

PROBLEM-BASED LEARNING MODEL TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM-SOLVING SKILLS AND LEARNING INTEREST: A DEVELOPMENT STUDY

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ABSTRACT

Mathematical problem-solving skills and interest in learning are essential competencies that must be developed to face future technological challenges. In line with the 2006 National Curriculum (KTSP), mathematics learning is expected to empower students to solve problems by understanding issues and designing appropriate mathematical models. This study aims to develop and test the effectiveness of a Canva-assisted Problem-Based Learning (PBL) model in improving students' mathematical problem-solving skills and learning interest. The method used in this research was Research and Development (R&D) through the 4D stages: Define, Design, Develop, and Disseminate. The Canva-assisted Problem-Based Learning (PBL) model was designed based on the results of initial interviews, field observations, and literature reviews to meet the needs of students and teachers. Data analysis techniques included validity and practicality tests by experts, as well as the calculation of N-Gain scores to measure improvement. The research results indicated significant differences in students' mathematical problem-solving abilities and improvements in their learning interest. This indicates that students who participated in the Canva-assisted Problem-Based Learning (PBL) model achieved better problem-solving skills and higher learning interest compared to those in conventional learning settings. Consequently, it can be concluded that students who are interested and actively engaged in learning are more capable of understanding problems, allowing their mathematical thinking processes to develop optimally.

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INTRODUCTION

Mathematical problem-solving skills are one of the essential competencies in mathematics learning and play a role in training students to learn mathematics (Hendriana et al., 2017), to plan solution strategies, to implement mathematical procedures (Yuhani et al., 2018; Yustianingsih et al., 2017), and to evaluate the solutions obtained (Johan et al., 2023). This aligns with the mathematics learning curriculum implemented in Indonesia, which, following

the recommendations of the National Council of Teachers of Mathematics (NCTM), positions problem-solving as the main focus of mathematics learning (Hendriana et al., 2018; Resilona et al., 2018). This ability becomes an essential part of mathematics learning because it is related to thinking logically, critically, and systematically (Lester dan Noah, n.d.). From the curriculum perspective, problem-solving ability becomes one of the objectives in mathematics learning at school, namely to train ways of thinking and reasoning in drawing conclusions (Yuhani et al., 2018; Siswanto, 2024), to develop problem-solving skills, and to develop the ability to convey information or communicate ideas through oral, written, and other forms (Sumartini, 2016). In line with the objectives of mathematics learning in the 2006 Indonesia National Curriculum (School-Based Curriculum or Kurikulum Tingkat Satuan Pendidikan; KTSP), students must possess problem-solving abilities, including understanding problems, designing mathematical models, solving the models, and interpreting the solutions obtained.

The conditions in the field indicate that the mathematical problem-solving skills of junior high school students are still relatively low (Kusnadi & Mardiani, 2022; Zahra et al., 2025), particularly in algebra material, which is abstract and symbolic in nature (Sugiarti, n.d.; Yustianingsih et al., 2017; Indarwati et al., 2014; Alfia et al., 2026). This is supported by the researcher's findings during the learning process in the classroom, where Grade VII students at one of the public junior high schools in Cianjur Regency still experienced difficulties in understanding and solving mathematical problems, especially in algebra. Students' difficulties in learning algebra are often caused by weak conceptual understanding, the use of symbols that are not meaningful to students, and learning that places more emphasis on procedures rather than conceptual understanding (Alfia et al., 2026). In line with this, Cahyani and Setyawati (2016) revealed that learning so far has provided limited opportunities for students to develop their problem-solving abilities. According to PISA, as cited in Pradhini (Yuhani et al., 2018), problem-solving ability in Indonesia remains very low, where out of 100 students, 73 are at Level 1, indicating that most students have not yet reached Level 1, which is the lowest level.

Mathematical problem-solving ability is not only influenced by conceptual mastery, but also by students' learning interests (Hanafi, 2024; Yuningsih et al., 2024). Students who have high learning interest demonstrate deeper engagement (W. R. Dewi et al., 2026; Sirait et al., 2025), persistence in facing difficulties, and willingness to try various alternative solutions, so that their problem-solving ability develops optimally. In addition to cognitive aspects, learning interest is an affective factor that also determines the success of mathematics learning (ES & Harta, 2014). However, the researcher found that students tended to be passive and less enthusiastic in participating in learning, which indicates low engagement and learning interest in mathematics (Fadli & Rilawati, 2025; Silfitriah & Mailili, 2020). Learning interest influences students' attention, engagement, and persistence in participating in the learning process (Ruhul Jihadah Gaffar, M. Juaini, 2023). Students' learning interest, as reflected in indicators such as feelings of enjoyment, having an interest in participating in every mathematics lesson, and demonstrating discipline in learning mathematics, shows that most students have an interest in learning mathematics (Asih & Imami, 2021; Hidayat & Widjajanti, 2018). Low learning interest can cause students to become passive and less motivated in solving mathematical problems.

