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DEVELOPMENT OF CANVA-ASSISTED REALISTIC MATHEMATICS EDUCATION WORKSHEET TO IMPROVE STUDENT'S PROBLEM SOLVING ABILITY AND LEARNING INDEPENDENCE ON JUNIOR HIGH SCHOOL

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ABSTRACT

This study aimed to develop a Canva-assisted Student Worksheet based on the Realistic Mathematics Education approach on the topic of Two-Variable Linear Equation Systems (SPLDV) for Grade VIII students of SMPN 1 Cisarua, West Bandung Regency. This study employed a Research and Development (R&D) approach using the Borg and Gall development model. The research instruments consisted of expert validation sheets, student response questionnaires, readability sheets, and learning achievement tests. Data were analyzed using descriptive quantitative techniques to determine the validity, practicality, and effectiveness of the developed product. The validation results showed that the developed LKPD obtained a validity score of 83.75%, indicating that the product was valid and suitable for use in mathematics learning. The practicality test showed a score of 89.30%, categorized as very practical, indicating that students responded positively to the developed LKPD. Therefore, the Canva-assisted LKPD based on the RME approach is feasible to support mathematics learning on the topic of Two-Variable Linear Equation Systems.

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INTRODUCTION

Mathematics is a fundamental discipline that plays a vital role in developing students' logical, analytical, critical, and creative thinking skills. More importantly, mathematics learning is expected to equip students with mathematical problem-solving skills, which are recognized as one of the essential competencies required to face increasingly complex challenges in the 21st century. In line with the implementation of the Kurikulum Merdeka (Independent Curriculum), mathematics instruction is directed not only toward mastering concepts and procedures, but also toward facilitating students in constructing knowledge through meaningful learning

experiences and contextual problem-solving activities (Kementerian Pendidikan Riset, dan Teknologi, 2022) Therefore, mathematics learning should create opportunities for students to actively investigate, analyze, and solve real-world problems while simultaneously developing conceptual understanding and higher-order thinking skills.

Mathematical problem-solving ability is considered a primary indicator of successful mathematics learning because it reflects students' capacity to understand problems, formulate mathematical models, select appropriate solution strategies, implement mathematical procedures, and evaluate the validity of the obtained solutions. Students with adequate problem-solving abilities are generally better able to apply mathematical concepts across various contexts rather than merely memorizing formulas and computational procedures. However, cognitive competence alone is insufficient to achieve meaningful learning outcomes. Students are also expected to demonstrate self-regulated learning, which enables them to manage their own learning, identify learning needs, utilize appropriate learning resources, and take responsibility for achieving learning goals. Therefore, mathematical problem-solving ability and self-regulated learning must be developed simultaneously, as they represent complementary hard and soft skills supporting students' academic achievement and lifelong learning.

Despite its importance, enhancing students' mathematical problem-solving ability remains a major challenge in mathematics education in Indonesia. Various studies report that many students still experience difficulties in interpreting contextual problems, translating real-world situations into mathematical representations, selecting effective solution strategies, and verifying the accuracy of their answers. These conditions indicate that mathematics instruction has not yet optimally facilitated students in independently constructing mathematical concepts through meaningful learning experiences. As a result, students often rely on memorizing procedural steps without fully understanding the underlying concepts, leading to relatively low levels of mathematical problem-solving ability and self-regulated learning.

One mathematical topic that frequently presents learning difficulties for Junior High School (SMP) students is the System of Linear Equations in Two Variables (SPLDV). Although this topic is closely related to real-life situations, many students struggle to formulate mathematical models from contextual problems, interpret mathematical relationships, and determine appropriate solution methods. Initial observations conducted at SMPN 1 Cisarua, West Bandung Regency, further revealed that mathematics instruction is still dominated by a teacher-centered approach. Learning activities mainly rely on textbooks and conventional worksheets that emphasize procedural practice over conceptual understanding. Consequently, students have limited opportunities to explore mathematical ideas independently, discuss alternative solution strategies, and develop reasoning through contextual learning activities.

To address these challenges, innovative learning materials are required to facilitate meaningful, contextual, and student-centered learning. One such learning material that can be developed is the Student Worksheet (Lembar Kerja Peserta Didik / LKPD). LKPD serves as a learning medium providing systematic learning activities that enable students to construct mathematical understanding through exploration, discussion, and problem-solving activities (Siregar & Nara, 2018). Therefore, the development of LKPD must consider students' learning needs and characteristics to create meaningful mathematics learning experiences.

One learning approach that has received widespread attention is Realistic Mathematics Education (RME), which emphasizes using meaningful real-life situations as the starting point for mathematics learning. Through contextual problems, students gradually construct mathematical concepts through processes of mathematization, discussion, reflection, and

communication, thereby fostering deeper conceptual understanding and enhancing mathematical problem-solving abilities (Gravemeijer & van Galen, 2017)

The implementation of RME is highly relevant to the System of Linear Equations in Two Variables (SPLDV), as this topic requires students to comprehend problems, construct mathematical models, and determine appropriate solution strategies. Students' difficulties in solving SPLDV problems are often related to their inability to connect contextual situations with mathematical concepts (Sutarto & Marpaung, 2018) Therefore, integrating RME principles into LKPD is expected to help students understand SPLDV concepts through problems close to their daily lives.

