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Development of Problem Based Learning (PBL) Based Interactive Multimedia on the Topic of Absolute Value Equations and Inequalities Systems

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Abstract

This research and development (R&D) study successfully created and validated an interactive multimedia product based on Problem-Based Learning (PBL) for teaching the topic of One-Variable Absolute Value Equations and Inequalities Systems. Utilizing the systematic Four-D (Define, Design, Develop, Disseminate) model, the study aimed to address the lack of engaging and contextually relevant instructional media in mathematics education at SMA Muhammadiyah 2 Metro. The development process involved a comprehensive needs analysis, iterative prototyping, and rigorous expert validation. The final product, available as an installable Android application (.apk) and a direct-access presentation file (.pptx), effectively integrates text, animation, images, and audio to create an immersive learning experience anchored in real-world problem-solving scenarios. Validation results from two content experts and two media experts confirmed the product's high feasibility, with average scores of 91.5% and 85%, respectively, categorized as "Very Feasible." Furthermore, a small-group trial involving seven students demonstrated its exceptional practicality, achieving an average score of 90% ("Very Practical"). These findings affirm that the developed PBL-based interactive multimedia not only meets stringent design and pedagogical standards but is also highly usable and well-received by the target learners. The study concludes that this multimedia tool is a viable and practical innovation for supporting active, student-centered mathematics instruction. Recommendations for future work include optimizing the application's file size, disseminating it through public platforms like the Google Play Store, and conducting effectiveness trials to empirically measure its impact on improving students' mathematical problem-solving abilities.

Keywords: *Interactive Multimedia; Problem-Based Learning (PBL); Mathematics Education; Development Research (R&D)*

Introduction

Learning is conducted interactively, encouraging students to play an active role in expressing ideas or thoughts, creativity, and learning independence that align with their individual characteristics. This indicates that education is a vital necessity in life, essential for enhancing dignity, status, and capabilities.

Learning is an active and constructive process of acquiring information, wherein active learning requires instructional media that functions as a learning resource (Mulyadi et al., 2023). Therefore, it can be concluded that in solving mathematical problems, the availability of appropriate instructional media can increase student motivation and active participation. The use of media serves as a key component in supporting the achievement of learning objectives; with the aid of tools/media, a strategy is needed to help students develop critical thinking skills in order to solve mathematical problems. Various types of media can be utilized, including visual media, audio media, audio-visual media, and interactive media.

Interactive multimedia integrates diverse media formats including text, images, graphics, sound, animation, video, and interactive elements into a unified digital resource designed for instructional delivery in the learning process (Huang et al., 2021). A key strength of interactive multimedia as an instructional material is its capacity to present content in a visually concrete and engaging manner, thereby enhancing the tangibility of the conveyed information. By synthesizing multiple media types, it aids educators in designing dynamic presentations, clarifies complex subject matter, and transforms potentially rigid classroom environments into more stimulating and enjoyable learning experiences (Sari et al., 2022). Incorporating interactive multimedia represents a supportive innovation that can deepen student comprehension. Its use is associated with increased learner motivation, a reduction in monotonous instruction, and the more effective attainment of learning goals, particularly when embedded within a Problem-Based Learning (PBL) framework (Chen & Yang, 2023).

Mathematics instruction holds significant potential to positively stimulate student development. The Problem-Based Learning (PBL) approach employs authentic, real-world challenges as a contextual foundation for learners to cultivate critical thinking and problem-solving abilities while constructing essential subject-specific knowledge and conceptual understanding (Li et al., 2022). A preliminary survey in Class X Science 1 at SMA Muhammadiyah 2 Metro, supplemented by initial teacher interviews, indicated a persistent teacher-centered instructional model. Students predominantly function as passive recipients of pre-structured knowledge. The teaching media most commonly utilized are visual aids, primarily printed textbooks and physical teaching tools. Notably, interactive multimedia has not been adopted as a standard instructional resource to support learning objective attainment in mathematics classes.