An effective approach to addressing students' low learning interest is the implementation of Canva-assisted learning, which presents material in a visual, interactive manner to foster curiosity (Halimah et al., 2024; Hernawati et al., 2024), increase attention, and encourage active student engagement during the learning process. In line with the development of educational technology, the government, through the Ministry of Education, has provided easier access to digital learning facilities by offering belajar.id accounts for educators and students (Fitria et al., 2025; Ispiyani et al., 2023). Through these accounts, teachers and students can use various learning applications for free, including <https://www.canva.com>. The use of Canva in learning

allows the presentation of algebra material and contextual problems visually and interactively (Ulya et al., 2025); thus, it is expected to help students understand abstract concepts and increase their interest in learning mathematics.

The integration of interactive learning media into the Problem-Based Learning (PBL) model strengthens the problem-based learning process (Hazmi dan Helsa, 2025; F. N. Dewi et al., 2025) because students are not only presented with contextual problems but also receive visual support and engaging stimuli to enable more optimal development of critical and collaborative thinking processes. One learning model relevant to addressing these problems is Problem-Based Learning (PBL). According to Cahyani and Setyawati (2016) one of the learning approaches to improve problem-solving ability is problem-based learning. Sumartini, as cited in (Cahyani & Setyawati, 2016; Rahmananda et al., 2024) emphasized that problem-based learning is designed to help students develop thinking skills, problem-solving skills, and intellectual skills. The implementation of PBL is closely related to Lev Vygotsky's perspective on social interaction as a key factor in students' cognitive development, where problem challenges are resolved through collaborative discussion (Ardianti et al., 2021). The implementation of PBL, supported by Canva media, is expected to create more engaging, meaningful, and student-centered learning, particularly in Grade VII algebra.

Based on previous studies on mathematical problem-solving skills and learning interest, there has been no research that implements the Problem-Based Learning (PBL) model to improve these skills and learning interest by using Canva-based learning media. Therefore, this study differs from previous studies because it integrates Canva media with the PBL model. Based on the facts and problems described above, this study develops Canva-based learning media using the PBL model to improve students' mathematical problem-solving skills and interest in learning. The objectives of this study are: (1) to describe the design of the development of Canva-based learning media using the PBL model; (2) to test the validity and practicality of Canva-based learning media using the PBL model in improving students' mathematical problem-solving skills and learning interest; and (3) to investigate the effectiveness of the implementation of Canva-based learning media using the PBL model on students' mathematical problem-solving skills and learning interest.

METHOD

This study used the Research and Development (R&D) method with the 4D model (Sugiyono, 2024) which includes the Define, Design, Development, and Dissemination stages. The product developed was a Canva-assisted Problem-Based Learning (PBL) model designed to improve students' mathematical problem-solving skills and learning interest. The data collection techniques used included interviews, preliminary studies, and rating-scale questionnaires to validate the feasibility and practicality of the learning materials. The measurement instrument, in the form of a questionnaire, used the feasibility criteria formula according to Utami et al. (2023).

In the *Define* stage, the researcher conducted an initial analysis to identify problems and needs in Grade VII mathematics learning for the 2024/2025 academic year, with a particular focus on algebra. Next, in the *Design* stage, the researcher developed the initial product design. The product developed in this study was a Problem-Based Learning (PBL) model assisted by interactive Canva-based learning media. The product design that had been developed was then validated by material and media experts to assess the feasibility of the content, the display, and the suitability of the learning model in alignment with the research objectives. In the Development stage, a limited field trial was conducted to assess the implementation and initial feasibility of the Canva-assisted PBL model that had been developed. In the final stage, namely the Dissemination stage, the researcher disseminated the completed revised results to assess the

product's effectiveness in improving junior high school students' mathematical problem-solving skills and learning interest.