Along with implementing appropriate learning approaches, the integration of digital technology has become an essential component of innovative mathematics instruction. Digital learning media allow teachers to design learning environments that are more interactive, flexible, and responsive to students' learning characteristics. One digital platform widely adopted in educational practice is Canva, which provides various features for developing visually appealing instructional materials without requiring advanced graphic design skills. Through the integration of images, diagrams, icons, animations, and interactive layouts, Canva enables teachers to transform conventional learning materials into more engaging resources that can boost student motivation and participation during the learning process (Hikmawati & Suryana, 2021).

Among various learning resources, Student Worksheets (LKPD) play a crucial role in guiding students to construct mathematical concepts through structured learning activities. Well-designed LKPDs do not merely present instructional content and exercises, but also facilitate students to investigate problems, formulate mathematical models, communicate their reasoning, evaluate alternative solutions, and reflect on the learning process. Therefore, integrating LKPD with Realistic Mathematics Education principles provides students with opportunities to experience meaningful mathematics learning by connecting abstract concepts to authentic situations encountered in daily life. Such learning activities are expected to strengthen both mathematical problem-solving skills and student self-regulated learning.

The advancement of digital technology in education offers opportunities for teachers to create innovative and engaging LKPDs. The utilization of digital-based media supports making LKPD presentations more interactive and easily understood by students. Canva is a digital design application that can be utilized to develop teaching materials because it provides various visual features supporting the delivery of instructional content. (Hikmawati & Suryana, 2021) revealed that Canva-based learning media can increase student learning motivation through more attractive and communicative learning presentations.

Several previous studies have demonstrated the effectiveness of Realistic Mathematics Education in improving students' conceptual understanding and mathematical problem-solving skills.(Putri & Zulkardi, 2019) reported that RME implementation contributed positively to mathematics education in Indonesia by emphasizing contextual learning experiences and active student participation in constructing mathematical knowledge. Similarly, (Sari & Wijaya, 2020) found that RME-based student worksheets significantly enhanced students' mathematical problem-solving skills through contextual activities that encouraged mathematical exploration and reasoning. Furthermore, the use of digital learning media has shown a positive impact on student engagement and learning outcomes. (Hikmawati & Suryana, 2021) reported that Canva-assisted learning media boosted student learning motivation, while (Yuliana & Sari, 2021) as well as (Zulfah & Armiati, 2020) concluded that digital worksheets provide a more interactive learning experience and foster active student participation during classroom instruction.

Previous studies have shown that developing RME-based LKPD can support the enhancement of students' mathematical problem-solving skills (Sari & Wijaya, 2020). However, the development of Canva-assisted LKPD integrated with RME specifically for SPLDV content at the junior high school level still requires further investigation to produce valid, practical learning materials aligned with student needs. In line with the views of Hendriana, Rohaeti, and Sumarmo (Hendriana et al., 2017), students' mathematical abilities encompass the integration of hard skills and soft skills. These abilities are not only related to the mastery of mathematical concepts and procedures but also include affective aspects, such as positive attitudes toward mathematics, learning independence, and the ability to manage the learning process. Therefore, this study aims to develop Canva-assisted LKPD based on Realistic Mathematics Education (RME) for SPLDV topic among Grade VIII junior high school students using the Borg and Gall model.

Despite these promising findings, several research gaps remain. First, previous studies generally examined Realistic Mathematics Education, Canva, and digital worksheets separately, rather than integrating them into a single comprehensive learning product. Second, research investigating Canva predominantly focuses on its effectiveness as a presentation tool, whereas its potential for developing mathematics worksheets that systematically facilitate contextual problem-solving activities has received limited attention. Third, many existing studies emphasize the effectiveness of learning media without adopting a systematic educational product development model that ensures product quality through stages of expert validation, limited testing, revision, and field implementation. Consequently, empirical evidence regarding the development of Canva-assisted LKPD based on Realistic Mathematics Education using Borg and Gall's Research and Development (R&D) model remains limited, particularly for the System of Linear Equations in Two Variables (SPLDV) topic at the junior high school level.

Based on these considerations, the novelty of this study lies in the development of Canva-assisted Student Worksheets that integrate the pedagogical principles of Realistic Mathematics Education through the systematic phases of Borg and Gall's Research and Development model. Unlike previous studies that primarily focused on evaluating learning outcomes or media appeal, the developed LKPD emphasizes the integration of contextual mathematical activities, visual design, structured learning tasks, and guided problem-solving processes within a single learning product. Therefore, the developed LKPD is expected not only to meet the criteria of validity and practicality, but also to provide meaningful learning experiences that support the improvement of students' mathematical problem-solving abilities and self-regulated learning.

For this reason, this study aims to develop Canva-assisted Student Worksheets based on Realistic Mathematics Education for the System of Linear Equations in Two Variables (SPLDV) topic using Borg and Gall's Research and Development model. Specifically, this research seeks to determine the validity and practicality of the developed LKPD as an innovative learning resource for Grade VIII junior high school students. The findings of this study are expected to contribute to the development of innovative mathematics learning resources while providing empirical evidence regarding the integration of digital technology and contextual mathematics learning to support students' mathematical competencies.

