

DEVELOPMENT OF A MATHEMATICS GAME ILLUSTRATED WITH JAMBI WEAVING ART TO IMPROVE STUDENTS' CRITIKAL THINKING ABILITIES

PENGEMBANGAN GAME MATEMATIKA BERILUSTRASI SENI ANYAMAN JAMBI UNTUK MENINGKATKAN KEMAMPUAN BERFIKIR KRITIS SISWA

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Abstrak

Penelitian ini bertujuan mengembangkan game matematika berilustrasi seni anyaman Jambi pada materi bangun ruang sisi lengkung untuk melatih kemampuan berpikir kritis siswa kelas IX. Penelitian menggunakan metode Research and Development (R&D) dengan model ADDIE yang pada artikel ini dibatasi hingga tahap Development. Proses pengembangan meliputi analisis kebutuhan, perancangan, dan pengembangan game berbentuk permainan petualangan yang dilengkapi soal penalaran, clue, dan pembahasan. Kualitas produk diuji melalui validasi ahli materi dan ahli media, serta uji praktikalitas oleh guru dan siswa. Hasil penelitian menunjukkan bahwa game yang dikembangkan berada pada kategori sangat layak, dengan persentase validasi ahli materi 93% dan ahli media 88%, serta kategori sangat praktis berdasarkan uji praktikalitas guru 84% dan siswa 92,67%. Dengan demikian, game matematika berilustrasi seni anyaman Jambi dinyatakan layak dan praktis untuk digunakan sebagai media pembelajaran matematika yang interaktif dan kontekstual.

Abstract

This study aimed to develop a mathematics game illustrated with Jambi weaving art on the topic of curved-surface solid geometry to train the critical thinking skills of Grade IX students. The study employed the Research and Development (R&D) method using the ADDIE model, which in this article was limited to the Development stage. The development process included needs analysis, design, and development of an adventure-based game equipped with reasoning problems, clues, and answer explanations. Product quality was evaluated through validation by content experts and media experts, as well as practicality testing by teachers and students. The results indicate that the developed game falls into the highly feasible category, with content expert validation of 93% and media expert validation of 88%, and is categorized as highly practical based on practicality tests by teachers (84%) and students (92.67%). Therefore, the mathematics game illustrated with Jambi weaving art is deemed feasible and practical for use as an interactive and contextual mathematics learning medium.

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INTRODUCTION

The rapid development of information technology in the current era of globalization has had a significant impact on various aspects of life, including the field of education (Yeyendra et al., 2024;

Yulianti, 2024). Digital technology, particularly smartphones, has become an integral part of daily life and is widely utilized in various activities such as learning, working, and communicating (Ayu et al., 2023). This condition has driven changes in students' learning patterns, as they are increasingly accustomed to using digital technology, thereby requiring education to adapt to the characteristics and needs of the current generation. In this context, education needs to leverage technological advancements to create learning experiences that are relevant, interactive, and effective by actively involving both teachers and students in the learning process (Harefa et al., 2022; Syafriadi, 2020). Twenty-first-century learning also demands a paradigm shift that emphasizes skills such as creativity, critical thinking, collaboration, problem solving, and communication, while positioning students at the center of the learning process (Dzikrulloh et al., 2024; Humayra et al., 2025). These skills are essential for students to face global challenges, advancements in science and technology, and increasingly complex real-life problems. Therefore, critical thinking ability is one of the key competencies that must be systematically developed within Indonesian education in the twenty-first century.

Critical thinking is the ability to evaluate and analyze ideas or concepts related to the issues or problems encountered (Wasqita et al., 2022). This ability involves the process of evaluating available evidence and information, derived from observation, personal experience, logical reasoning, and communication media, before drawing an appropriate conclusion (Putri et al., 2020). Critical thinking plays a crucial role for students because it helps them select, analyze, and utilize information effectively, while also fostering structured and reflective thinking patterns in addressing various problems (Damayati, 2020). In mathematics learning, critical thinking skills are essential for enabling students to express ideas, explain their thought processes, and solve problems logically and systematically (Amelia et al., 2022), as well as to understand concepts more deeply and develop creative and contextual problem-solving strategies (Minangkabau et al., 2024). However, in practice, many students still experience difficulties in applying critical thinking skills in mathematics learning, as classroom instruction often remains focused on procedural delivery and the use of textbooks as the primary source, leading students to memorize formulas without fully understanding the underlying concepts and leaving them insufficiently trained to solve contextual problems that require reasoning (Indriani et al., 2025; Ramadhani et al., 2025). Therefore, the development of critical thinking skills needs to be a primary focus in mathematics instruction so that students can think more analytically and reflectively and be better prepared to face learning challenges as well as real-life problems in the future.