All data obtained were classified into two types, namely qualitative and quantitative. The data were obtained from validation results by material experts, media experts, and field trials. The steps or data analysis techniques used in this study involved calculating the average scores from the validation sheets of material experts, media experts, and large-scale trials in order to determine the levels of feasibility and validity, and the data were processed using Microsoft Excel 2021 (Adam et al., 2024) as follows:

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

Description:

P = Percentage
 Σx = Total score of responses per aspect
 Σx_i = Total ideal score

Next, the researcher determined the feasibility and practicality criteria based on the predetermined intervals (Accraf et al., 2018):

Table 1. Feasibility and Practicality Criteria of the Product

Percentage	Criteria	Description
81%–100%	Very Good	Very valid / no revision needed
61%–80%	Good	Valid / no revision needed
41%–60%	Fair	Less valid / revision needed
21%–40%	Poor	Not valid / revision needed
0%–20%	Very Poor	Very invalid / revision needed

The N-Gain calculation was conducted to determine the improvement in students' learning interest. According to Hake, as cited in (Agustini et al., 2024), the N-Gain was calculated using the following formula:

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Description:

g = N-Gain S_{pre} = posttest score
 S_{post} = pretest score S_{maks} = maximum possible score

The criteria are as follows:

Table 2. N-Gain Score Criteria

Criteria	Description
$g > 0.7$	High
$0.3 < g \leq 0.7$	Moderate
$g \leq 0.3$	Low

RESULTS AND DISCUSSION

Results

This study was conducted in one of the public junior high schools in Cianjur Regency with research subjects consisting of Grade VII junior high school students in the 2024/2025 academic year totaling 36 students, 6 students were assigned to the limited trial and 30 students were assigned to the large-scale trial, as well as Grade VII students in the 2025/2026 academic year totaling 60 students (30 students from the experimental class and 30 students from the control class). The development of the learning materials used the 4D method (Define, Design, Development, Disseminate).

Development Process of the Canva-assisted PBL Model

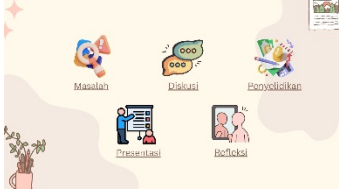
In the *Define* stage, a needs analysis was conducted through classroom observation and interviews with teachers and Grade VII students to identify learning problems. Observation was conducted to directly examine the learning process, teaching methods, and student engagement. The results of the analysis indicated that although teachers had followed government policies and the latest curriculum, the use of technology had not yet become a common practice due to limited time for developing learning materials and uneven technological understanding. This condition made it difficult for students to solve mathematical problems and construct mathematical models. These findings formed the basis for the researcher to design learning tools that are engaging, practical, and aligned with students' needs.

The *Design* stage focused on developing instructional materials and research instruments, including the mathematical problem-solving skills test and the learning interest questionnaire. Based on the results of the needs analysis in the previous stage, the researcher began developing a prototype of the learning tools that adhered to the syntax of the Problem-Based Learning (PBL) model. The activities in this stage included determining the learning objectives, developing algebra materials in accordance with the curriculum, and designing interactive Canva media and Student Worksheets (*Lembar Kerja Peserta Didik*; LKPD).

In addition to the instructional materials, the researcher prepared supporting instruments, such as expert validation sheets, student response questionnaires, and observation sheets, to facilitate learning implementation. In this stage, the selection of format and visual design was also carried out so that the developed materials were not only systematic and aligned with the instructional objectives, but also aesthetically appealing and easy to use for both teachers and students. The details of the initial design of the Canva media for each meeting are presented in Table 3 below:

Table 3. Initial Design of Canva Media

Meeting	Cover	Menu
1		
2		

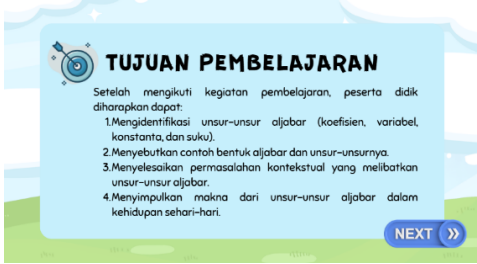
Meeting	Cover	Menu
3		
4		

The initial design in Table 3 above then became the product draft that would be tested for feasibility in the next stage. All forms of icon selection, menu layout, and the suitability of illustrations in the table above were still provisional and would be refined based on suggestions and feedback from experts in the Develop stage to ensure that the media is truly feasible in terms of both content and technical aspects.

Next, in the *Development* stage, the learning tools designed in the Design stage were developed into a final product ready for use through a validation and revision process. In this stage, the product was validated by experts, namely material experts and learning media experts, to obtain feedback, suggestions, and evaluations regarding the suitability of the material, the completeness of components, the clarity of presentation, and the appearance of the media.