METHOD

This study utilizes a Research and Development (R&D) method using the Borg and Gall development model. The R&D method was selected because the main objective of this study is not merely to test a theory or determine relationships between variables, but to produce a learning product in the form of a Realistic Mathematics Education (RME)-based Student Worksheet (LKPD) assisted by Canva. This product aims to achieve high levels of validity,

practicality, and effectiveness in enhancing middle school students' problem-solving abilities and learning independence. The Borg and Gall model is considered appropriate because it offers systematic stages starting from needs analysis, product development, validation, testing, and revision, up to producing the final product.

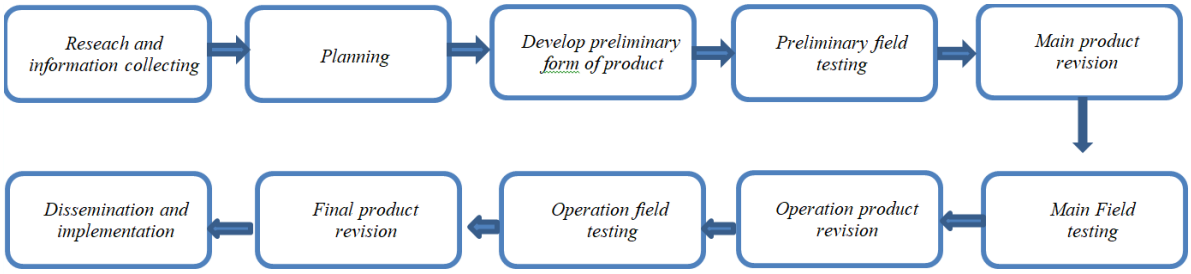

Figure 1. Adapted Borg and Gall Development Stages

The research began by gathering information through a literature review, observations, and interviews with mathematics teachers to map out needs, student characteristics, and learning obstacles. The results served as the foundation for designing the LKPD based on the Realistic Mathematics Education (RME) approach. The subsequent stage was planning, which encompassed defining competencies, formulating RME-based materials and activities, and designing the visual layout of the LKPD using Canva to make it more appealing and interactive.

Next, the initial product development (developing the preliminary form of product) was carried out to create an LKPD prototype based on RME steps—including real-world context, mathematization, knowledge construction, interaction, and concept interconnections. This prototype was then validated by subject-matter and media experts to evaluate content appropriateness, language, presentation, and layout design. The validation results provided the basis for revisions to produce a viable product ready for testing.

Following the validation phase, preliminary field testing was conducted with 9 ninth-grade middle school students. This testing aimed to evaluate readability, ease of use, and gather initial student feedback regarding the developed LKPD. The input obtained at this stage was used to perform main product revisions, addressing any identified shortcomings prior to conducting broader field testing.

The revised product was subsequently tested in main field testing involving 30 ninth-grade middle school students to measure the practicality of the LKPD based on student and teacher responses, as well as to observe the implementation of Canva-assisted RME learning. The results of this test served as a reference for operational product revisions to refine and optimize the product.

Furthermore, operational field testing was conducted with 60 ninth-grade middle school students, divided into an experimental class (using the Canva-assisted RME LKPD) and a control class (using conventional teaching materials) to measure the product's effectiveness on problem-solving ability and learning independence. The test results guided the final product revision to produce a valid, practical, and effective LKPD. The process concluded with dissemination and implementation to teachers and schools for broader use.

The research subjects comprised several groups corresponding to the development stages. In the preliminary testing phase, the subjects consisted of 10 ninth-grade students selected to obtain initial information regarding readability and user-friendliness. Next, in the main field testing stage, the study involved 30 ninth-grade students to determine the product's level of practicality. Finally, in the operational field testing stage, the study involved 60 Grade VIII

students divided into an experimental class and a control class to test the effectiveness of the LKPD on students' problem-solving skills and learning independence.

This study employed several instruments, including interview guides, validation questionnaires (for content and media), response questionnaires (for teachers and students), a problem-solving ability test (pre-test and post-test), and a learning independence questionnaire. The interview guide was utilized during the needs analysis stage. The content validation questionnaire evaluated content, concepts, presentation, and alignment with RME principles, while the media validation questionnaire assessed Canva's layout design, readability, and visual quality. Response questionnaires measured product practicality. Meanwhile, the effectiveness of the LKPD was measured through essay-based problem-solving tests and student learning independence questionnaires.

The research subjects consisted of several groups corresponding to the development stages. In the limited trial phase, the subjects were 9 ninth-grade junior high school students selected to obtain preliminary information regarding the legibility and usability of the student worksheets (LKPD). Subsequently, in the main field trial phase, the study involved 30 seventh-grade junior high school students to determine the product's practicality level. Meanwhile, in the operational field trial phase, the study involved 65 students from two ninth-grade classes, divided into an experimental class and a control class, to test the effectiveness of using the LKPD on students' problem-solving skills and learning independence.