To support the development of critical thinking skills, interactive learning media can serve as an effective solution in the learning process. Learning media play an important role in explaining concepts that are difficult to understand, thereby helping students comprehend the material more clearly and deeply (Charline et al., 2023). The appropriate use of learning media is also capable of creating a more structured, effective, and efficient learning process, as well as fostering a conducive classroom environment and encouraging active student engagement (Ashari et al., 2022). Visual media, in particular, contribute to stimulating imagination, strengthening memory retention, and accommodating diverse student learning styles, enabling information to be received and understood more optimally (Arsyad et al., 2024). Along with technological advancements, digital-based learning media, such as educational games, have been increasingly utilized because they are able to integrate learning and entertainment elements in a balanced manner, thereby creating engaging and interactive learning experiences for students (Mokoagow et al., 2021). Educational games function not only as visual aids but also as interactive media that promote active student participation, enhance learning motivation, and contribute to improved learning outcomes (Syaikhu et al., 2022). Furthermore, the

challenging and enjoyable characteristics of educational games can enhance memory, conceptual understanding, and students' enthusiasm for participating in the learning process (Sulistiyawati et al., 2021). Therefore, the development of educational games as learning media is relevant for supporting the creation of more meaningful learning experiences oriented toward the enhancement of students' critical thinking skills.

Educational games have been proven effective in enhancing students' motivation and learning outcomes, as demonstrated by research conducted by (Hendratmoko et al., 2024) which indicates that interactive educational games can improve mathematics learning outcomes, as well as by (Pahlevi & Apriliyani, 2023) who found that Android-based educational games are capable of increasing students' motivation through engaging visual displays. However, most educational game developments still primarily focus on visual aspects and interactivity and have not optimally integrated local wisdom as a meaningful context for mathematics learning that is capable of fostering students' critical thinking skills (Nurhikmah et al., 2024; Taopik, 2025). Integration of local wisdom into educational games, such as Jambi weaving art, which contains mathematical elements, can provide more meaningful learning experiences, assist students in understanding mathematical concepts, and contribute to cultural preservation (Jaizul & Putra, 2025; Kumala et al., 2024). Incorporating local wisdom as the contextual foundation of educational games, students can learn mathematics in a more authentic manner while simultaneously developing an appreciation for their regional culture (Zulkarnain et al., 2021). Therefore, it is necessary to develop learning media in the form of a mathematics game illustrated with Jambi weaving art that is specifically designed to train students' critical thinking skills.

METHOD

This study employed the Research and Development (R&D) method. The Research and Development method is a systematic series of processes or stages conducted to produce new products or to improve existing ones (Okpatrioka, 2023). The development model applied in this study was the ADDIE model, which consists of the analysis, design, development, implementation, and evaluation stages (Winaryati et al., 2021). However, in this article, the research was limited to the development stage; therefore, the implementation and evaluation stages were not conducted.



Figure 1. Stages of the ADDIE Development Model

In analyzing the data, this study employed quantitative data analysis techniques to measure the feasibility of the developed product, while the data obtained from expert evaluations were analyzed using descriptive qualitative analysis (Sugiyono, 2019). The results of the experts' assessments were intended to provide clear and objective feedback on the quality of the game, as

well as to serve as a basis for revising and refining the product. Validation sheets were used to assess various aspects of the game, including content, design, interactivity, and alignment with learning objectives.