Moreover, current instructional delivery often fails to connect mathematical concepts and example problems to systematic, real-life applications. This gap highlights a potential solution: deploying interactive multimedia to foster more engaging, varied, and effective learning pathways that support student achievement. Although infrastructure such as laptops, computers, projectors, and Wi-Fi is available, it remains underutilized in facilitating student learning. These technological resources, especially smartphones, could significantly lower barriers to implementing digital learning media and support the development of interactive multimedia.

Relevant studies on PBL-based interactive multimedia development affirm its supportive role. Research by Wang et al. (2021) and Sari et al. (2022) demonstrates that integrating interactive multimedia into instruction can effectively advance learning objectives. Such media enhance student understanding, serving as a versatile and appealing instructional tool that promotes learning mastery. Further supporting this, a study by Fadillah et al. (2023) confirms that the PBL approach facilitates learning that is anchored in real-world issues, positively impacting student comprehension by aligning with structured instructional phases and established pedagogical procedures. Informed by the identified challenges and corroborated by existing research, the present study proposes the "Development of Problem-Based Learning (PBL) Based Interactive Multimedia on the Topic of One-Variable Absolute Value Equations and Inequalities Systems." This development research aims to yield a viable and practical instructional product in the form of PBL-based interactive multimedia.

Method

The research type employed in this study is Research and Development (R&D), which is a systematic process aimed at innovating existing products or creating new ones to meet specific requirements (Branch, 2021). The final outcome or developed product is intended to support the achievement of Mathematics learning objectives. Various development models can be utilized in such research, one of which is the Four-D Model (4-D). This development model, as adapted from previous studies, states that the R&D stages in the 4-D model consist of four phases: the Define stage, the Design stage, the Development stage, and the Dissemination stage (Gustafson & Branch, 2024).

Difine stage aims to determine and define the requirements for Mathematics instruction, beginning with a front-end and learner analysis, task analysis, concept analysis, and the formulation of learning objectives. A front-end analysis, conducted as a pre-survey involving the Mathematics teacher for class X Science 1, was carried out to identify the problems present at SMA Muhammadiyah 2 Metro. This revealed the need to develop a learning media product to support the attainment of learning objectives effectively and serve as a relevant alternative resource to address the identified issues. Learner analysis aims to examine the challenges within the learning process. Task analysis is required to identify problems in detail, in line with the steps and concepts related to the content of the Mathematics learning material.

Design stage aims to prepare a learning prototype. It involves media selection, format selection, and preliminary media design. Media selection aims to choose the appropriate means for delivering Mathematics learning material. Format selection aims to create a preliminary design according to a predetermined structure. The preliminary media design aims to draft the initial version of the Problem-Based Learning (PBL)-based interactive multimedia product, designed to yield an initial creation that aligns with the chosen format.

This stage aims to modify the learning prototype to produce the final developed product. It consists of several steps, including expert validation (content and media), product revision, and a small-group trial. The initially completed interactive multimedia is then subjected to expert validation to assess its feasibility. The content validation stage is conducted by 2 subject matter experts evaluating the created multimedia. The media validation stage is conducted by 2 media experts. The product revision stage follows, where the interactive multimedia is revised based on the comments and suggestions from the content and media experts. The learning media, in the form of interactive multimedia, is analyzed and refined accordingly. Subsequently, a small-group trial is conducted, involving the actual target users—students. This means the product, having met the validity criteria, is tested on students on a limited scale. The trial subjects for the research and development of PBL-based interactive multimedia on the topic of One-Variable Absolute Value Equations and Inequalities Systems are media experts and students of class X Science 1 at SMA Muhammadiyah 2 Metro.