This study utilized instruments consisting of an interview guide, validation questionnaires (for material and media), response questionnaires (for teachers and students), a problem-solving ability test (pre-test and post-test), and a learning independence questionnaire. The interview guide was used during the needs analysis stage. The material validation questionnaire evaluated the content, concepts, presentation, and alignment with RME (Realistic Mathematics Education) principles, while the media validation assessed Canva's design, readability, and visual quality. The response questionnaires measured the product's practicality. Meanwhile, the effectiveness of the LKPD (Student Worksheet) was measured through an essay problem-solving test and the student learning independence questionnaire.

RESULTS AND DISCUSSIONS

Results

The development process of RME-based digital student worksheets assisted by Canva

The preliminary research and information gathering stage was conducted to identify the actual conditions of mathematics learning, students' characteristics, and the need for developing learning materials on the topic of Two-Variable Linear Equation Systems (SPLDV). This stage is an essential component of the Borg and Gall development model because it provides the empirical basis for designing a product that addresses the needs of teachers and students.

The preliminary study was carried out through classroom observations, interviews with the mathematics teacher, and analysis of the curriculum and learning resources used in Grade VIII at SMPN 1 Cisarua, West Bandung Regency. The observation results indicated that mathematics learning was generally implemented using textbooks and conventional worksheets. Although these learning resources had been aligned with the curriculum, they had not optimally facilitated students in constructing mathematical concepts through contextual learning activities. Consequently, students tended to focus on procedural problem solving rather than conceptual understanding.

The interview with the mathematics teacher revealed that students still encountered difficulties in solving contextual problems related to SPLDV. Most students were able to solve routine

computational problems; however, they experienced difficulties when interpreting word problems, formulating mathematical models, and determining appropriate solution strategies. These findings indicate that students require learning resources capable of guiding them to understand mathematical concepts through meaningful learning experiences.

Furthermore, the analysis of the existing learning materials showed that the available worksheets were dominated by routine exercises with limited opportunities for exploration, discussion, and reflection. In addition, the visual appearance of the worksheets was relatively simple, resulting in low student engagement during the learning process. Therefore, more innovative learning materials are needed to improve students' participation and facilitate active learning.

Based on the findings of the preliminary study, a Canva-assisted Student Worksheet (LKPD) based on the Realistic Mathematics Education (RME) approach was developed. The product was designed to integrate contextual problems, collaborative learning activities, guided mathematical exploration, and attractive visual elements to support students in constructing mathematical concepts independently. The results of the needs analysis became the primary foundation for the subsequent stages of product planning and development. The summary of the preliminary study is presented in Table 1.

Table 1. Summary of Preliminary Study Results

Aspect	Summary of Analysis Results	Implications for LKPD Development
Needs Analysis	Learning remains teacher-centered, Student Worksheets (LKPD) lack contextual relevance and visual appeal, and students' problem-solving ability and learning independence remain low.	Develop Canva-assisted LKPD based on RME that is engaging, contextual, and encourages independent learning.
Curriculum Analysis	The *curiculum Merdeka* emphasizes student-centered, contextual, higher-order thinking skills (HOTS), problem-solving, and learning independence.The	The E-LKPD is structured in accordance with the Learning Outcomes (CP), Learning Objectives (TP), and Learning Progression (ATP) for the SPLDV topic using RME steps.
Student Analysis	Junior high school students favor visual media and contextual learning, possess diverse initial abilities, and still require guidance in problem-solving and independent learning..	The E-LKPD is designed with an attractive layout, simple language, and contextual activities to enhance problem-solving skills and learning independence.

Based on the results of the needs analysis, the researcher designed the product development plan. At this stage, the development objectives were established, including the target competencies aligned with *Kurikulum Merdeka* (the Independent Curriculum), the selected mathematics content, indicators of problem-solving abilities and learning independence, as well as the layout design of the Student Worksheets (LKPD). The researcher also developed research instruments comprising expert validation sheets, teacher and student response questionnaires, learning independence questionnaires, and a problem-solving ability test. Furthermore, a learning flow was designed based on Realistic Mathematics Education (RME) syntax, which encompasses the presentation of contextual problems, mathematization, discussion, reflection, and drawing conclusions.

The development of the Canva-assisted Student Worksheet (LKPD) was carried out based on the results of the preliminary study, which indicated the need for innovative learning materials capable of facilitating students in understanding the topic of Two-Variable Linear Equation Systems (SPLDV). The product was developed using the Borg and Gall development model and designed by integrating the principles of Realistic Mathematics Education (RME) into learning activities supported by digital visual media created using Canva.

The developed LKPD consists of four learning meetings covering the SPLDV topic. Each meeting contains a cover page, learning objectives, learning outcomes, instructions for use, contextual problems, group discussion activities, guided investigations, presentation activities, reflection, and evaluation exercises. The contextual problems presented in each worksheet encourage students to identify known information, formulate mathematical models, solve the problems systematically, and communicate the obtained solutions.

The learning activities were organized through collaborative group discussions and guided investigations to encourage students' active participation during the learning process. Attractive layouts, illustrations, icons, and colour combinations were incorporated into the worksheet to improve readability and learning motivation. Consequently, the developed LKPD was expected to provide meaningful learning experiences while supporting students in understanding mathematical concepts and solving contextual mathematical problems.