The revisions from the media experts included relocating the “next” icon, which was initially placed at the bottom, to the top. This was carried out because the icon frequently experienced errors when clicked, likely due to its imprecise position, which became a technical obstacle when the media was used. The details of the improvements suggested by the experts on the developed media are as follows:

Table 4. Product Development Revisions

Before	After
a Relocated the position of the “next” icon	
	
b Added slides to select stages	

Before	After
No slides displaying stage selection options	

c Added a QR code to the teaching module

Kegiatan Inti	Kegiatan Inti
Face 1 Orientasi Siswa Pada Masalah 1. Guru mengarahkan siswa untuk menggesek bahan ajar melalui scan QR Code dibawah. 2. Guru menyajikan permasalahan yang berkaitan dengan unsur-unsur aljabar dalam Canva. Pemmasalahan Nadia dan Dinda belajar membuka usaha dengan membuka toko alat tulis. Harga 1 buku tulis = Rp 4.000,- Harga 1 pulpen = Rp 3.000,- Harga 1 penghapus = Rp 1.000,- Jika Nadia membeli x buku, y pulpen, dan z penghapus, bagaimana cara menuliskan total harga seluruh barang yang dibeli dalam bentuk aljabar? Pertanyaan pemantik: a. Pernahkah kamu menghitung harga beberapa barang sekaligus? b. Bagaimana jika jumlah barang tidak diketahui pasti (misalnya hanya diketahui x atau y)? c. Apakah kamu bisa menuliskan bentuk matematikanya? Tuliskan pendapat awalmu! 3. Peserta didik mencermati masalah yang diberikan oleh guru dan mengumpulkan informasi yang didapat dari hasil orientasi pada masalah. (<i>Communication, Critical Thinking-CT, Elementary Kritis-PPP, Mengenal</i>)	Face 1 Orientasi Siswa Pada Masalah 1. Guru mengarahkan siswa untuk menggesek bahan ajar melalui scan QR Code dibawah.  2. Guru menyajikan permasalahan yang berkaitan dengan unsur-unsur aljabar dalam Canva. Pemmasalahan Nadia dan Dinda belajar membuka usaha dengan membuka toko alat tulis. Harga 1 buku tulis = Rp 4.000,- Harga 1 pulpen = Rp 3.000,- Harga 1 penghapus = Rp 1.000,- Jika Nadia membeli x buku, y pulpen, dan z penghapus, bagaimana cara menuliskan total harga seluruh barang yang dibeli dalam bentuk aljabar? Pertanyaan pemantik: a. Pernahkah kamu menghitung harga beberapa barang sekaligus? b. Bagaimana jika jumlah barang tidak diketahui pasti (misalnya hanya diketahui x atau y)? c. Apakah kamu bisa menuliskan bentuk matematikanya? Tuliskan pendapat awalmu! 3. Peserta didik mencermati masalah yang diberikan oleh guru dan mengumpulkan informasi yang

d Added music to each stage

No music was included in each stage slide	Instrumental music was added to each stage slide
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After undergoing a series of revisions based on expert suggestions, the learning tools were tested in a limited trial involving 6 Grade VII students from different classes in the 2024/2025 academic year, followed by a large-scale trial in a single class of 30 students. This trial aimed to assess the product's practicality and students' responses to it, as well as its effectiveness in classroom learning activities. The results of the entire series of trials were then analyzed to ensure that the quality of the learning tools met the criteria of being very feasible before entering the dissemination stage.

In the final *Disseminate* stage, the revised product was disseminated in the experimental class. The disseminate stage is the final stage in the 4D development model, which aims to distribute the learning tools that have been developed and declared feasible for use. In this stage, the learning tools that had undergone expert validation, revision, and trials were introduced so they could be used more broadly.

In this study, the disseminated activities were implemented using the developed Canva-assisted Problem-Based Learning (PBL) model with Grade VII-B students. During the learning process, students interacted directly with digital media and instructional materials developed in accordance with the Problem-Based Learning syntax. Documentation of the implementation of the learning activities and students' enthusiasm in the experimental class is presented in the following figure:

Scanning the QR Code by Students



Group Discussion



The Teacher Explaining the Learning Process



Presentation of Group Work Results



Figure 1. Documentation of the Dissemination Stage

Feasibility of the Canva-assisted Problem-Based Learning (PBL) Model

After the initial problems were identified and the product draft was developed, the researcher conducted a validation test to determine the feasibility level of the developed Canva-assisted Problem-Based Learning model. This feasibility assessment included an in-depth review by experts of the material and media aspects to ensure that the learning tools met quality standards before being tested. The following presents the validation results from three material experts and media experts on the developed learning tools:

Table 5. Material Expert Validation

No	Aspect	Percentage	Description
1	Content	94.44%	Very feasible/very valid/no revision needed
2	Language	92.00%	Very feasible/very valid/no revision needed
3	Suitability of Materials	96.00%	Very feasible/very valid/no revision needed
4	Discovery Elements	95.00%	Very feasible/very valid/no revision needed

Based on the results in the table above, all aspects obtained the very feasible category, so the instructional materials can be declared very feasible and very valid with no revision needed. However, there were still some minor suggestions for improvement. In addition, the validation results of the developed Canva-assisted learning media are presented as follows. The following shows the validation results from the media experts:

Table 6. Media Expert Validation Results

No	Indicator	Percentage	Description
1	Display Feasibility Aspect	92.22%	Very feasible/very valid/no revision needed
2	Suitability with Learning Objectives	93.33%	Very feasible/very valid/no revision needed
3	Creativity and Innovation	91.11%	Very feasible/very valid/no revision needed
4	Design and Visual Aspect	94.44%	Very feasible/very valid/no revision needed

Based on the table, all four aspects were considered very feasible for use with minor revisions. After a series of revisions based on expert input, the development stage continued with the implementation of a limited trial. This limited trial was conducted in two stages: first, involving 3 students to measure the level of understanding and readability of the algebra material in the developed learning tools. Next, the second stage of the limited trial was conducted by involving the same 3 students from the first stage, along with 3 new students who had not previously participated in the test. The recapitulation of data from students' responses to the aspects of product development is presented in the following table:

Table 7. Student response questionnaire results

Yes	Aspects	Response of 3 students		Responses of 6 students	
		P	Description	P	Description
1	Display feasibility	86%	Very feasible/very valid/no revision needed	89%	Very feasible/very valid/no revision needed
2	Fit with Learning Objectives	85%	Very feasible/very valid/no revision needed	89%	Very feasible/very valid/no revision needed
3	Creativity and Innovation	82%	Feasible/valid/no revision needed	86%	Very feasible/very valid/no revision needed
4	Visual Design	88%	Very feasible/very valid/no revision needed	86%	Very feasible/very valid /no revision needed

After revisions were made to the four aspects of feasibility and readability, the criteria were classified as very feasible and valid. Subsequently, the researcher conducted a large-scale trial involving 30 students with limited experience using the Canva application to assess the product's readability, effectiveness, and feasibility in greater depth. The data collection technique involved administering a questionnaire to participants in learning using the Canva-assisted Problem-Based Learning (PBL) model. The implementation of this large-scale field trial included two main steps: (a) the implementation of the revised interactive Canva media to obtain direct responses from teachers and students; and (b) the evaluation of the instructional materials by students through a practicality-scale questionnaire as a basis for development evaluation. The data collection instrument used was a student response questionnaire. The results of this trial were used as the basis for final revisions to produce high-quality instructional

materials. The revision process was carried out by re-evaluating the design's feasibility based on findings from field implementation. The following presents the recapitulation of the large-scale trial results regarding the feasibility and readability of the product:

Table 8. Students' Response Scores toward the Product

No	Aspect	P	Description
1	Media Attractiveness	89%	Very feasible/very valid/no revision needed
2	Physical Appearance	88%	Very feasible/very valid/no revision needed
3	Color and Image Combination in the Media	87%	Very feasible/very valid/no revision needed
4	Suitability of the Media with the Environment	87%	Very feasible/very valid/no revision needed

After the entire series of large-scale trials had been completed and the product was declared to meet the validity standards of both material experts and media experts, the study proceeded to the *Dissemination* stage. In this stage, the learning tools were implemented in practice in Grade VII-B as the experimental class and Grade VII-C as the control class to assess the product's effectiveness in the field.

Effectiveness of the Canva-assisted Problem-Based Learning (PBL) Model on Mathematical Problem-Solving Skills

After the learning media were considered feasible and practical, the next stage was to test the product's effectiveness by analyzing students' mathematical problem-solving skills. The data were obtained through the administration of tests (pretest and posttest) in the experimental class that used the Canva-assisted PBL model and the control class that used conventional learning.