The questionnaire scores provided by the experts were then calculated as percentages based on the responses given by each validator. Subsequently, the collected data were analyzed using the following formula (Akbar, 2013):

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Description:

P : Percentage

$\sum x$: Total score of respondents' responses

$\sum xi$: Total possible score

The results of the calculation using the questionnaire scoring formula were then categorized based on the predetermined criteria. The criteria applied are as follows (Akbar, 2013):

Table 1. Percentage Criteria for Validity

No	Percentage	Criteria Validity
1.	$P \leq 20\%$	Not Feasible
2.	$20\% < P \leq 40\%$	Less Feasible
3.	$40\% < P \leq 60\%$	Moderately Feasible
4.	$60\% < P \leq 80\%$	Feasible
5.	$80\% < P \leq 100\%$	Highly Feasible

RESULT AND DISCUSSION

The results obtained from this study are as follows: (1) a mathematics game illustrated with local wisdom from Jambi weaving art designed to enhance students' critical thinking skills; (2) an evaluation of the mathematics game learning media illustrated with local wisdom from Jambi weaving art in terms of validity, conducted by an instrument expert, a design expert, and a media expert; and (3) an assessment of the practicality aspect of the mathematics game learning media conducted by mathematics teachers and students who participated as subjects in the small-group trial.

A. Analysis stage

The analysis stage was conducted through observations and interviews at SMP Negeri 1 Kerinci to identify learning needs, student characteristics, curriculum implementation, and supporting resources. The results of the analysis indicated that although the school has implemented the Merdeka Curriculum using a deep learning approach, mathematics instruction is still dominated by lecture-based methods and the use of printed textbooks. As a result, students tend to memorize formulas, experience difficulties in analyzing problems, and demonstrate low levels of critical thinking ability and learning concentration. Furthermore, there is considerable potential in Jambi weaving art (lulung and tudung saji) to be utilized as a learning resource for students. Based on these findings, a mathematics game illustrated with local wisdom from Jambi weaving art was developed as a more engaging, contextual, and challenging learning medium to train the critical thinking skills of Grade IX students.

B. Design Stage

At this stage, the initial framework of the learning media in the form of a mathematics game illustrated with local wisdom from Jambi weaving art was developed. This media was specifically designed for Grade IX students on the topic of curved-surface solid geometry. The game design was carried out using Construct 3 to structure the game flow and logic. The output of this stage was an initial prototype, which was subsequently refined based on feedback and suggestions from the expert team to ensure that the resulting product is of high quality and suitable for use in learning activities.



Figure 2. The Design of the Mathematics Game

C. Development Stage

The development stage focused on testing the quality of both the product and the research instruments, which included instrument validation as well as assessments of the mathematics game through validity and practicality tests to ensure its feasibility and usefulness in enhancing students' critical thinking skills.

1. Expert Validation

a. Content Validation

Content validation by a subject-matter expert was conducted to ensure that the mathematics content presented in the educational game was accurate, aligned with the applicable curriculum, and capable of supporting the development of students' critical thinking skills. This content validation was carried out by a lecturer in mathematics education at Universitas Jambi on November 25, 2025. The following are the results of the questionnaire administered to the subject-matter expert:

Table 2. Expert Validation Results of the Mathematics Game

Aspect	Number of Items	Maximum Score	Obtained Score	Percentage (%)	Category
Format	4	20	18	90	Highly Feasible
Content	7	35	33	94	Highly Feasible
Language	4	20	19	95	Highly Feasible
Total	15	75	70	93	Highly Feasible

Based on Table 2, the overall validation results from the content expert yielded a total score of 70 with a percentage of 93%, categorizing the media as "Highly Feasible." These results indicate

that the material presented in the educational game is highly aligned with the objectives of mathematics learning and is effective in supporting the development of students' critical thinking skills.

In addition to providing assessments, the content validator also offered several suggestions for improvement to be considered in refining the media. One of the suggestions provided, was to develop more varied practice exercises with different levels of difficulty and more contextual content, so that they can further enhance students' critical thinking skills.

b. Media Validation

Media validation by a media expert was conducted to ensure that the design and visual elements of the educational game are engaging for students and easy to understand and use. This media expert validation was carried out by a lecturer in mathematics education at Universitas Jambi on December 10, 2025. The following are the results of the questionnaire administered to the media expert:

Table 3. Results of Media Expert Validation

Aspect	Number of Items	Maximum Score	Obtained Score	Percentage (%)	Category
Simplicity	4	20	18	90	Highly Feasible
Integration	2	10	9	90	Highly Feasible
Emphasis	1	5	4	80	Feasible
Balance	3	15	14	93,3	Highly Feasible
Form	3	15	13	86,6	Highly Feasible
Color	2	10	8	80	Feasible
Total	15	75	66	88	Highly Feasible

Based on Table 3, the overall media validation results yielded a total score of 66 with a percentage of 88%, categorizing the educational game as "Highly Feasible." These results indicate that the educational game meets the expected standards in terms of visual design, alignment with learning content, and interactivity. The critiques and suggestions provided by the validator for this mathematics game media are as follows:

1. Adding more visual elements to the content sections to make them more engaging.
2. In the practice exercise section, incorporating visual image elements such as geometric solids or weaving patterns to create a more organized layout and make it easier for students to observe.
3. Extending the game pathway so that students have sufficient interaction time with the game.

Overall, this educational game can be used in mathematics learning with revisions to several design and interaction elements. By improving certain aspects of visuals, instructions, and the alignment of game elements, this game can become a more effective and enjoyable learning medium for students. Additionally, the game can help enhance students' critical thinking skills while introducing them to the richness of Jambi's local culture.

2. Practicality Testing of the Mathematics Game

a. Individual Trial

In this study, the subject of the individual trial involved one mathematics teacher at SMP Negeri 1 Kerinci on December 22, 2025. The individual trial was conducted using a questionnaire to obtain the teacher's comments and suggestions regarding the quality of the developed mathematics game learning media. The feedback and suggestions provided by the teacher through the

questionnaire were analyzed to identify aspects that require improvement. The following are the results of the individual trial:

Table 4. Results of the Teacher Practicality Test

Aspect	Number of Items	Maximum Score	Obtained Score	Percentage (%)	Category
Feasibility	5	25	21	84	Highly Feasible
Language	4	20	16	80	Feasible
Presentation	5	25	22	88	Highly Feasible
Graphics	4	20	17	85	Highly Feasible
Total	18	90	76	84	Highly Feasible

Based on Table 4, the results of the individual trial conducted by the mathematics teacher showed that the educational game obtained a score of 84%, categorizing it as “Highly Feasible.” The teacher provided positive feedback regarding the quality of the game, particularly in terms of the alignment of the content and the language used, which greatly helps students understand mathematical concepts in an enjoyable and contextual manner. The teacher also offered several critiques and suggestions, including:

1. Clarifying the game instructions, especially in the initial section, so that students do not feel confused when starting the game.
2. Adding more practice questions to avoid monotony and to further increase students’ learning motivation.
3. Incorporating more immediate feedback elements in response to students’ choices to enhance their engagement and understanding.

Overall, with the suggested improvements, this game has the potential to become a highly effective learning medium, increasing student engagement and introducing them to Jambi’s local culture while simultaneously honing their critical thinking skills within a relevant context.

b. Small-Group Trial

The small-group trial involved nine Grade IXA students of SMP Negeri 1 Kerinci who were selected based on low, moderate, and high academic ability levels. The selection of participants was based on the results of a critical thinking skills test and teacher-provided data. The activity was conducted on January 5, 2025. The results of the students’ practicality assessment are presented in the following table:

Tabel 5. Results of the Student Practicality Questionnaire

Assessment Aspect	Number of Items	Maximum Score	Obtained Score	Percentage (%)	Category
Game Display	6	270	247	91,4	Highly Feasible
Time Efficiency	1	45	42	94,4	Highly Feasible
Language Use	1	45	43	95,5	Highly Feasible
Visuals & Local Wisdom	2	90	85	94,4	Highly Feasible
Total	18	90	76	92,6	Highly Feasible

Based on Table 5, the analysis of the student practicality questionnaire indicates that the mathematics game media obtained a total score of 417 out of a maximum score of 450, with a

practicality percentage of 92.67%, thus falling into the highly practical category. This high percentage demonstrates that the majority of students responded positively to the use of the mathematics game, as reflected by the dominance of “agree” and “strongly agree” responses across all assessment indicators.

