strengthen external validity and to further refine the media based on

diverse learner characteristics. Nevertheless, the present study contributes robust evidence that systematically designed, Canva-based interactive learning media can serve as an effective and context-sensitive strategy for enhancing students' conceptual understanding in mathematics.

CONCLUSIONS

This study was conducted to address persistent conceptual difficulties that junior high school students experience in understanding negative integer operations, particularly those arising from predominantly teacher-centered instructional practices. To respond to this problem, the research aimed to develop and implement interactive mathematics learning media based on Canva for Education using a Research and Development approach guided by the ADDIE model. Through systematic stages of analysis, design, development, implementation, and evaluation, the study sought to produce learning media that were pedagogically sound, practically feasible, and effective in supporting students' conceptual understanding. The findings demonstrate that the developed interactive learning media successfully addressed the identified learning needs. Students showed meaningful improvement in conceptual understanding, as evidenced by a substantial increase in learning outcomes following the implementation of the media. In addition to improved test performance, classroom observations revealed increased student engagement, independent interaction with learning content, and smoother instructional flow. Expert validation further confirmed that the media met high standards of content quality, curriculum alignment, language clarity, inquiry-based design, and material presentation. At the same time, the practicality evaluation indicated that the media was easy to use, visually engaging, and well-received by students.

This study contributes to mathematics education research by providing empirical evidence that Canva for Education–based interactive learning media, when systematically developed using the ADDIE model, can effectively enhance students' conceptual understanding of mathematics. The study also extends existing development research by demonstrating that instructional design quality plays a more critical role than technological availability alone in improving learning outcomes. The integration of needs analysis, expert validation, practicality testing, and learning outcome evaluation offers a validated development framework that can inform future instructional media design and research in similar educational contexts. The findings have important implications for educational practice and research. In practice, teachers are encouraged to use Canva for Education to design concept-oriented, interactive learning media that promote active student engagement without requiring advanced technical expertise. Schools can maximize the impact of existing digital infrastructure by focusing on pedagogically informed instructional design. From a research perspective, future studies are recommended to include broader samples, longer implementation periods, and a wider range of mathematical topics to enhance generalizability and examine long-term retention and transfer. In conclusion, this study demonstrates that systematically designed, interactive digital learning media can serve as an effective and sustainable instructional solution for enhancing students' conceptual understanding in mathematics. By aligning instructional design with learners' conceptual needs and classroom realities, the developed media offers a valuable contribution to both educational practice and research, reinforcing the potential of technology-enhanced learning to support meaningful mathematical understanding.

REFERENCES

- Asfar, A. I. T., Asmawaty, A., Asfar, A. I. A., & Nursyam, A. (2019). Mathematical concept understanding: The impact of integrated learning model. *Al-Jabar: Jurnal Pendidikan Matematika*, 10(2), 211–222. <https://doi.org/10.24042/ajpm.v10i2.3880>
- Cheung, L. (2016). Using the ADDIE model of instructional design to teach chest radiograph interpretation. *Journal of Biomedical Education*, 2016(1), 9502572. <https://doi.org/10.1155/2016/9502572>
- De Zeeuw, A., Craig, T., & You, H. S. (2013, October). Assessing conceptual understanding in mathematics. In *2013 IEEE Frontiers in Education Conference (FIE)* (pp. 1742–1744). IEEE. <https://doi.org/10.1109/FIE.2013.6685135>
- Etyarisky, V., & Marsigit, M. (2022). The effectiveness of interactive learning multimedia with a contextual approach to students' understanding of mathematical concepts. *Al-Ishlah: Jurnal Pendidikan*, 14(3), 3101–3110. <https://doi.org/10.35445/alishlah.v14i3.941>
- Fajriah, F., Rahmah, H., & Novianti, N. (2025). Canva and Quizizz foster algebraic thinking in junior high students. *Academia Open*, 10(2), 10–21070. <https://acopen.umsida.ac.id/index.php/acopen/article/view/12797>
- Feladi, V., Debora, T. P., Firanda, Y., Patrisia, K., & Sari, C. F. K. (2023). Development of Canva-based learning media for the mathematics subject of fractional numbers. *Research in Education and Technology (REGY)*, 2(1), 42–45. <https://doi.org/10.62590/regy.v2i1.95>
- Forster, P. A. (2006). Assessing technology-based approaches for teaching and learning mathematics. *International Journal of Mathematical Education in Science and Technology*, 37(2), 145–164. <https://doi.org/10.1080/00207390500285826>
- Green, J. L., & Blankenship, E. E. (2015). Fostering conceptual understanding in mathematical statistics. *The American Statistician*, 69(4), 315–325. <https://doi.org/10.1080/00031305.2015.1069759>
- Hutapea, N. S., Manullang, Z. P. J., & Hartati, R. (2024). Enhancing student engagement and academic performance through digital literacy: A transformative approach in Canva application. *Fonologi: Jurnal Ilmuan Bahasa dan Sastra Inggris*, 2(4), 154–170. <https://doi.org/10.61132/fonologi.v2i4.1227>
- Imamuddin, M. (2020, February). Students' understanding of mathematical concepts using manipulative learning media in elementary schools. In *Journal of Physics: Conference Series* (Vol. 1471, No. 1, p. 012050). IOP Publishing. <https://doi.org/10.1088/1742-6596/1471/1/012050>
- Jojo, Z. M. M., Maharaj, A., & Brijlall, D. (2013). From human activity to conceptual understanding of a mathematical concept. *Journal of Research in Mathematics Education*, 2(1), 77–99. <https://doi.org/10.4471/redimat.2013.21>
- Kholid, M. N., Imawati, A., Swastika, A., Maharani, S., & Pradana, L. N. (2021, February). How are students' conceptual understanding for solving mathematical problems? In *Journal of Physics: Conference Series* (Vol. 1776, No. 1, p. 012018). IOP Publishing. <https://doi.org/10.1088/1742-6596/1776/1/012018>
- Kurniasari, I., Siswono, T. Y. E., Setianingsih, R., & Manoy, J. (2022, September). Mathematics teacher's ability in inclusion school made learning media with Canva application. In *AIP Conference Proceedings* (Vol. 2633, No. 1, p. 030020). AIP Publishing LLC. <https://doi.org/10.1063/5.0103020>