The developed LKPD prototype was first validated by subject matter experts, media experts, and language experts. Once deemed eligible, the LKPD was field-tested in a small group of 9 junior high school students. The objective of this preliminary trial was to assess readability, ease of use, clarity of instructions, media layout, and the suitability of learning activities. Both teachers and students were also asked to provide feedback on the product quality.

Following the expert validation process, several revisions were made to improve the quality of the developed LKPD based on the recommendations provided by the validators. The revisions primarily focused on improving the clarity of instructions, refining the presentation of learning materials, correcting several language inaccuracies, and enhancing the visual appearance of the worksheet. These revisions were intended to ensure that the developed product met the expected standards in terms of content accuracy, readability, and instructional design.

The revision process also emphasized the consistency between the contextual learning activities and the principles of the Realistic Mathematics Education (RME) approach. In addition, several visual components created using Canva were refined to improve readability and facilitate students in following each stage of the learning activities. After all suggested revisions had been implemented, the developed LKPD was considered suitable for classroom implementation and proceeded to the field testing stage.

The field testing was conducted to evaluate the effectiveness of the developed Canva-assisted Student Worksheet (LKPD) based on the Realistic Mathematics Education (RME) approach in improving students' learning outcomes on the topic of Two-Variable Linear Equation Systems (SPLDV). The effectiveness of the developed product was analyzed through descriptive statistics, prerequisite tests, hypothesis testing, and N-Gain analysis. These analyses were performed to determine whether there was a significant difference in students' learning improvement between the experimental and control groups after the implementation of the developed LKPD.

The feasibility of RME-based digital student worksheets assisted by Canva

Media validation was conducted to assess the feasibility level of the Canva-assisted RME-based E-LKPD learning media prior to its implementation in the learning process. This validation aimed to determine the feasibility of the media in terms of design appearance and the feasibility

of the material in terms of instructional content. The validation was carried out by subject matter experts and media experts using a pre-developed instrument. The validation results from each expert are presented in the table 4.

Table 2. Material Expert Validation Results of the Developed LKPD

Indikator	Score	Maximum skor	Percentage	Category
Facilitating Concept Discovery	24	30	80	Verry Valid
Language	24	30	80	Verry Valid
Content Feasibility	25	30	83.3	Verry Valid
Suitability of the RME Approach	25	30	83.3	Verry Valid
Appropriateness of Canva as Learning Media	18	20	90	Sangat Valid
Average Percentage			83,75	Verry Valid

Based on Table 2, the developed LKPD achieved an overall validity percentage of 83.75%, which is categorized as Very Valid. These findings indicate that the developed LKPD has fulfilled the required criteria as a mathematics learning resource and is suitable for classroom implementation after minor revisions. The assessment results show that the aspects of the implementation of the RME approach and the utilization of Canva as learning media obtained the highest percentage (90.00%). This indicates that contextual learning activities and visual presentation successfully support students in understanding mathematical concepts through meaningful learning experiences. Meanwhile, aspects related to concept presentation, language, and content feasibility achieved percentages ranging from 80.00% to 83.30%, demonstrating that the developed LKPD meets the expected quality standards while still requiring several minor improvements.

Overall, the expert validation results demonstrate that the developed LKPD possesses good content quality, an appropriate learning design, and an attractive visual appearance. Therefore, the product is considered feasible to proceed to the revision stage before being implemented in classroom learning. After the RME-based E-LKPD supported by Canva was declared valid by the material experts, it was subsequently validated by media experts. The media expert validation results are presented in Table 3.

Table 3. Media Expert Validation Results of the Developed LKPD

Indicator	Score	Maximum skor	Percentage	Category
Display	18	20	90	Sangat Valid
Typography	12	15	80	Sangat Valid
Canva Media	16	20	80	Sangat Valid
Usability	9	10	90	Valid
Presentation Quality	23	25	92	Sangat Valid
Average Percentage			85,4	Sangat Valid

Based on Table 3, the media validation results show an average percentage of 85.4%, which falls into the Very Valid category. The indicator with the highest score is the Presentation Quality aspect at 92%, while the lowest scores are found in the Typography and Canva Media aspects at 80%. Thus, the learning media is declared very valid and suitable for supporting mathematics learning..

The next phase involves a practicality evaluation to assess the ease of use and implementation of the media in learning. This evaluation relies on practicality questionnaires administered during preliminary and expanded trials. The findings are summarized in the table 6

Table 4. Results of Limited Trial Practicality Test

Indicator	Score	Maximum skor	Percentage	Category
Usefulness	135	180	75,00	Practical
Attractiveness	150	180	83,33	Verry Practical
Novelty	140	180	77,78	Practical
Helpfulness	160	180	88,89	Verry Practical
Average Percentage			81,25	Verry Practical

Based on Table 4, the practicality test results in the limited trial show that all indicators achieved the 'very practical' category, with an average percentage of 81.25%. The indicator with the highest score was in the Helpfulness aspect at 88.89%, while the lowest score was in the Usefulness aspect at 75%. This indicates that the RME-based E-LKPD supported by Canva is easy for students to use, engaging, and effective in supporting the learning process during the limited trial. Following the practicality test in the limited trial, a practicality test was conducted in the field trial. The results of the practicality test in the field trial are presented in Table 7.