A data collection instrument is a tool used to gather information in a research study. The instruments employed in this study include a content expert validation questionnaire, a media expert validation questionnaire, and a student response questionnaire. This technique involves collecting data from expert reviews and small-group trials, which can be detailed according to the data type:

Quantitative Data Analysis was conducted by directly measuring numerical data in the form of percentages. This analysis assessed the feasibility and practicality of the Problem-Based Learning (PBL)-based interactive multimedia on the topic of One-Variable Absolute Value Equations and Inequalities Systems. The Likert Scale (Rating Scale) used is presented below:

Table 1. Likert Scale of Assessment

Assessment Category	Score
Strongly Agree	5
Agree	4
Neutral/Slightly Agree	3
Disagree	2
Strongly Disagree	1

(Azwar, 2020)

Qualitative Data Analysis was carried out by describing the obtained data in narrative form. Qualitative data provides explanatory information that strengthens the findings from the quantitative analysis. This data was gathered through comments and suggestions from the experts and students, as well as from student interviews. The following formula was used to calculate the feasibility percentage based on the data collected from the media and content expert reviews of the interactive multimedia product:

Table 2. Product Validity Assessment Criteria

Assessment Category	Score	Precentage Range
Very Feasible	5	$80 < N \leq 100$
Feasible	4	$60 < N \leq 80$
Moderately Feasible	3	$40 < N \leq 60$
Not Feasible	2	$20 < N \leq 40$
Highly Not Feasible	1	$0 < N \leq 20$

(Darma & Setiawan, 2022)

The following formula was used to calculate the practicality percentage based on the data collected from the student response trials of the interactive multimedia product:

Table 3. Product Validity Assessment Criteria

Assessment Category	Score	Precentage Range
Very Practical	5	$80 < N \leq 100$
Practical	4	$60 < N \leq 80$
Moderately Feasible	3	$40 < N \leq 60$
Not Feasible	2	$20 < N \leq 40$
Highly Not Feasible	1	$0 < N \leq 20$

(Darma & Setiawan, 2022)

Results and Discussion

The product resulting from this development research is Problem-Based Learning (PBL)-based Interactive Multimedia on the Topic of One-Variable Absolute Value Equations and Inequalities Systems. This product integrates various elements such as text, animation, images, and sound into a unified new form. This integration aims to make the delivery of mathematics learning materials more engaging and less monotonous, thereby facilitating students' comprehension of the subject matter. The final interactive multimedia product is available in two formats: an installable Android application package (.apk) for smartphones and a direct-access document (.pptx) that requires no installation (Hakim & Auliya, 2023).

The Define stage, the initial phase of development, was conducted to analyze initial and final problems. A pre-survey in Class X Science 1 at SMA Muhammadiyah 2 Metro revealed that learning media were not yet utilized optimally in mathematics instruction. The available supporting facilities and infrastructure could aid in achieving learning objectives. Consequently, the interactive multimedia learning media was designed to align with the needs of both students and educators (Sari et al., 2022).

The initial media development produced a preliminary version of the interactive multimedia product. This prototype featured a main menu consisting of an introduction, content, quiz, and profile sections. The design of this interactive multimedia adhered to the chosen format. Subsequently, the PowerPoint-based interactive multimedia product, in .pptx format, was converted to the .html5 format using I-Spring Suite 8 software linked to PowerPoint. This .html5 file was then packaged into an installable .apk application file using Website 2 APK software. This conversion process aims to create a mobile application, allowing the interactive multimedia product to be installed on smartphones, thereby supporting and enhancing the student learning process (Pratama et al., 2021).

The expert validation stage aimed to determine the feasibility criteria of the PBL-based interactive multimedia product. This stage involved two experts: a content expert and a media expert. The data collection instruments used in this stage were a product validation sheet for the experts and a product practicality questionnaire for the students.