- Kusnandar, N., & Yusuf, Y. (2023). Efforts to improve students' mathematical concepts understanding ability using Dienes block media. *Mathline: Jurnal Matematika dan Pendidikan Matematika*, 8(2), 603–620. <https://doi.org/10.31943/mathline.v8i2.416>
- Margareta, D., & Karimah, S. (2025). Developing interactive learning media through Canva website and Quizizz mastery peak integration to enhance problem-solving skills. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 5(3), 1358–1372. <https://doi.org/10.51574/kognitif.v5i3.3655>
- Maspupah, & U.S., S. (2025). Pengaruh penggunaan media pembelajaran dan motivasi belajar terhadap kemampuan pemahaman konsep matematika. *Himpunan: Jurnal Ilmiah Mahasiswa Pendidikan Matematika*, 5(1), 135–144. <https://doi.org/10.30653/004.201812.18>
- Naipospos, N. Y., Ain, L. T., Lubis, R. D., Benny, L., Damanik, N. S., & Ramadhani, N. (2025). Analisis keterampilan guru dalam menggunakan aplikasi Canva sebagai media pembelajaran digital. *Juripol (Jurnal Institusi Politeknik Ganesha Medan)*, 8(2), 31–39. <https://jurnal.polgan.ac.id/index.php/juripol/article/view/15113/3425>
- Niemi, D. (1996). Assessing conceptual understanding in mathematics: Representations, problem solutions, justifications, and explanations. *The Journal of Educational Research*, 89(6), 351–363. <https://doi.org/10.1080/00220671.1996.9941339>
- Nurhaswinda, & Parisu, C. Z. L. (2025). Kesulitan belajar matematika di sekolah dasar dan solusinya. *Jurnal Pendidikan Multidisiplin*, 1(1), 50–58. <https://doi.org/10.54297/jpmd.v1i2.1246>
- Nurfauzia. (2023). *Pengembangan media pembelajaran matematika bantuan Canva pada materi peluang kelas VIII SMP Negeri 4 Enrekang* (Undergraduate thesis). Institut Agama Islam Negeri Parepare. <https://repository.iainpare.ac.id/id/eprint/6827>
- Okpatrioka. (2023). Research and development (R&D): Penelitian yang inovatif dalam pendidikan. *Jurnal Pendidikan, Bahasa Dan Budaya*, 1(1), 86–100. <https://doi.org/10.47861/jdan.v1i1.154>
- Ozdilek, Z., & Robeck, E. (2009). Operational priorities of instructional designers analyzed within the steps of the ADDIE instructional design model. *Procedia–Social and Behavioral Sciences*, 1(1), 2046–2050. <https://doi.org/10.1016/j.sbspro.2009.01.359>
- Pirie, S. E., & Schwarzenberger, R. L. E. (1988). Mathematical discussion and mathematical understanding. *Educational Studies in Mathematics*, 19(4), 459–470. <https://doi.org/10.1007/BF00578694>
- Pratama, R., Alamsyah, M., Siburian, M. F., Marhento, G., & Jupriadi. (2023). Pemanfaatan Canva sebagai media pembelajaran interaktif dalam meningkatkan pemahaman peserta didik. *EduBiologia: Biological Science and Education Journal*, 3(1), 40–46. <https://doi.org/10.30998/edubiologia.v3i1.16070>
- Pratiwi, N. M. S., & Sudiarsa, I. W. (2023). Small group discussion: Pengaruhnya terhadap hasil belajar siswa. *Jurnal Santiaji Pendidikan*, 13(2), 103–112. <https://doi.org/10.36733/jsp.v13i2.6972>
- Putra, F. H. K., Taufik, M., & Nadlifah, M. (2024). Development of MATLAB GUI-based mathematics learning media with ADDIE model to enhance students' mathematical connection ability. *Mathematics Education Journal*, 8(1), 102–113. <https://doi.org/10.22219/mej.v8i1.28850>
- Putri, Z. E., Reni, Hermita, N., & Barakah, R. G. S. (2025). Implementasi media pembelajaran interaktif berbasis Canva dalam pembelajaran IPA. *Edukasi Tematik: Jurnal Pendidikan Sekolah Dasar*, 6(2), 109–118. <https://doi.org/10.59632/edukasitematik.v6i2.545>