Analysis of Students' Mathematical Problem-Solving Skills

As an initial step, the researcher presented a recapitulation of average students' learning outcomes to provide an overview of improvement in ability before and after the treatment. The summary of the processed data from the pretest, posttest, and the average N-Gain scores is presented in the following table.:

Table 9. Comparison of Mean Scores of Pretest, Posttest, and N-Gain

Statistics	Experimental Class			Control Class		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
Mean	9.60	58.93	0.54	9.17	51.43	0.46
Number of Students	30			30		

Based on Table 9, the experimental class using the Canva-assisted Problem-Based Learning (PBL) model showed a greater improvement in mathematical problem-solving skills than the control class. This is evidenced by the mean posttest score for the experimental class, 58.93, which is higher than that of the control class, 51.43. Although both classes began the learning process with nearly equivalent initial abilities, namely 9.60 for the experimental class and 9.17 for the control class, the final results showed a clear difference in achievement following the treatment. This improvement was also supported by the mean N-Gain score in the experimental class, which was 0.54, while the control class reached only 0.46. Although both were

categorized as having a “moderate” level of improvement, the experimental class showed a greater margin of gain.

To determine whether the difference in mean scores was statistically significant and not due to chance, a hypothesis test was conducted. Before conducting the hypothesis test, the researcher first performed prerequisite analyses, including normality and homogeneity tests, on the pretest, posttest, and N-Gain data for both classes. The results of the normality test on students’ scores are presented as follows:

Table 10. Recapitulation of Normality Test of Mathematical Problem-Solving Skills Data

Class	Variable	<i>Shapiro-Wilk</i>		
		<i>Statistic</i>	<i>Df</i>	<i>Sig.</i>
Experimental	Pretest	.941	30	.100
Control		.950	30	.173
Experimental	Posttest	.972	30	.588
Control		.882	30	.003
Experimental	N-Gain	.983	30	.900
Control		.914	30	.019

The Shapiro–Wilk normality test in Table 10 indicates that all data in the experimental class are normally distributed, as their significance values (Sig.) are > 0.05 ; however, some variables are not normally distributed, particularly the posttest and N-Gain data for the control class. Therefore, the researcher decided to use the Mann–Whitney U test to test the hypothesis across all variables.

The Mann–Whitney U test was conducted on the pretest, posttest, and N-Gain to determine whether there was a significant difference in students’ mathematical problem-solving skills between the experimental class using the Canva-assisted Problem-Based Learning (PBL) model and the control class using conventional instruction. The summary of the calculation results is presented in Table 11 below:

Table 11. Mann–Whitney U Test Results for Pretest Scores of Mathematical Problem-Solving Skills

Mann-Whitney U	Asymp. Sig. (2-tailed)
422.000	.677

Based on the results of the Mann–Whitney test in the table above, the significance value (Asymp. Sig. 2-tailed) for the pretest data was 0.677. Since $0.677 > 0.05$, it can be concluded that there was no significant difference in the initial ability between the two classes.

Table 12. Mann–Whitney U Test Results for Posttest and N-Gain Scores of Mathematical Problem-Solving Skills

Variabel	Mann-Whitney U	Asymp. Sig. (1-tailed)
Posttest	216.000	.0005

N-Gain	235.000	.0005
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Based on the results of the Mann–Whitney test on the posttest and N-Gain data in the table above, the significance value (Asymp. Sig. 1-tailed) was the same: 0.0005. Since $0.0005 < 0.05$, H_0 was rejected, and H_1 was accepted. Thus, it can be concluded that students who used the Canva-assisted Problem-Based Learning (PBL) model showed better mathematical problem-solving skills than those of students who used a conventional learning method.

Effectiveness of the Canva-assisted Problem-Based Learning (PBL) Model on Students' Learning Interest

In addition to mathematical problem-solving skills, this study also measured the effectiveness of the Canva-assisted PBL model on students' learning interest. The learning interest data were obtained by administering a questionnaire to students in the experimental and control classes after the treatment was completed.

Analysis of Students' Learning Interests

Based on the results of data processing, the following is the comparison of the mean scores of students' learning interest between the two classes:

Table 13. Comparison of Students' Learning Interest Scores

Statistics	Experimental Class	Control Class
	Learning Interest Score	Learning Interest Score
Mean	67.67	58.17
Number of Students	30	30

To test the significance of the difference in learning interest, prerequisite tests were first conducted. The results of the normality test of learning interest are presented in Table 14 below:

Table 14. Recapitulation of Normality Test of Learning Interest Scores

Class	<i>Shapiro-Wilk</i>		
	<i>Statistic</i>	<i>Df</i>	<i>Sig.</i>
Experimental	.954	30	.212
Control	.926	30	.040