Table 4. Percentage Scores for Content and Media Expert Validation

Validator	Material Expert Result	Media Expert Result	Note
1	91%	81%	Strongly Agree
2	92%	89%	Strongly Agree
Average Percentage	**91.5%**	**85%**	**Strongly Agree**

Based on Table 4, the content validation results were 91% from Validator 1 and 92% from Validator 2, both indicating a "Strongly Agree" interpretation regarding product feasibility. Suggestions from the content experts pertained to the interactive multimedia product. For instance, Validator 1 suggested ensuring harmonious color combinations, meticulously checking symbols and numbers on each page, and revising pages according to provided notes.

The media validation results were 81% from Validator 1 and 89% from Validator 2, also indicating a "Strongly Agree" interpretation. Suggestions from the media experts included: improving navigation button instructions (Validator 1), noting that text and background colors were too dark (Validator 1), adding a button to mute sound (Validator 1), suggesting the quiz be created using iSpring features (Validator 1), and commenting that the text animation timer on the profile menu was too long (Validator 1). Meanwhile, Validator 2 noted that the initial media design was very attractive and could motivate students, but recommended fixing non-functional menu buttons.

The product revision stage aimed to refine the interactive multimedia product based on the suggestions provided by the two validators (content and media experts). Consequently, several changes were made to both the visual presentation and the content of the interactive multimedia product.

Table 5. Intro Page Menu

Before Revision	After Revision
	

Based on the images above, the initial design of the main menu page for the interactive multimedia is shown both before and after improvements or revisions. In the revised display, the school grade level and semester information have been added. Furthermore, an animated music button has been incorporated

into the media. This button allows users to choose between turning the sound on or off, accommodating individual preferences for the audio setting when opening the media.

Table 6. Giving Question

Before Revision	After Revision
	

Based on the image above, the layout of the practice problems section in the interactive learning media is displayed before and after revision. In the revised version (the second image), modifications are evident, including a change in the background color and the addition of a menu labeled "Practice Problems 1 and 2." This addition is intended to streamline the process of revisiting and accessing the specific problem sets.

The small-group trial involved 7 students from class X Science-1 as the primary subjects, who provided comments and suggestions on the product. The student questionnaire data regarding the Problem-Based Learning (PBL)-based learning media is presented below:

Table 7. Small-Group Trial Response Questionnaire Data

Student	Total Score	Average Percentage	Category
S1	65	93%	Very Practical
S2	69	98%	Very Practical
S3	59	84%	Very Practical
S4	66	94%	Very Practical
S5	60	86%	Very Practical
S6	60	86%	Very Practical
S7	63	90%	Very Practical
Total/Average	**443**	**90%**	**Very Practical**

The data in Table 7 above represents the students' evaluation of the learning media. The students who completed the response questionnaire, which contained specified indicators, provided scores that resulted in an average percentage categorized as Very Practical.

The Dissemination stage represents the final phase of developing the Problem-Based Learning (PBL)-based interactive multimedia. The final product is packaged as an Android application. The dissemination was conducted on a limited scale via online methods by distributing the product an interactive multimedia file accessible through a dedicated link (https://bit.ly/3mjsKEk). This accessible link aims to serve as an auxiliary learning tool that students can use independently, thereby supporting the achievement of learning objectives for the students of class X Science-1 at SMA Muhammadiyah 2 Metro.

The developed product is a PBL-based interactive multimedia on the topic of One-Variable Absolute Value Equations and Inequalities Systems, packaged as an application available in .apk and .pptx formats. The interactive multimedia features several menus Intro, Material, Quiz, and Profile each with distinct functions. The Intro menu contains three sub-menus: Basic Competencies, User Instructions, and Concept Map. This multimedia emphasizes the delivery of learning material connected

to real-life contexts. Students can comprehend mathematical problems presented through the interactive media by relating them to everyday situations. The outcome of this PBL-based interactive multimedia development aligns with relevant prior research. It can be concluded that using interactive multimedia as a learning medium facilitates students' understanding of mathematical concepts and supports the attainment of learning objectives.