Table 5. Results of the Practicality Test in the Large-Scale Trial

Indicator	Score	Maximum skor	Percentage	Category
Usefulness	553	600	92,17	Verry Practical
Attractiveness	560	600	93,33	Verry Practical
Novelty	542	600	90,33	Practical
Helpfulness	541	600	90,17	Verry Practical
Average Percentage			91,50	Verry Practical

Based on Table 5, the practicality results from the large-scale trial reveal that all indicators reached the very practical" category, averaging 91.50%. The Attractiveness aspect recorded the highest percentage at 93.33%, whereas the Helpfulness aspect yielded the lowest at 90.17%. These findings indicate that the learning media retains high practicality despite being tested on a larger respondent pool. Thus, the learning media is categorized as valid and practical for classroom instruction.

The Effectiveness of Canva-Assisted RME-Based E-Worksheets in Improving Mathematical Problem-Solving Ability

An effectiveness test was conducted to determine the extent to which the developed Canva-assisted RME-based LKPD could improve students' mathematical problem-solving abilities

and learning interest. This test involved two classes: an Experimental Class using the developed LKPD and a Control Class using conventional learning.

The effectiveness in this aspect is measured by comparing the pre-test and post-test results between the two classes, as presented in Table 6.

Tabel 6. Recapitulation of Students' Mathematical Problem-Solving Ability Test Results

Statistic	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Average	59,40	70,51	56,73	64
Standard Deviation	8,09	3,58	4,66	5,25
Number of Students	35	35	30	30

Based on the data in Table 6, it is evident that both classes began the learning process with comparable initial abilities, as indicated by the pretest average of 59.40 for the experimental class and 56.73 for the control class. However, following the treatment, a significant difference in improvement was observed between the two groups. The experimental class, which utilized Canva-assisted RME-based worksheets, achieved a posttest average of 70.51, whereas the control class reached 64.00

Hypothesis Testing

Prior to hypothesis testing, an analysis prerequisite test in the form of a normality test was conducted. This test aims to determine whether the distribution of the research data is normally distributed, which subsequently dictates the type of statistics (parametric or non-parametric) to be utilized for hypothesis testing. The results of the normality test using the Shapiro-Wilk technique (given that the sample size is less than 50) are presented in Table 7

Table 7. Normality Test Results

Class	**Variabel**	***Shapiro-Wilk***		
		Statistic	***Df***	***Sig.***
Eksperimen	Pretest	0.988	35	0.963
Kontrol		0.935	30	0.069
Eksperimen	Posttest	0.968	35	0.380
Kontrol		0.957	30	0.252

Based on Table 7, it can be seen that all classes, both pretest and posttest in the experimental and control groups, have a Sig. value > 0.05. Thus, it can be concluded that the samples for all classes are normally distributed. Subsequently, a homogeneity test was conducted using Levene's test, the results of which are presented in Table 8.

Tabel 8. Homogeneity Test Results

Variabel	Lavene	Sig,	Keteangan
Pretest	7, 024	0,010	Inhomogeneous
Postest	8,517	0,005	Inhomogeneous

Based on Table 10, the Levene's statistic for the pretest is 7.024 with a Sig. value of 0.010, while the Levene's statistic for the posttest is 8.517 with a Sig. value of 0.005. Because the Sig.

values for both variables are less than 0.05, the variances of the two datasets are not homogeneous. Subsequently, Welch's t-test (t' test) was used to test the hypothesis, the data processing results of which are presented in Table 9.

Tabel 9. Hypothesis Test Results

Variabel	t	df	Sig. (2-tailed)	Sig. (1-tailed)
Pretest	0.579	55.602	0.565	0,282
Posttest	5.747	49.902	0.000	0.000

Based on Table 9, the pretest obtained a Sig. value of 0.565. Since the Sig. value is greater than 0.05, it can be concluded that there is no significant difference in students' problem-solving abilities between those taught using Canva-assisted RME-based E-LKPD and those in conventional learning. Meanwhile, for the posttest, the Sig. (2-tailed) value obtained is 0.000, and the Sig. (1-tailed) value is 0.000. Since the Sig. (1-tailed) value is less than 0.05, it can be concluded that the problem-solving ability of students taught using Canva-assisted RME-based E-LKPD is significantly better than those in conventional learning. Thus, the implementation of Canva-assisted RME-based E-LKPD is effective in improving students' problem-solving abilities

In addition to cognitive ability, the effectiveness of the Canva-assisted RME worksheet (E-LKPD) was also evaluated from the affective aspect, namely students' learning independence. Learning independence data was obtained through a questionnaire administered to students in both the experimental and control classes after the entire learning series was completed. A summary of the results of the student learning interest questionnaire is presented in Table 10.

Table 10. Comparison of Students' Learning Interes

Statistik	Experimental Class	Control Class
	Pretest	Posttest
Average	113,03	84,30
Standard Deviation	7,85	4,95
Number of Students	35	30

Table 10 shows a significant difference in learning interest between the two classes. The control class achieved an average score of 84.30, categorized as High. Meanwhile, the experimental class achieved a higher score of 113.03, falling into the Very High category. A difference of 28.73 points demonstrates that the use of Canva-assisted RME-based LKPD is more effective in improving student learning independence compared to conventional learning. Subsequently, a normality test was conducted, the results of which are presented in Table 11.