Based on Table 14, the results of the normality test show that the learning interest data in the experimental class are normally distributed ($\text{Sig. } 0.212 > 0.05$). However, the data in the control class are not normally distributed because the significance value ($\text{Sig. } 0.040 < 0.05$). Therefore, the subsequent hypothesis testing was conducted using the Mann–Whitney test. This test aims to determine whether there is a significant difference in learning interest between students who used the Canva-assisted Problem-Based Learning (PBL) model and students who followed conventional learning. The results of the analysis are presented in Table 15 below:

Table 15. Mann–Whitney U Test Results for Learning Interest Scores

Mann-Whitney U	Asymp. Sig. (1-tailed)
287.500	.008

Based on the Mann–Whitney test results in the table above, the significance value (Asymp. Sig. 1-tailed) obtained was 0.008. Since $0.008 < 0.05$, H_0 was rejected. Thus, it can be concluded that students' learning interest was higher when using the Canva-assisted Problem-Based Learning (PBL) model than when using conventional learning media.

Discussions

Development Process of the Canva-assisted Problem-Based Learning (PBL) Model

Define Stage

After all stages of the interviews, validation of the learning tools, and classroom observations were completed, several important findings were obtained. Based on the interview results, the mathematics teacher at the school had implemented the learning process effectively by consistently following the latest government policies and directives. In line with Baru and Suhandi (2022), this indicates that teachers make efforts to adapt to the development of educational regulations so that they are not left behind in curriculum implementation. However, in line with findings in the field (Anggriyani et al., 2024; Hr et al., 2024) the use of technology in mathematics learning has not yet fully become a routine practice. One of the challenges faced is the limited time teachers have to design technology-based instructional materials that are aligned with the characteristics of the content (Capah et al., 2025; Prinanda, 2025; Imansyah et al., 2024). In addition, not all teachers have adequate understanding and skills in using current educational technology. This condition is one of the reasons for developing Canva-assisted learning tools in this study.

To ensure that students have a high learning interest, it is necessary to design learning that can attract attention and actively engage students in each stage of the activities, which is in line with the studies of Waruwu and Sitinjak (2022) and Annisa et al. (2025). Students are guided to follow a challenging, contextual learning flow so that they are directly involved in understanding problems and finding solutions through activities aligned with the learning objectives. Based on these considerations, the researcher selected the Canva-assisted Problem-Based Learning (PBL) model to optimize student engagement in the learning process, which is consistent with the findings of Irawan et al. (2024), Widayanti et al. (2025), Theresya and Lisnasari (2026), and Meilani and Ritonga (2025). Through the presentation of contextual problems and the engaging visualization of the material, students develop a greater interest in learning mathematics.

Design Stage

Based on the results of the preliminary study in the Define stage, the researcher proceeded to the design stage, which included learning media, Student Worksheets (Lembar Kerja Peserta Didik; LKPD), and modules designed to meet students' needs. The learning media were designed in Canva to make the presentation of the material more engaging and communicative. Meanwhile, the Student Worksheets (LKPD) and learning modules were developed using Microsoft Word 2021, resulting in instructional materials that are systematic, visual, and easy to use in the learning process.

Development Stage

In this stage, the media and instructional materials developed through the trial process received feedback and improvements from teachers, supervisors, and students. The product produced

was declared feasible and effective after undergoing a series of evaluations and revisions. The validity test was conducted with the involvement of experienced teachers and learning media experts. From this process, various constructive suggestions were obtained to refine the product. Likewise, during implementation in the field, several technical obstacles were encountered in both the individual-trial stage and the large-scale group-trial stage. These obstacles were recorded and analyzed by the researcher as evaluation material; thus, they could be anticipated and minimized in the dissemination stage.

Dissemination Stage

The product trial was conducted with Grade VII-B and VII-C students, both of whom had not yet received algebra material. This stage was the final step to test the effectiveness and usefulness of the developed learning tools in algebra material, with thorough preparation and a predetermined implementation schedule. Although the initial abilities of both classes were relatively comparable, the learning processes applied had different characteristics. The experimental class (VII-B) was given treatment using the Canva-assisted Problem-Based Learning (PBL) model, while the control class (VII-C) followed conventional learning under the Merdeka Curriculum through lecture and discussion methods. The implementation results showed that both classes improved their mathematical problem-solving skills. However, the improvement in class VII-B as the experimental class was more significant than in class VII-C as the control class. This difference was not only influenced by the learning model used, but also by the use of interactive visual media in the experimental class. Meanwhile, in the control class, the learning process focused more on textbooks as the primary learning resource, without support from interactive visual media.