The aspects of ease of use, visual appearance, clarity of the material, language usage, and the integration of local wisdom elements were perceived as helpful in enabling students to understand the topic of curved-surface solid geometry and in making the learning process more engaging. Therefore, based on the results of the small-group trial, the mathematics game media illustrated with Jambi weaving art is considered highly practical and suitable for use as a learning medium.

D. The Results of the Mathematics Game

The mathematics game illustrated with Jambi weaving art is the final product of the development process designed to support the learning of curved-surface solid geometry for Grade IX students. The resulting product has undergone expert validation as well as practicality testing by teachers and students and has therefore been deemed feasible and practical for use in learning. The design of the developed mathematics game is presented as follows:



Figure 3. Initial Display



Figure 4. Level Menu Display



Figure 5. Gameplay Display



Figure 6. Practice Exercise Display

The developed mathematics game is designed to resemble an adventure game similar to *Super Mario*, in which students follow the game flow to reach a red chest at each level. When the chest is opened, students are presented with mathematics problems that require reasoning and critical thinking skills. If students encounter difficulties, the game provides clues to assist them in solving the problems, while correct answers are accompanied by explanations to reinforce their understanding of mathematical concepts. Through this gameplay mechanism, students not only play the game but also actively analyze and comprehend the learning material in a gradual and structured manner.

DISCUSSION

The results of the analysis stage indicate that mathematics learning is still predominantly characterized by lecture-based instruction and the use of textbooks as the primary learning resources, resulting in low levels of active student engagement and insufficient development of critical thinking skills, particularly in solving contextual problems. These findings are consistent with previous studies reporting that procedurally oriented instruction tends to limit students' higher-order thinking activities and reduce cognitive engagement in mathematics learning (Datu et al., 2022; Indriani et al., 2025; Ramadhani et al., 2025). This condition underscores the need to develop more interactive and meaningful learning media, especially by incorporating local wisdom contexts that are still rarely integrated into mathematics instruction (Jaizul & Putra, 2025; Kumala et al., 2024).

At the design and development stages, the mathematics game was developed in the form of an adventure game using Construct 3, incorporating reasoning-based problems, clues as scaffolding, and answer explanations to reinforce conceptual understanding. The expert validation results indicated that the game fell into the highly feasible category, while the practicality tests conducted by teachers and students revealed very positive responses regarding ease of use, visual appearance, and clarity of the material. These findings are aligned with previous studies concluding that game-based learning can enhance student engagement, facilitate reasoning processes, and support the quality of mathematics learning in a more interactive manner (Pahlevi & Apriliyani, 2023; Sulistiyawati et al., 2021; Syaikhu et al., 2022).

The novelty of this study lies in the integration of Jambi weaving art as an ethnomathematical context within the game mechanics, thereby orienting learning not only toward conceptual understanding and the development of critical thinking skills but also toward the preservation of local culture. This approach is consistent with international research emphasizing that the integration of local culture into mathematics learning can enrich learning experiences and enhance the relevance of the material for students (Zulkarnain et al., 2021). However, as this study has only reached the development stage, further research at the implementation and evaluation stages is still required to examine the broader effectiveness of the game in improving students' critical thinking skills.

CONCLUSION AND RECOMMENDATIONS

[This study produced a mathematics game illustrated with Jambi weaving art on the topic of curved-surface solid geometry for Grade IX students, developed using the ADDIE model up to the Development stage. The validation results indicate that the game falls into the highly feasible category, with a material expert validation percentage of 93% and a media expert validation percentage of 88%. Furthermore, the practicality test results show that the game is considered highly practical, with a practicality percentage of 84% based on teacher assessments and 92.67% based on student responses. The adventure-based gameplay mechanism, which is complemented by reasoning-oriented problems, clues, and answer explanations, is considered capable of supporting more interactive learning and stimulating students' critical thinking skills. Therefore, the developed mathematics game is deemed feasible and practical for use as a mathematics learning medium at the junior high school level. Future research is recommended to proceed to the Implementation and Evaluation stages in order to examine the effectiveness of the game in enhancing students' critical thinking skills on a broader scale. In addition, further development may focus on increasing the variety and levels of problem difficulty, improving the clarity of game instructions, and strengthening visual elements and interactivity, so that the game can more optimally support meaningful and contextual mathematics learning.]

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