Table 11. Normality Test

Class	**Variabel**	***Shapiro-Wilk***		
		Statistic	***Df***	***Sig.***
Experimental	Self-Regulated Learningt	0.909	35	0.007
Control		0.952	30	0.194

Based on Table 11, the Sig. value for the experimental class is 0.007. Since the Sig. value is less than 0.05, it can be concluded that the sample originates from a non-normally distributed

population. Meanwhile, for the control class, the Sig. value is 0.194. Because the Sig. value is greater than 0.05, it is concluded that the sample is derived from a normally distributed population. Since one of the classes is not normally distributed, the Mann-Whitney U test was subsequently used for hypothesis testing. The results of the Mann-Whitney test are presented in Table 12.

Table 12. Mann-Whitney U Test

Statistic	Grade
Mann-Whitney U	0.000
Sig. (2-tailed)	0.000

Based on Table 12, the p-value (sig.) is 0.000. Since the p-value is less than 0.05, it can be concluded that the self-regulated learning of students who learned using Canva-assisted RME-based e-worksheets is significantly better than those receiving conventional instruction. Furthermore, a comparison of each self-regulated learning indicator between the control class and the experimental class is presented in Table 13.

Table 13. Results of Students' Learning Independence Scale Analysis

Indicator	**Eksperimen**		**Criteria**	**Control**		**Kiteria**
	Pretest	**posttest**		**Pretest**	**Postest**	
Learning initiative		90%	Very Good		74%	Good
Diagnosing learning needs		89%	Very Good		76%	Good
Setting learning goals		90%	Very Good		77%	Good
Viewing difficulties as challenges		87%	Very Good		74%	Good
Independent learning		90%	Very Good		74%	Good
Average percentage		89,8%	Vey Good		75%	Good

The analysis of students' learning independence is presented in Table 15. The results show that the experimental class achieved higher results across all indicators compared to the control class. The average percentage of students' learning independence in the experimental class reached 89%, categorized as very good. Meanwhile, the control class showed an achievement of 74%, categorized as good. The highest achievement was found in the indicators of setting learning goals and independent learning at 90%. Other indicators—including learning initiative, diagnosing learning needs, viewing difficulties as challenges, and self-directed learning—also demonstrated positive achievements. These findings indicate that the quality of students' learning independence in the experimental class was superior to that of the control class. This supports the conclusion that the implementation of RME-based E-LKPD assisted by Canva is more effective than conventional learning.

Discussions

Based on the research results described above, it can be concluded that the development process of Canva-assisted RME-based e-worksheets aligns with the steps outlined by Borg and Gall, yielding a product that is both valid and practical. This finding is consistent with the research by (Simanjuntak et al., 2025), which similarly demonstrated that Canva-assisted worksheets developed using the Borg & Gall model received highly feasible evaluations from both experts and users, thereby successfully enhancing students' higher-order thinking skills.

The success of each Borg and Gall stage is supported by several recent studies. (Lisnawati et al., 2023) developed a worksheet based on a scientific approach using the Borg and Gall model, showing that systematic development procedures produce worksheets that meet the criteria of being valid, practical, and effective in improving mathematical problem-solving abilities. Their study emphasizes that expert validation followed by product revisions and iterative field testing are crucial factors in determining product quality.

Furthermore, research by (Lukmana et al., 2026) on the development of Canva- and GeoGebra assisted worksheets using nine stages of Borg and Gall also concluded that systematic development procedures result in learning instruments that are valid, practical, and effective in enhancing students' mathematical problem-solving skills and learning interest. These findings indicate that integrating digital media with the Borg and Gall development framework is capable of producing feasible learning products for implementation in mathematics education.

From the perspective of feasibility based on validity, the Canva-assisted RME-based E-LKPD falls into the valid category. This aligns with the research findings of (Darmawan et al., 2024), which demonstrated that developing LKPD using the Borg & Gall model yields learning instruments that are not only valid and practical, but also effective in improving students' mathematical problem-solving skills. The high validity of the RME-based E-LKPD is attributed to the feasibility of its content, language, and media, which ultimately enhances students' motivation and understanding of mathematics. This is also consistent with the study by(Said et al., 2023), who developed Canva-assisted LKPD for relations and functions. Their research showed that the LKPD achieved a validity level of 93.02% and was categorized as highly valid due to meeting the content, presentation, language, and media criteria. Furthermore, the LKPD was evaluated as capable of boosting students' motivation and conceptual understanding of mathematics..

The practicality of the LKPD, which is categorized as very practical, indicates that the product is easy to use by both teachers and students. Positive responses from students were not only influenced by the attractive visual appearance but also by the systematic arrangement of learning activities. The use of Canva enables the presentation of learning materials to become more communicative through the combination of illustrations, colors, icons, and proportional layouts. This condition increases students’ attention during learning activities so that they become more active in following each stage contained in the LKPD. These findings are supported by research by (Nurhayati et al., 2023) which states that Canva-assisted learning media with an RME approach fall into the practical category because they are easy to use, visually appealing, and increase student engagement during mathematics learning. Research by(Linda et al., 2020) also shows that Canva-assisted digital LKPD achieved a very high level of practicality based on responses from both teachers and students. Teachers assessed the LKPD as easy to implement in learning, while students felt more interested and found it easier to understand the material through the interactive digital design.