Feasibility of the Canva-assisted Problem-Based Learning (PBL) Model

Based on the results of the analysis conducted through the stages of the 4D development model (Define, Design, Development, and Disseminate), the product produced in the form of a Canva-assisted Problem-Based Learning (PBL) model was declared feasible and valid for use in improving students' mathematical problem-solving skills and learning interest. The learning tools that were developed underwent validation by material and media experts, with discussions and revisions carried out gradually until an optimal form was achieved. This series of processes ensured that the resulting product not only met the theoretical feasibility criteria but was also aligned with teachers' needs and students' characteristics in the field. This product contains elements of procedural, conceptual, and factual knowledge that are presented through contextual problem scenarios. Thus, the learning process places greater emphasis on students' active engagement with concepts through real-life situations, thereby improving both the learning process and learning outcomes.

User Responses to Canva-assisted Learning Media in the Learning Process

In addition to the learning model used, the success of the learning process is also influenced by the availability of media that can support students' needs, in line with the opinions of Kurniawan and Zabeta (2025) and Adha et al. (2025). The Canva-assisted learning media developed in this study received very positive responses from both students and teachers, which is consistent with the results of Mubarok and Wijayanti (2025) and Wangi and Bukhori (2023). Although the development process went through several stages of revision and refinement, the final result produced a product that is engaging, communicative, and aligned with classroom learning needs. Canva media not only helped teachers deliver the material but also increased students' interest and engagement during the learning process, in line with the findings of

Susanti and Susanti (2025) and Purba and Nora (2025). In this study, the visual elements designed through Canva enabled students to visualize and illustrate problems more effectively.

In addition to the support of learning media, well-planned, systematic instruction also plays an important role in creating an effective learning process in the classroom. Clear guidance, broad opportunities for exploration, and a conducive social environment support successful learning. These conditions help students feel more comfortable and confident in participating in learning activities. Students' comfort and engagement in the learning process influence the increase in learning interest. In line with Anggraini et al. (2022) and Pujiastuti et al. (n.d.), this increase in learning interest is subsequently associated with students' mathematical problem-solving skills. The results of the study indicate a significant relationship between students' learning interest, as also found in Aziz et al. (2020); thus, the better their learning interest, the better their ability to solve mathematical problems.

Effectiveness of the Canva-assisted Problem-Based Learning (PBL) Model on Mathematical Problem-Solving Skills and Learning Interest

In addition, several factors contribute to improving students' mathematical problem-solving skills and interest in learning. These factors include the implementation of effective instruction through the application of models or methods that are aligned with students' needs, the use of interactive and engaging learning media, and teachers' adequate competence in managing the classroom and facilitating the learning process (Ismaya et al., 2024; Marliani et al., 2025). The combination of these factors enables students who receive innovative learning treatment to demonstrate better outcomes compared to those who follow conventional learning (Bitu et al., 2024; Hasnawiyah dan Maslena, 2024). In line with Abdullah and Budiman (2025) and Aditama (2025), learning that is systematically designed and supported by relevant media can encourage students' active engagement, thereby positively influencing the quality of both the learning process and learning outcomes.

The differences in instructional treatment between the two classes had a significant influence on the outcomes. Students who received instruction through the Canva-assisted Problem-Based Learning (PBL) model demonstrated better mathematical problem-solving skills and learning interest compared to students who followed conventional learning (Ayu et al., 2024; Cahyaningrum, 2026). On the other hand, during the implementation of the study, several challenges were encountered, including unequal distribution of learning facilities among students and variations in student attendance levels, which affected the optimization of learning outcomes. To address these limitations, the researcher implemented a device-sharing strategy within groups, allowing students to continue actively participating in the learning process. This strategy not only helped overcome technical constraints but also fostered collaborative attitudes and cooperation among students during the learning process.

CONCLUSION

After a series of development stages, using the 4D model and statistical data analysis, this study produced the following main conclusions:

1. The developed Canva-assisted Problem-Based Learning (PBL) model was declared very valid and very feasible based on the evaluation of material experts and media experts. In addition, students' responses to the use of this media were also in the very valid and very feasible category for use in mathematics learning.
2. The mathematical problem-solving skills of students who learned using the Canva-assisted PBL model showed better results than those of students who used conventional learning.
3. The learning interest of students who received instruction using the Canva-assisted PBL model showed better results compared to students who followed conventional learning.

Considering that this study was limited to algebra material, future researchers are recommended to develop similar media for other mathematics topics or to test its effectiveness on different mathematical ability variables, such as critical thinking skills or mathematical communication skills.

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