- Rahmawati, S., & Jamaluddin, M. (2024). Development of game-based mathematics learning media to improve mathematical understanding abilities. *Riemann: Research of Mathematics and Mathematics Education*, 6(2), 202–214. <https://doi.org/10.38114/pnn19445>
- Ramot, R., & Bialik, G. (2023). Toward a consensual definition of educational research and development: A Delphi study. *Higher Education Research & Development*, 42(2), 427–441. <https://doi.org/10.1080/07294360.2022.2052814>
- Rittle-Johnson, B., & Siegler, R. S. (2022). The relation between conceptual and procedural knowledge in learning mathematics: A review. In *The development of mathematical skills* (pp. 75–110). Routledge. <https://doi.org/10.4324/9781315784755-6>
- Rustandi, A., & Rismayanti. (2021). Penerapan model ADDIE dalam pengembangan media pembelajaran. *Jurnal Fasilkom*, 11(2), 57–60. <https://doi.org/10.37859/jf.v11i2.2546>
- Safitri, D., Jihadah, A., Yarmi, G., Marini, A., Sujarwo, D., L., & Irwansyah, P. (2025, March). Multimedia-based interactive learning media to improve students' concept understanding of mathematics. In *AIP Conference Proceedings* (Vol. 3142, No. 1, p. 020070). AIP Publishing LLC. <https://doi.org/10.1063/5.0262033>
- Serlina, Rahmatudin, J., & Lusiyana, D. (2022). Pengembangan media pembelajaran matematika berbantuan GeoGebra untuk meningkatkan kemampuan pemecahan masalah matematis siswa. *Jurnal Didactical Mathematics*, 4, 230–240. <https://doi.org/10.25217/numerical.v2i2.232>
- Sodri, S. (2018). Pengaruh model pembelajaran dan motivasi belajar terhadap pemahaman konsep matematika. *Journal of Mathematics Learning*, 1(2), 18–28. <https://doi.org/10.30653/004.201812.18>
- Suarsana, I. M., Mahayukti, G. A., Sudarma, I. K., & Pujawan, A. A. G. S. (2019, February). The effect of interactive mathematics learning media toward mathematical conceptual understanding on probability of hearing-impaired students. In *Journal of Physics: Conference Series* (Vol. 1165, No. 1, p. 012021). IOP Publishing. <https://doi.org/10.1088/1742-6596/1165/1/012021>
- Tambychik, T., & Meerah, T. S. M. (2010). Students' difficulties in mathematics problem-solving: What do they say? *Procedia–Social and Behavioral Sciences*, 8, 142–151. <https://doi.org/10.1016/j.sbspro.2010.12.020>
- Widyastuti, E. (2019, March). Using the ADDIE model to develop learning material for actuarial mathematics. In *Journal of Physics: Conference Series* (Vol. 1188, No. 1, p. 012052). IOP Publishing. <https://doi.org/10.1088/1742-6596/1188/1/012052>
- Zainal Abidin, S. R., Jalaluddin, N. F., Ismail, N. Z., & Zainal, M. A. (2025). The efficacy of Canva as a digital tool for enhancing student learning in multimedia interactive subjects. *International Journal on E-Learning and Higher Education*, 20(2), 1–18. <https://doi.org/10.24191/ijelhe.v20n2.2021>