Similar results were found by (Janna et al., 2025), who reported that Canva-assisted LKPD met the practical category because they were easy to use, facilitated the learning process, and received positive responses from teachers and students during learning implementation.

Research by (Fitrahtunnisa et al., 2022) on Canva and Liveworksheets-based electronic LKPD also indicates that the high level of practicality was influenced by ease of use, usefulness, and increased student learning motivation while using digital LKPD. Furthermore, research by (Toruan et al., 2025) concluded that the developed Canva-assisted learning media met the valid, practical, and effective categories because it was able to increase student engagement, facilitate the learning process, and support the improvement of mathematical problem-solving ability.

In terms of effectiveness, it was found that the implementation of Canva-assisted RME-based E-Worksheets (E-LKPD) is effective in improving mathematical problem-solving skills. This aligns with research by (Panjaitan et al., 2023), which stated that RME-based worksheets demonstrate that the use of real-world contexts can enhance students' mathematical problem-solving skills. Furthermore, (Sihotang & Elfitra, 2025) noted that Canva-assisted learning media proves that attractive and interactive material presentation can increase student engagement, thereby positively impacting their problem-solving skills.

The high effectiveness of the Canva-assisted RME E-Worksheets is driven by the fact that the RME approach begins with introducing everyday problems to help students understand mathematical concepts prior to the formal stage. This process trains students to identify information, design and execute strategies, and reflect on their answers, allowing all problem-solving indicators to develop optimally. This is consistent with research by Melsita, (Melsita et al., 2025), which emphasizes that the use of RME-based worksheets can improve problem-solving skills because it encourages independent concept formation through real-world contexts.

Another decisive factor is the utilization of Canva as an interactive visual medium. The combination of appealing colors, illustrations, and layout within the E-Worksheet boosts students' concentration and learning motivation. This visual presentation helps students digest problem information more easily to determine solution steps. These findings reinforce research by (Hafizah & Samosir, 2023), which states that Canva-based learning media is effective in triggering active student engagement, ultimately having a positive impact on the improvement of mathematical problem-solving skills.

The findings of this study also indicate that the improvement in mathematical problem-solving skills was accompanied by an increase in students' learning independence. This aligns with (Damayanti et al., 2024) regarding the development of interactive RME-based E-Worksheets using Liveworksheets, which showed that one of the primary reasons for developing the media was to enhance students' Self-Regulated Learning, and the development results were declared valid and practical, making them suitable for use as a learning tool that supports independent learning. In addition, research by (Firmansyah et al., 2025) on RME-based E-LKPD (electronic student worksheets) through Liveworksheets demonstrates that this medium is effective for use in mathematics learning because it can enhance student engagement during the learning process. Although the study focuses on improving learning outcomes and problem-solving skills, the characteristics of E-LKPD which allow students to learn flexibly, actively explore materials, and receive immediate feedback also support the development of students' self-directed learning (or independent learning).

The integration of the RME approach and Canva digital media becomes one of the main contributions of this study. The RME approach provides a pedagogical framework that emphasizes knowledge construction through contextual experiences, while Canva supports the visual presentation of information so that abstract mathematical concepts become easier for students to understand. The combination of both elements produces a learning experience that not only improves learning outcomes but also strengthens students’ engagement during the learning process.

The results of this study are consistent with previous studies stating that the Realistic Mathematics Education approach can improve mathematical problem-solving abilities through the use of real contexts in learning. However, this study provides a different contribution by integrating the approach with Canva digital design media in the form of LKPD developed systematically using the Borg and Gall model. This integration produces learning materials that are not only feasible to use but also effective in improving students' mathematical problem-solving abilities and learning independence.

Nevertheless, this study has several limitations. The implementation of the product was only conducted in one school, so the characteristics of the respondents may not fully represent the general conditions of junior high school students. In addition, the developed material was limited to the Two-Variable Linear Equation Systems topic; therefore, the effectiveness of the product for other mathematical topics cannot yet be generalized. Future studies are recommended to implement the LKPD in a wider range of schools, involve more diverse student characteristics, and develop the product for other mathematical topics to obtain more comprehensive information regarding the effectiveness of Canva-assisted LKPD based on RME.

CONCLUSION

Based on the research results and discussion regarding the development of Canva-assisted Student Worksheets (LKPD) based on Realistic Mathematics Education (RME) to improve junior high school students' mathematical problem-solving skills and learning independence, the following conclusions can be drawn:

1. The development process of RME-based LKPD assisted by Canva is in accordance with the steps of the Borg and Gall model, producing a valid, practical, and effective E-LKPD to improve problem-solving skills.
2. The feasibility of the Canva-assisted RME-based E-LKPD in terms of validity is categorized as valid, and in terms of practicality, it is categorized as practical. Therefore, the Canva-assisted RME-based E-LKPD is suitable for use in mathematics learning.
3. The implementation of the Canva-assisted RME-based E-LKPD is effective in improving students' mathematical problem-solving skills.

The implementation of the Canva-assisted RME-based E-LKPD is effective in improving students' self-regulated learning**.**

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