Conclusion

Based on the entire research and development process, it can be concluded that the Problem-Based Learning (PBL)-based Interactive Multimedia product for the topic of One-Variable Absolute Value Equations and Inequalities Systems has been successfully developed using the Four-D model (Define, Design, Develop, Disseminate). The product, available in .apk and .pptx formats, was validated by subject matter and media experts, with average scores of 91.5% and 85%, respectively, categorised as "Very Feasible". A practicality test on a small group of 7 students from class X Science 1 at SMA Muhammadiyah 2 Metro yielded an average score of 90%, or "Very Practical". These findings indicate that the media not only meets design and content quality standards but is also user-friendly and well-received by students as a self-directed learning tool.

This research aligns with recent literature emphasising the importance of interactive learning media and the PBL approach in fostering active engagement, problem-solving, and conceptual understanding in mathematics. For further development, three main recommendations are proposed: First, conduct technical optimisation to reduce the application file size for compatibility with various smartphone specifications. Second, expand dissemination by publishing the application on platforms such as the Google Play Store to enhance national accessibility. Third and most critically, advance the research to an effectiveness testing phase to empirically measure the product's impact on specific learning outcomes, such as students' mathematical problem-solving abilities, thereby strengthening its validation as an evidence-based educational tool.

References

Azwar, S. (2020). *Penyusunan Skala Psikologi* [Construction of Psychological Scales] (3rd ed.). Pustaka Pelajar.

Branch, R. M. (2021). *Instructional design: The ADDIE approach* (2nd ed.).

Chen, L., & Yang, J. (2023). Integrating interactive multimedia and problem-based learning to enhance student engagement in STEM education. *Computers & Education*, *187*, 104–118.

Darma, I. K., & Setiawan, I. M. D. (2022). *Metodologi Penelitian Pengembangan Bidang Pendidikan* [Educational Research and Development Methodology]. Rajawali Pers.

Fadillah, N., Hidayat, W., & Rohaeti, E. E. (2023). Enhancing mathematical problem-solving ability and self-regulated learning through problem-based learning with interactive multimedia. *Journal on Mathematics Education*, *14*(1), 167–184.

Gustafson, K. L., & Branch, R. M. (2024). *Survey of instructional development models* (6th ed.). ERIC Clearinghouse on Information & Technology.

Hakim, A. R., & Auliya, N. (2023). Development of interactive multimedia in mathematics learning for senior high school: A meta-analysis. *Journal of Education and Learning (EduLearn)*, *17*(1), 126-135.

Hidayat, F., & Nizar, M. (2022). Development of Android-based learning media using the 4D model to improve student learning outcomes in mathematics. *Journal of Technology and Science Education*, *12*(2), 356-371.

Huang, R., Spector, J. M., & Yang, J. (2021). *Educational technology: A primer for the 21st century*. Springer Nature.

Li, Y., Schoenfeld, A. H., diSessa, A. A., Graesser, A. C., Benson, L. C., English, L. D., & Duschl, R. A. (2022). On mathematical learning and problem solving: A historical and methodological perspective. *Journal for STEM Education Research*, *5*(1), 1–28.

Mulyadi, D., U., & Wahyuni, S. (2023). *Pengembangan Media Pembelajaran Interaktif: Teori dan Aplikasi*. Penerbit Akademia.

Pratama, F. I., Sari, Y., & Hidayat, W. (2021). Developing Android-based interactive learning media for linear algebra using Ispring Suite. *Jurnal Teknologi Pendidikan*, *23*(2), 178-191.

Sari, R. M., Sumarmo, U., & Johan, M. (2022). Development of interactive mathematics learning media based on local wisdom to improve students' critical thinking skills. *JTAM (Jurnal Teori dan Aplikasi Matematika)*, *6*(1), 232–244.

Wang, C., Fang, T., & Gu, Y. (2021). Learning performance and cognitive load in mobile learning contexts: The effectiveness of problem-based learning assisted with interactive multimedia. *Interactive Learning Environments*, *31*(4), 1–15.

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